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Foreword by Patron

It is a matter of great pride and honour that Department of Food Technology, Shaheed Rajguru College of Applied Sciences for Women is hosting the UGC and DBT sponsored **"National Conference on Advances in Food Science and Technology"** on 16th and 17th March, 2016. The aim of this conference is to develop and motivate students towards research and innovation and provide a platform for faculty members of various institutions to exchange their expertise and ideas. This conference is a high profile event attracting students of undergraduate and postgraduate level, research scholars, academicians and industry professionals from all over the country. Such conferences play an important role in apprising the students of the latest developments in their discipline.

The papers contributed for the conference are from the vast field of Food Science and Technology including emerging food processing technologies, food safety, nutrition, functional foods, gluten free bakery products, novel product development, designer foods and food packaging. The whole team of our teachers and students has worked hard with great dedication to make sure that the conference is a big success and researchers get a chance to present their ideas. The conference will be graced by the presence of honourable chief guest, Professor A. K. Srivastava, Vice chancellor of National Dairy Research Institute, Karnal, Haryana.

I congratulate the students and staff of Department of Food Technology for their dedicated efforts and wish all the best for a successful NCAFST'2016.

Dr. Payal Mago
Principal

Foreword by Editors

With immense pleasure, we welcome you to the National Conference on Advances in Food Science and Technology (NCAFST'2016) This conference will provide a platform to students, research scholars, academicians and industry professionals to share their expertise, technological innovations, research findings and new insights in the area of food science and technology with others and enrich their own knowledge. Students will find it extremely valuable as the knowledge they have acquired during classroom teaching will be extended.

We express our heartfelt gratitude to our Principal, Dr. Payal Mago for giving her constant support in conceptualisation, planning, implementation and execution of the conference.

We sincerely thank our advisory committee for guiding us towards the right direction and extending their support in organising this conference. It is an honour for us to thank Mr. K. L. Radhakrishnan, Chief Editor, All India Food Processors' Association, whose constant guidance, supervision and support helped us complete this arduous task. We also thank Dr. Eram Rao, Associate Professor, Bhaskaracharya College of Applied Sciences, for helping us from time to time.

We would like to thank our authors for their contribution for this conference. We also acknowledge the contribution of our technical programme committee for their efforts in reviewing and selecting papers. They elevated the level of the conference with their expert views. We extend out thanks to our Chief Guest, Dr. A. K. Srivastava, Vice Chancellor, NDRI, to deliver the inaugural address and Dr. Chacko, Director, Sri Ram Institute of Industrial Research, for giving the keynote address in the conference. Our appreciation is

due for all our guest speakers for sharing their knowledge with the participants. Our special thanks to our sponsors University Grants Commission (UGC) and Department of Biotechnology (DBT), Mother Dairy Fruits and Vegetables Pvt.. Ltd. and Gogia Chemicals for providing financial assistance for the conference.

Our deepest gratitude is for our mentors, Dr. Ranjana Singh and Dr. Deepa Joshi for their trust and support.

We will be failing in our duties if we do not mention the significant contributions made by Ms. Savitri Gupta for her constant assistance in this endeavour. Thanks to our lab staff for smooth execution throughout. We also thank Ms. Deepali Bajaj, Ms. Sonia Ahlawat and Ms. Akanksha Dhingra for their valuable inputs which made our work much easier.

Last but not the least; we thank our department student council and all student volunteers who worked enthusiastically to make this event successful.

Editorial Team

National Conference on Advances in Food Science and Technology (NCAFST'2016)

16-17 March, 2016

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Encapsulation of Medicinal Herbal Plants

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Abstract

Herbal plants have been extensively used throughout the world due to their medicinal, antioxidant, antimicrobial and various other properties. Encapsulation of extract from herbal plants can be an effective tool for their innovative applications in manufacturing of functional foods as well as increased stability for longer time span. Thus various aspects related to encapsulation methods that can be used for the purpose have been comprehensively looked upon in the paper. Apart from this, the paper provides insight over the limitations and factors affecting the efficiency of each method in context to herbal plant extract encapsulation.

Introduction

Plants have been used by people for their nutritional purposes since ages but after the discovery of medicinal properties, herbal plants became a useful source of disease cure and health improvement due to their mild features and low side effects. Egyptians have used coriander and castor oil for medicinal applications, cosmetics and preservatives for long time. Greek and Roman scholars described therapeutic uses of herbal plants years back. Romanians are known for their use of medicinal herbs since very long and in 1904 the first institute of medicinal herbs was established by them (2). Herbal extracts are increasingly used as functional ingredients in foods and beverages due to antioxidant, anti-hypertensive, anti-carcinogenic and antimicrobial activities shown by them (1). Sweet Basil, Oregano, Rosemary, Sage and Thyme are known for their natural flavour compounds and bacterial inhibition properties (3). Apart from these, medicinal herbs provide a variety of bio-actives like vitamins, polysaccharides, and minerals. Thus, supplementation of diet with various herbs is recommended for healing properties and nutritive value.

Encapsulation technology can be used for conversion of herbal extract to an effective functional ingredient which not only increases the stability of such products but also enables controlled release of same. It is the process of confining active compounds within another material in particulate form. Herbal intake through food has shortcomings such as susceptibility to adverse external effects, or detrimental processing conditions. Chemical instability is another issue that affects oral bioavailability of herbal extracts. Encapsulation leads to better stability by isolating active compounds from the detrimental effects of oxygen, moisture or incompatible compounds. Use of encapsulated compounds as functional ingredients in various foods and beverages enables enrichment of food products with natural antioxidants as well (1).Therefore, encapsulation could be a useful tool to develop value added products. The present paper is aimed to provide a comprehensive review of different methods for encapsulation of herbal plant extracts and various factors affecting them.

Factors affecting encapsulation

According to the encapsulation process used, the matrices of encapsulated matter will differ in shape and structure which will influence diffusion of herbal bio-actives as well as external substances. This affects product stability during storage. Thus selection of appropriate technique is crucial. Chemical nature of the extract depends upon the herb used as each contains unique compounds responsible for its characteristics which differ in molecular weight, chemical functionality, polarity etc. Thus, chemical nature of material to be encapsulated must be kept in mind while deciding the ratio of it to encapsulation material and selection of encapsulation material as per compatibility. The material must have no reactivity with enclosed herbal ingredients and should be present in a form that is easy to handle, give the maximum protection of the active ingredient against the external factors; ensure good emulsion-stabilization properties and effective re-dispersion behaviour in order to release the extract when desired. Materials that can be used for the purpose include proteins, carbohydrates, lipids, gums and cellulose as well as their composite formulations. The ability of carbohydrates, such as starches, malto-dextrins, corn syrup solids and acacia gums, to bind is complemented by their diversity, low cost, and widespread use in foods and makes them the preferred choice for encapsulation. Proteins such as sodium caseinate, whey protein and soy protein isolates have amphiphilic properties, ability to self-associate and interact with a variety of different types of substances, large molecular weight, and molecular chain flexibility and excellent functional properties such as solubility, viscosity, emulsification, and film-forming properties which provides physical stability during processing and storage.

Methods used for encapsulation

Although there are various methods that can be used for encapsulation of herbal extracts but none can be considered universally applicable procedure for all. This is due to the individual unique characteristics of each component. The one suitable for a herb might not be for another. Differences in molecular weight, polarity, solubility etc. imply that different approaches have to be applied in order to meet the specific physicochemical and molecular requirements for a specific component. It is essential to select a system that can be easily incorporated into the food without interfering with the texture and taste of the food (5). Methods used for encapsulation are :

Emulsification

Emulsification is a process of dispersing one liquid in another immiscible liquid. By including the core herbal material in the first liquid we can encapsulate the bioactive component. Encapsulation is done using food grade (Generally Regarded As Safe (GRAS)) derived molecules only, applying electrostatic interactions, hydrophobic interactions, or hydrogen bonding between the bioactive molecule and an encapsulating molecule. Addition of a surfactant that induces encapsulation by forming micelles, vesicles, bilayers, and reverse micelles around the bioactive molecules is commonly done. Another approach of encapsulation is the application of biopolymers such as a variety of proteins and polysaccharides that can envelop the sensitive bioactive molecule. A huge amount of food components may be applied as building blocks for emulsions. (5,6)

Co-acervation

Coacervate is a tiny spherical droplet of organic molecules that is held together by hydrophobic forces from a surrounding liquid. The term is derived from a latin word *coacervare* that means "to assemble together". Organic compounds do not remain uniformly dispersed but may separate out in to layers or droplets, surrounded by tight skin of solvent molecules. This process of

separation is called coacervation. Boundries of coacervates allow selective absorption of simple organic molecules from surrounding medium, giving scope for encapsulation. The process can be simple or complex. Simple coacervation involves only one type of polymer with the addition of strongly hydrophilic agents to the solution. Complex coacervation involves use of two or more types of polymers and process involves three steps carried under continuous agitation which are formation of three immiscible chemical phases i.e. solvent or vehicle phase; core material phase and coating material phase followed by deposition of liquid coating material upon core material by adsorption at interface of core and solvent phase under controlled mixing; temperature and pH changes may also be done ending with final step of rigidity development of coating. The technique is often used to encapsulate oils and other hydrophobic herbal liquids. Resultant encapsulated form can be paste; powder or capsule. Drawbacks of Co-acervation are evaporation of volatiles, dissolution of active compound into the processing solvent and oxidation of product. It is in a way, modified emulsification technology which involves use of complex formation by using opposite charge molecules and mixing them with extract solution. The size and characteristics of capsule are varied by changing pH, concentration and ratio of components. (2,5)

Spray drying

Spray drying is a commercial, most commonly used method, widely used in large-scale production of encapsulated volatiles. This method however, is not so extensively used for herbal extract encapsulation. The process involves the dispersion of the substance to be encapsulated in a carrier material, followed by atomization and spraying of the mixture into a hot chamber. The resulting microcapsules are then transported to a cyclone separator for recovery. Retention of volatile core material during encapsulation by spray drying is achieved by chemical and physical properties of the wall and core materials solid content of the dryer, processing temperature and also by the nature and the performance of the encapsulating support. Powdered particles are then separated from the drying air at outlet. Process affecting factors are extract, co-solvent if any, carrier wall material composition, emulsion preparation as well as operational conditions. Problem with spray drying is chances of oxidative changes and exposure of bioactive compounds to hot air which leads to certain activity loss. In fact this is the major reason spray drying is not used in case of herbal extracts. The merits of the process are availability of equipment, low process cost, good retention of volatiles, good stability of the finished product, and large-scale production in continuous mode. (5,6)

Spray cooling and chilling

These two methods are used for encapsulation of volatile extract compounds to improve heat stability and/or convert liquid extract into free-flowing powders. These technologies are similar to spray drying where the core material is dispersed in a liquefied coating or wall material and atomized. Followed by atomization to disperse droplets from the feedstock, droplets are immediately mixed with a cooling medium and subsequently solidify into powder form.

In the spray chilling technique, the coating material is melted and atomized through a pneumatic nozzle into a vessel generally containing a carbon dioxide ice bath. Thus droplets adhere on particles and solidify forming a coat film. The process is suitable for protecting water-soluble materials that may otherwise be volatilized or damaged during thermal processing. Spray cooling/chilling results in powder form of product.(2,5)

Extrusion technologies

Comparatively mild but laborious technology of encapsulation, extrusion includes producing

small droplets of encapsulation material by forcing the solution through fixed nozzles or cross-sectional area. Simple extrusion process involves dispersion of extract in a matrix polymer. Mixture is then forced through a die and filaments obtained are plunged into a desiccant liquid that, by hardening the extruded mass, traps the active substances. Most common liquid used is isopropyl alcohol. Double-capilarity extrusion devices can be used for encapsulation as well. In coaxial device, bioactive substance and the carrier material are fed through, respectively, the inner and outer opening of a coaxial double capillary. At the tip of the coaxial nozzle the two fluids form a unified jet flow, which breaks up to form the corresponding microdroplets. Another variant is Centrifugal extrusion device where liquid extract is pumped through the inner orifice and the liquid shell material through the outer orifice of a rotating cylinder forming a coextruded rod of extract components surrounded by wall material. As the device rotates, rod breaks into droplets which form capsules. Extrusion gives powder/ granular product. Large scale droplet production can be achieved by multiple-nozzle systems, spinning disc atomizer etc. Extrusion technology does not involve deleterious solvents and can be done under both aerobic and anaerobic conditions. (1, 5)

Molecular inclusion

Method involves use of compounds with structure that fits smaller bioactive herbal molecules within their lattice. The retention of compounds can be influenced to a greater or lesser extent by the molecular weight and shape, steric hindrance, chemical functionality, polarity and volatility of the core material. Material usually used for molecular inclusion is Cyclodextrin. Typical inclusion involves stirring or shaking extract in aqueous solution, filtering off precipitated complex; blending and bubbling of volatile as vapours, through a solution of inclusion molecules. Encapsulated form is powder and hence encapsulated herbal extract can be used in instant drinks, extruded snack etc. Another example is application of liposomal spherical bilayers that enclose bioactive molecules. These are formed by dispersion of polar lipids (mostly phospoholipids) in an aqueous solution. (5)

Conclusion

The success of an encapsulation process is often linked to formulation and chemical properties of extract as well as wall material used to achieve stabilisation. This is especially the case in the food industry where the number of acceptable materials is very limited. Most often, researchers are essentially concerned with finding the optimum formulation while engineering aspects are often neglected despite the fact that it plays crucial role towards maintaining integrity of active compounds, providing right properties to microcapsules and the cost is directly related to these aspects, design and operating parameters. Developing an encapsulated product remains a challenge, requiring a multi-disciplinary and integrated approach. The increasing economic significance of herbal components may lead to find out more sophisticated encapsulation methods for them in future.

References

1. *Ana Belšak-Cvitanovi, Radoslava Stojanovi, Verica Manojlovi, Dra•enka Komes, Iva Juranovi Cindri, Viktor Nedovi, Branko Bugarski. Encapsulation of polyphenolic antioxidants from medicinal plant extracts in alginate-chitosan system enhanced with ascorbic acid by electrostatic extrusion. Food Research International 44 (2011) 1094-1101*
2. *J. Azmir, I.S.M. Zaidul , M.M. Rahman, K.M. Sharif , A. Mohamed, F. Sahena, M.H.A. Jahurul, K. Ghafoor, N.A.N. Norulaini, A.K.M. Omar. Techniques for extraction of bioactive compounds from plant materials: A review. Journal of Food Engineering 117 (2013) 426-436.*

3. *M.M. Tajkarimi, S.A. Ibrahim, D.O. Cliver. Antimicrobial herb and spice compounds in food. Food Control 21 (2010) 1199-1218.*
4. *Eng-Seng Chan, Zhi-Hui Yim, Soon-Hock Phan, Rachel Fran Mansa, Pogaku Ravindra. Encapsulation of herbal aqueous extract through absorption with ca-alginate hydrogel beads. Food and bio-products processing 88 (2010) 195-201.*
5. *Paul de Vos, Marijke M. Faas, Milica Spasojevic, Jan Sikkema. Encapsulation for preservation of functionality and targeted delivery of bioactive food components. International Dairy Journal 20 (2010) 292-302.*
6. *Atmane Madene, Muriel Jacquot, Joe¨ Scher & Ste´phane Desobry, Flavour encapsulation and controlled release — a review, International Journal of Food Science and Technology 2006, 41, 1-21*

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Sustainable Utilization of Waste From Citrus Fruit Processing Industry — A Review

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Abstract

Citrus fruits are produced all around the world due to their commercial importance as well as high nutritional content. India ranks sixth in its production after China, Brazil, USA, Spain and Mexico. In India few species are commercially cultivated, which include grape fruit, lemons, limes, sweet oranges, and mandarins. In the last three decades the production and consumption have grown strongly. The growth of the citrus juice industry has driven the large-scale processing of citrus. Due to the large amounts being processed into juice results in large amount of waste products .Citrus fruit juice recovery is about 40-55%, with the by or waste product contained of peel and rag, pulp wash, seeds and citrus molasses. The amount of the discarded portion is very high and it is becoming a difficult environmental issue. This arises the urgent need to make full use of them in the food, pharmaceutical and in other industries. Citrus peel and rag are normally used for pectin manufacture or can be sold dried as cattle feed. Citrus waste products are the important source of dietary fibre obtained from lime peels. They are also in great demand by beverage industry as they are source of natural clouding agents. d-Limonene can be recovered from citrus waste streams and is used industrially as feedstock for adhesives, flavors, cleaners, and solvents and as a diluent for other flavors. Essential oils are obtained from the citrus peel and find their use as food and beverage flavors, in the perfume industry, for personal care and consumer products etc. Citrus seeds can be used for oil extraction and recovery of terpenoids while the remaining meal is good source of protein which can be use in processing.

Introduction

Citrus fruit rank first in production (1) with a worldwide production of 115525.2 thousand tons (2). *India* ranks sixth in the *production* of *citrus fruit* in the world. Citrus fruit belong to the family Rutaceae and sub-family Auranti-oedae, main cultivation is tropical and sub tropical lands of Southeast Asia. Orange, grapefruit, lemon, limes, sweetlimes and tangerines are few of the important fruits belonging to citrus family. Orange constitutes about 60% of the total citrus world production (10) Literature has reported various phyto-chemicals from citrus fruits to be extremely favorable in some chronic diseases like cancer and heart attack (3). Flavanoids from citrus fruit have been found beneficial in inhibiting human breast cancer (4). 33% of citrus production (oranges, lemon, grapefruit, mand-arins) are exploited for juice production and the rest is citrus waste including peel, segment membrane, seeds (5). The seeds of lemon and sweet orange have been found rich in caffeic acid, ferulic acid, syringic acid, chlorgenic, neohespiridin and hesperidin.coumarins (8-geranyloxypsolaren, 5-geranyloxypsolaren, 5 geranyloxy-7 methoxy-coumarin) are extracted from lemon peel. (7). Peel of oranges is also rich source of various polyphenols (8). Lime residues are rich in vitamin C, phenolic compounds, nomilin and limonin (9) and if not utilized is a cause of many economic and environmental problems because of its fermentability (6).

Many researchers have worked towards extraction of phytochemicals from citrus waste

and also utilizing them for various applications. Rehman (11) in his studies showed antioxidant activity of methanolic extract of almost equal to synthetic antioxidants. A very innovative application of lemon peel was concluded by application of lemon albedo in sausage that caused a significant reduction of residual nitrite level (23).

Source of Dietary Fibre

Dietary fibre mainly includes cellulose, hemicellulose, lignin and pectins. Dietary fibre increase the fecal bulk, incites peristalsis and provide favorable environment for the growth of intestinal flora. (12) Dietary fibre from citrus fruits has high proportion of soluble fibre in comparison to other waste sources with antioxidant activity. Dietary fibre apart from providing bulk in diet also has nutraceutical benefits in prevention of constipation, hemorrhoids, hypercholesterolemia and colorectal cancer. (13). Orange peel with water recycling also is used to produce high dietary fibre powder. (14). High dietary fibre from Valencia orange peels has a total dietary fibre content in the range of 61-69% with an appreciable amount of soluble fibre in range of 19-22%. (15)

Since time immemorial lime juice industry by-products have also been used to obtain high dietary fibre (16). Lemon peels are good source of high dietary fibre (61-69% (15). Dietary fibre obtained from citrus fruits offer an additional advantage over traditional fibre as it has antioxidant property. (17) Lemon fibre apart from nutritional benefits has high water holding capacity and many other functional properties (16) In study conducted by Figuerola et al., Ruby variety of Grapefruit showed highest content of of 8.42 g/100g DM whereas eureka lemons showed highest ash content out of different eight varieties of fibers from grapefruit, lemons and apple. (18) In another comparative study between Persian and Mexican lime peel, total dietary fibre was 70.4% and 66.7 % respectively. Dietary fibre concentrates from Persian lime peel had greater polyphenol activity. Thus, the peels can not only be used a source of dietary fibre but also as food additive. (19) Kanget al., developed functional powder from citrus peel by gamma irradiated which holds potential application as functional component in food processing industry (22)

As antimicrobial

Silver nanoparticles have varied applications and most commonly are known for their very strong antioxidant activity (40). Researchers are aiming towards green chemistry. Novel synthesis of silver nanoparticles has been carried out using citrus sinensis peel extract as reducing and capping agent. The silver nanoparticles so synthesized showed antibacterial activity against gram-positive as well as gram-negative bacteria (20). In another similar study by Basavegowda and Lee (21) silver nanoparticles were syntheised from Satsuma mandarin (Citrus unshiu) without any external surfactant or capping agent. Thus, citrus waste can be used for synthesis of noble metal nanoparticles.

Pectin and pectinase production

Pectins are used in food industry for their gelation and stabilizing property. Orange, lime and lemon peels of citrus fruits have shown as a potential pectin source. Pectin is released from citrus peels in combination with apple pomace in dried sweet whey medium in the presence of yeast Kluver-omyces fragilis (24). Thibault and Dreu (25) extracted pectins from citrus peel in presence of enzymes endo-arabinanase, endo-galactanase and residual endo-pectate lyase. The pectin obtained was of low molecular weight in comparison to acid-extracted pectin. Flavedo and albedo of orange peels can also be used for efficient pectin extraction. Pectin is mainly extracted from albedo and very small proportion (27% of total pectin) is found in flavedo. Extrcation techniques of hand-pressure and microwave using water gives a total pectin yield

of 12% which is far greater than the yield obtained when the hand-pressure or microwave are used alone (26)

Since citrus peels are rich not in pectin, they can be used as a inducer for production of pectinase. In the presence of fungus Aspergillus niger., high enzyme activity and substrate concenteration of 15% is obtained. (27)pectinase can also be produced from lemon peel pomace using fungal strains of Aspergillus niger (31).

Clouding Agents

Consumers prefer natural clouding agents to synthetic ones. Molasses, concenterated citrus peel juice and pulp upon fermentation can be used to synthesize beverage clouds. Pectolytic treatment (28) of citrus by-products and wastes has been used for production of clouding agent with limited stability in model-test beverage. In another one such procedure, polygalactouronase and cellulose are used to as lysing agent. The so obtained clouding agent provides cloud stability for 94.7 days (29)

Source of Glucose in Fermentation

Citrus waste can be used as natural food in fermentation by Xanthomonas (30). Mahmood et al. (32) used potato and orange peel extracts as media for growth of Bacillus. The conclusions of their study proved potato and orange peel extract equivalent or better substrate in comparison to glucose. Various modifications have been reported in literature to enhance the extraction and enzyme activity (33). Simultaneous saccharification and fermentation of citrus waste have been used in ethanol production (34, 35).

Livestock and Ruminat Feed

Livestock implies rearing animals for financial gain or commercial purpose. It plays an important part in the livelihood of farmers. According to FAO the world would need 73% more meat and 58% more milk in 2050. So, to meet these demands, large quantity of feed resources will be required.

Wing (2003) reported that Adult crossbred cattle can consume 50-60 kg fresh citrus pulp daily. But due to the presence of high contents of water (perishable) and soluble sugars and may cause environmental pollution. In order to solve this problem the pulp is sun dried and pelleted to increase density or should be ensiled. During drying, lime is added to neutralize the free acids, bind the fruit pectins and release water. It is used as a cereal substitute for lactating dairy cows. Citrus pulp rich in fiber content which on long rumination produces large amount of saliva that has a buffering effect. (Crawshaw, 2004).Citrus molasses is a by- product of citrus juice extraction. . It has bitter taste due to the presence of naringin, a flavonoid (Hendrickson and Kesterson, 1965). It can be fed to animals, or added to grass silage. (40)

Conclusion

The reduction and utilization of citrus food industry waste provides promising field in the food. The waste management is motivated by legislation in many countries with restriction in land filling which motivates to look for other options like composting, anaerobic digestion, fermentation and animal feed.

Citrus food waste found to be a good source of nutrients. It is an important source of phenolic compounds having antioxidant properties which avoids oxidation during processing and storage. The citrus seed oil used for edible purpose as well as for value added products. The conversion of waste into bioethanol used as biofuel in refineries processes. Due to the large waste production and considerable disposal problem ,it should be utilize in judicious manner**.** This paper conclusively shown that wastes can be an important resource for economy and serves various purpose .They can be used as consumer product as such or serves as the raw material for other product production.

References

1. *Citrus Fruit: Biology, Technology and Evaluation By Milind Ladanyia, Milind Ladaniya*
2. *http://www.fao.org/fileadmin/templates/est/Comm_Markets_Monitoring/Citrus/Documents/Citrus_Bulletin_2012.pdf*
3. *Health benefits of fruit and vegetables are from additive and synergistic combinations of phytochemicals Rui Hai Liu Am J Clin Nutr September 2003 Vol. 78 No. 3 517S-520S*
4. *Inhibition of human breast cancer cell proliferation and delay of mammary tumorigenesis by flavonoids and citrus juices Nutrition and Cancer volume 26 v issue 2 1996 Felicia V. So, Najla Guthrie, Ann F. Chambers, Madeleine Moussa & Kenneth K. Carroll pages 167-181*
5. *Process design and economic analysis of a citrus waste biorefinery with biofuels and limonene as products Mehdi Lohrasbia, c, Mohammad Pourbafranib, c, ,, Claes Niklassonb, Mohammad J. Taherzadehc Bioresource TechnologyVolume 101, Issue 19, October 2010, Pages 7382-738*
6. *Bioresour Technol. 2004 Jan;91(2):111-5.Citrus waste recovery: a new environmentally friendly procedure to obtain animal feed. Tripodo MM1, Lanuzza F, Micali G, Coppolino R, Nucita F*
7. *Natural antioxidants from residual sources Andres Moure, Jose M. Cruz, Daniel Franco, J. Manuel Dominguez, Jorge Sineiro, Herminia Dominguez, Maria Jose Nunez, J. Carlos Parajo, Food Chemistry 72 (2001) 145±171 Review*
8. *Quantification of main phenolic compounds in sweet and bitter orange peel using CE-MS/MS Saleh M.S. Sawalha, David Arráez-Román, Antonio Segura-Carretero, Alberto Fernández-Gutiérrez, Food Chemistry 116 (2009) 567-574*
9. *Evolution of antioxidant compounds in lime residues during drying Thitima Kuljarachanan, Sakamon Devahastin, Naphaporn Chiewchan, Food Chemistry 113 (2009) 944-949*
10. *Antioxidant Activities of Orange Peel Extracts A.E. Hegazy and M.I. Ibrahium World Applied Sciences Journal 18 (5): 684-688, 2012*
11. *Citrus peel extract — A natural source of antioxidant Zia-ur-Rehman, Food Chemistry 99 (2006) 450-454*
12. *Dietary fibre fractions from fruit and vegetable processing waste Agnieszka Nawirska, Monika Kwasniewska Food Chemistry 91 (2005) 221-225*
13. *By-products from different citrus processes as a source of customized functional fibres Francisco R. Marn, Cristina Soler-Rivas, Obdulio Benavente-Garca, Julian Castillo, Jose A. Perez-Alvarez, Food Chemistry 100 (2007) 736-741*
14. *New approaches in the preparation of high dietary fibre powders from fruit by-products, J.A. Larrauri Trends in Food Science & Technology 10 (1999) 3±8*
15. *High dietary fibre powders from orange and lime peels : associated polyphenols and antioxidant capacity, Jo. 4, A. Larrauri, Pilar Rupbrez, Laura Bravo & Fulgencio Saura-Calixto, Food Research Inter-national, Vol. 29, No. 8, pp. 751-162, 1996*
16. *Preparation of high dietary fiber powder from lemon juice by-products,Y. Lario, E. Sendra, J. Garca-Perez, C. Fuentes, E. Sayas-Barbera, J. Fernandez-Lopez, J. A. Perez-Alvarez Innovative Food science and emerging technologies (2004) 113-117*
17. *Marn, F. R., Martnez, M., Uribesalgo, T., Castillo, S., & Frutos, M. J. (2002). Changes in nutraceutical composition of lemon juices according to different industrial extraction systems. Food Chemistry, 78, 319-324.*
18. *Fibre concentrates from apple pomace and citrus peel as potential fibre sources for food enrichment Fernando Figuerola, Mara Luz Hurtado, Ana Mara Estevez, Italo Chiffelle, Fernando Asenjo, Food Chemistry 91 (2005) 395-401*

Preventing Nutrient Losses and Keeping Food Safe — A Study on Food handling Practices by Mothers of Delhi

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Abstract

Food purchase, pre-preparation, cooking/processing, handling and storage in the domestic environment are important factors affecting nutrient retention in and safety of food served to young children. Even in food secure households, poor processing and storage practices can reduce the nutrient content of diets. An interview schedule was used to collect information on food handling practices before cooking, cooking and after cooking from mothers of young children (n=400) belonging to low and middle income families of Delhi. Working educated mothers tended to shop for fruits and vegetables less frequently and store them for a longer period in the refrigerator ($p < 0.05$). Wrapping of fruits and vegetables to prevent them from drying out was being done in 80% of MIG households as compared to only 40 % LIG households. About 60 % women cut vegetables before washing and 11% cooked them in an open pan resulting in greater nutrient losses. Nearly 82.5 % of the children were consuming fruits and vegetables immediately after cutting them without any time lag, the rest were eating it after leaving the cut surface exposed for half hour to 3-4 hours. Out of 400 mothers 97.8 % leave cooked dishes on kitchen counter till the meal is consumed. Among MIG families, 95.5 % of the women left cooked dishes on the counter till the meal was consumed. Among LIG families, all of the women left cooked dishes on the counter till the meal was consumed. Most of the mothers were storing refined oils in transparent (61.8 %) containers and 67.8% in plastic containers. Around 56 % of mothers were reusing frying oil more than 2 times. About 53.6 % educated women were discarding used oils as compared to only 10.7 % of the illiterate women ($p < 0.05$). Nearly 27 % of the families were consuming their morning breakfast, 28.2 % lunch and 29.2 % dinner, within half an hour of cooking whereas 23.2% were consuming their lunch after 3 to 4 hours of cooking. About 46.5 % of the families were keeping leftover food in refrigerator and 48.8 % of the families were keeping at room temperature. In MIG families 86 % of the families were keeping leftover food items in refrigerator. It is thus important to spread awareness about ways to reduce nutrient losses during processing, cooking, before cooking and storage at the household level. Some of the simple ways to prevent losses are keeping fruits and vegetables cool to prevent enzymes from destroying vitamins, cutting fruits and vegetables into big pieces, refrigerating food, cooking with very small amounts of water and a tight-fitting lid and avoiding of repeated reheating of food and cooking oil.

Key words : Nutrient losses, food handling practices, food safety.

Introduction

Malnutrition is a major public health issue in developing countries, in spite of better food security and availability of health care facilities. Micronutrient malnutrition is globally affecting over half the world's population, mostly women, infants and children in resource-poor families (UNICEF, 2008). Food-based strategies are described as a sustainable approach for combating micronutrient deficiencies in developing countries. Fruits and vegetables are a storehouse of micronutrients. Nutrients losses in them may begin as soon as they are harvested and continue till they are consumed. Pre-preparation, cooking/processing, handling

practices in the domestic environment and storage conditions are important factors for preventing nutrient losses and keeping food safe. Thus, this study was designed with the **objective** to study various handling and cooking/ processing practices employed for fruits and vegetables by low and middle socioeconomic mothers residing in Delhi. The frequency of purchase of fruits and vegetables, storage practices of raw and cooked foods, household practices followed during pre-preparation and cooking of vegetables, typical time lapse between cutting and consuming of fruits, time lapse between cooking and serving of different meals to young children were the aspects which were looked at.

Methodology

The respondents of the study were 400 mothers of young children (1-9 year olds) of whom 200 were from middle income group families and 200 from low income group families. Four zones were randomly selected out of 9 zones of Delhi listed by the Registrar of Cooperative Societies, Delhi Government, using fish bowl method. Areas were selected purposively from every selected zone using convenience sampling. Middle Income Group (MIG) apartment complexes were identified in these areas and households were approached through key informants in the community and through snowball sampling method. Nearby low income group (LIG) colonies were also selected from the same areas. Ethical clearance was obtained from the Institutional Ethics Committee of Lady Irwin College and Informed consent was taken from the respondents for participation in the study.

An interview schedule was used to obtain data on purchase, handling, cooking and storage practices especially for fruits and vegetables which are a storehouse of micronutrients and for cooked dishes in general. The tool was subjected to a preliminary validation (30 women) to assess its clarity, the suitability of wording, and the average time needed for its completion. Based on this pilot testing necessary modifications were made. The results of the pilot survey were not included in the final survey. All raw data was entered in Microsoft Excel and statistical analysis was performed using statistical analysis software SPSS version 16. The descriptive variables such as mean, median and standard deviations were computed. The association between educational levels of mothers and different household practices were also seen using chi square.

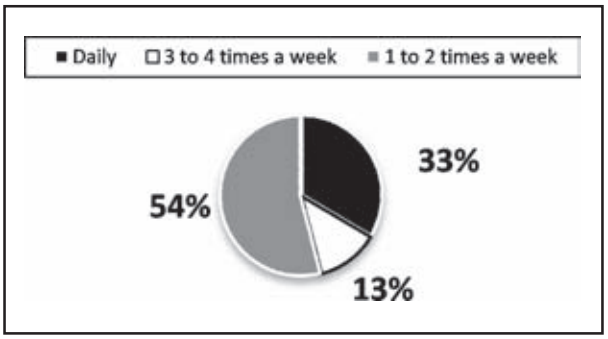
Results and Discussion

Socio-Demographic profile of the study population : A total of 400 families participated in the study. Most (55%) women in the low income group families were illiterate while 26% of their husbands were illiterate. None of the women or men was illiterate in the middle income group. Most (69% of the men and 65.5% of women) were graduates or post graduates in MIG families. In both low and middle income group families most of the women were unemployed (77.5% and 83% respectively). For males, majority (73.5%) were employed as unskilled labour in low income group families while in middle income group families 46.5% and 22% males were in the semi-professional and skilled worker category respectively.

Frequency of purchasing fruits and vegetables and storage : One of the outstanding benefits of consuming fruits and vegetables is their contribution to the intake of micronutrients (vitamins and minerals) by children. Some vitamins are lost during storage of raw fruits and vegetables. In LIG families 48 % buy daily, 8.5 % 3 to 4 times a week while 43.5 % buy 1 or 2 times a week. However, in MIG families 19 % buy daily, 16.5 % 3 to 4 times a week while 64.5 % buy 1 or 2 times a week. The overall picture is presented in Figure 1.

Mostly households in the middle income group families (94%) were keeping perishable

Figure 1 : Frequency of people purchasing Fruits and Vegetables (N = 400)

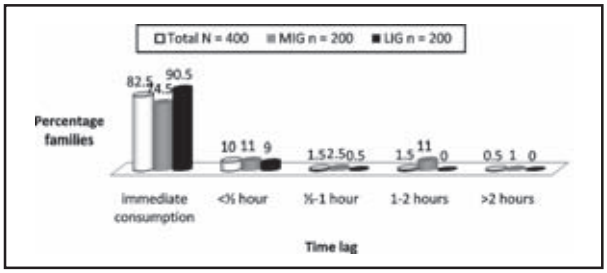


vegetables in the refrigerator as compared to 4.5% only in LIG. Most LIG households were storing their fruits and vegetables at room temperature due to unavailability of refrigeration facilities. Wrapping of fruits and vegetables to prevent them from drying out was being done in 80% of MIG households as compared to only 40 % households in LIG. In both the income groups wrapping in plastic/poly bag was most common method of wrapping, in MIG (92%) and LIG (100%) households. The storage time to which fruits and vegetables have been subjected will also affect the percent losses of nutrients from them. Plastic wraps, bags, net bags, paper bags or air tight containers are suitable options for storage under refrigerated conditions (Potter., 2003). Vitamin C is very susceptible to oxidation during processing and storage. Fat soluble vitamins like vitamins A and E are affected by various factors like the presence of oxygen, light, heat, trace metal ions and storage time (Santosa et al., 2012; Ball, 2006). Postharvest losses in nutritional quality, particularly vitamin C content, can be substantial and are enhanced by physical damage, extended storage duration, high temperatures, low relative humidity, and chilling injury of cold-sensitive commodities (Lee & Kader., 2000; Hussein et al., 2000).

Frequency of people washing vegetables after or before chopping : About 60 % of people reported that they wash vegetables after cutting whereas 33.2 % said that they wash vegetables before chopping. However, 6.5 % people are washing vegetables both before and after chopping. Similar numbers in LIG (62.5 %) and MIG (58 %) families said that they wash vegetables after cutting. It has been known that water soluble vitamins are usually prone to leaching losses during washing (Ball, 2006). Water soluble vitamins are mainly lost due to leaching and hence processing with minimum amount of water conserves most of these vitamins in the food. Riboflavin leaching out into the soaking and cooking water gets more easily destroyed. Similar destruction is seen in spinach cooked in open pan or pressure cooker. Niacin is most susceptible to leaching losses among the B vitamins and hence the major loss of this vitamin during cooking is due to this reason.

Typical time lapse between cutting and consuming of fruits by children : In our study nearly 82.5 % of the children were consuming fruits and vegetables immediately after cutting them without any time lag, the rest were eating it after leaving the cut surface exposed from half hour to 3-4 hours (Figure 2). Damaging fruit tissues by mashing or macerating or cutting leads to increased exposure of nutrients to air and light and consequently greater losses. Cutting leads to the exposure of the fruit surface to light or oxygen which causes the degradation of the antioxidant constituents. Polyphenol oxidase enzyme leads to the oxidation of phenols to form colored melanins causing browning which in turn also decreases the nutrient content. Vitamin C concentration usually decreases during storage and processing of fruit and vegetables and browning has been related to this degradation (Rocha et al., 1995).

Figure 2 : Typical time lapse between Cutting and Consuming of Fruits (%)



Household cooking practices for vegetables : There are many factors which can lead to losses of nutrients in vegetables during cooking, such as temperature, presence of oxygen, light, water content, pH and metal trace elements. It has been known that heat treatments such as deep frying, prolonged cooking, and baking, and a combination of multiple preparation and processing methods result in substantial losses of heat sensitive vitamins. Mostly mothers were making vegetables with a combination of cooking methods. Nearly 70% of mothers were using pressure cooking for boiling vegetables while the remaining 30 % were using pan boiling. Among pan boiling 11 % were using open pan boiling while 19 % were using closed pan boiling. Considerable amounts of β-carotene losses have been reported during cooking. Results show the losses ranging from 27 to 71% during pressure cooking and 16-67% during boiling of vegetables like pumpkin, carrot, amaranth and drumstick leaves (Gayathri et al., 2002). Since heat liable vitamins are susceptible to loss during heat treatment it is important to ensure maximum retention either by adopting minimum or faster cooking procedures, or by including specific ingredients which may minimize the loss.

Vitamin C losses are less when dry methods of cooking are used rather than wet. The loss of this vitamin in sun dried vegetables is less than in vegetables cooked by boiling. Least loss of the vitamin was seen in steaming followed by stir frying in oil, stir frying with water and the maximum loss was on boiling. It is also recommended that frozen vegetables should not be thawed before cooking. Blanching raw vegetables before freezing helps to remove oxygen and hence ensure better retention of vitamin C. Pressure cooking and microwave cooking are preferred as cooking methods rather than boiling, for better retention. Leaching of water soluble vitamins into the washing/soaking/ cooking water leads to significant loss of these nutrients as the vitamin becomes even more susceptible to destruction by heat.

Household practices for storage of different fats and fat products — If vegetables oils are reused during frying then vitamin E content in them decreases. Vitamin E is unstable in the presence of reducing agents like oxygen, light and peroxides which occur as a result of unsaturated fat auto-oxidation (Maskova et al., 1994).

In this study most of the mothers were storing refined oils in plastic (67.8%) containers. However, nearly 61.8 % of the mothers were storing refined oils in transparent containers which expose the oil to light (Table 1). A similar picture was seen for *desi ghee* and mustard oil.

Table 1 : Different household practices for storing fats and oil (N= 400)

Containers	***Refined Oils***	***Desi Ghee***	***Mustard Oil***
Opaque	132 (33)	168 (42)	134 (33.5)
Transparent	247 (61.8)	212 (53)	245 (61.2)
Translucent	21 (5.2)	20 (5)	21 (5.2)
Type of Containers			
Plastic	271 (67.8)	230 (57.5)	270 (67.5)
Steel	124 (31)	167 (41.8)	126 (31.5)
Glass	5 (1.2)	3 (0.8)	4 (1)

(Figures in parentheses represent percentages)

Nearly 15 % of mothers were adding new oil to used frying oil for frying. Only 7 % of people were discarding the used frying oil while others were using in the preparation of dry vegetables and paranthas. Some of them (2.5%) were using in miscellaneous uses like applying on the wood using it as a hair oil etc. (Table 2). When fats and oils are given exposure to light, auto-oxidation occurs which lead to the formation of singlet oxygen and further forms a free radical

Table 2 : Cooking practices related to use of fats and oils

S. No.	Parameters	Total (N = 400)	MIG (n = 200)	LIG (n = 200)
1.	Smoking stage of oil during frying			
	• Almost every time	125 (31.2)	50 (25)	75 (37.5)
	• Sometimes	244 (61)	127 (63.5)	117 (58.5)
	• Rarely	23 (5.8)	15 (7.5)	8 (4)
	• Never	8 (2)	8 (4)	—
2.	Addition of new oil to old oil used for deep frying			
	• Yes	59 (14.8)	46 (23)	13 (6.5)
	• No	341 (85.2)	154 (77)	187 (93.5)
3.	Frequency of reusing the frying oil			
	• 0 time	23 (5.8)	20 (10)	3 (1.5)
	• 1 time	153 (38.2)	69 (34.5)	84 (42)
	• 2 times	198 (49.5)	94 (47)	104 (52)
	• 3 times	23 (5.8)	14 (7)	9 (4.5)
	• more than 3 times	3 (0.8)	3 (1.5)	—
4.	Use of used oil			
	• Discard	28 (7)	19 (9.5)	9 (4.5)
	• Incorporated in other dishes	342 (85.5)	111 (87)	188 (94)
	• Miscellaneous use in other things	10 (2.5)	7 (3.5)	3 (1.5)

(Figures in parentheses represent percentages)

from unsaturated fatty acids resulting in the production of hydroperoxides and ultimately to carbonyl compounds leading to the formation of undesirable off flavors in oils (Pristouri, Badeka & Kontominas., 2010). The exposure to atmosphere badly affects the quality of ghee and oil and affects the vitamin A content of fortified brands. So exposure should be minimized to ensure good quality of the ghee and oils.

Time Lapse between cooking and serving of the dishes at different meals and storage of leftover food : 46.5 % of the families were keeping leftover food in refrigerator and 48.8 % of the families were keeping at room temperature. In MIG families 86 % of the families were keeping leftover food items in refrigerator.

Out of 400 mothers 97.8 % leave cooked dishes on kitchen counter till the meal is consumed. Among MIG families, 95.5 % of the women left cooked dishes on the counter till they are consumed. Among LIG families, all of the women left cooked dishes on the counter till the meal are consumed. Nearly 27 % of the families were consuming their morning breakfast, 28.2 % lunch and 29.2 % dinner, within half an hour of cooking whereas 23.2% were consuming their lunch after 3 to 4 hours of cooking. The reason was that children and were taking lunch to their schools.

Reheating foods although important from point of food safety, results in loss of vitamins- 5% loss of riboflavin and niacin, 10 % losses of vitamin A, 30 to 50% of the losses of vitamin B6, folate, vitamin B12, thiamin and vitamin C have been reported after reheating foods as compared to raw foods (USDA Table of Nutrient Retention Factors (2003).

From this study some of the good and bad practices were identified and percentage of families following those practices has been presented in Table 3.

Table No. 3 : Percentage of families following good and practices (N=400)

S. No.	*Good practices*	*Proportion (%)*	*Bad practices*	*Proportion (%)*
1.	Buying vegetables Daily	33	Buying vegetables 1 to 2 times a week	54
2.	Storing perishable fruits and vegetables in refrigerator	52	Storing perishable fruits and vegetables at room temperature	58
3.	Washing vegetables before chopping	33.2	Washing vegetables after chopping	60
4.	Consuming fruits immediately	82.5	Consuming fruits after time lag of 1 to 4 hours of cutting	17.5
5.	Storing fat and fat products in opaque containers	31.5	Storing fat and fat products in transparent/translucent containers	68.5
6.	No Smoking stage of frying oil	8	Smoking stage of oil	92
7.	No Addition of new oil to old oil used for deep frying	85.2	Addition of new oil to old oil used for deep frying	14.8
8.	No reusing the frying oil	5.8	Reusing the frying oil	94.2
9.	Consuming cooked food immediately	10	Consuming food after a time period	90
10.	Storing leftover food in refrigerator	47	Storing leftover food at room temperatures	53

Conclusions / Recommendations

Various studies have documented the changes in the level of nutrients in food during cooking, processing and storage. Buying small quantities of fruits and vegetables fresh daily or alternate days is better than storing them for the week. Fruits and vegetables need to be protected from moisture loss by wrapping them and then preferably storing at low temperatures to decrease enzymatic activity. It is advisable to consume/cook cut fruits and vegetables immediately after cutting them without any time lag, to avoid oxidative changes and loss of vitamins like vitamin C. Two third families were washing after cutting thus increasing losses of water soluble vitamins and phytochemicals. Almost all mothers were leaving cooked food on the counter at ambient temperature while nearly half (48.8 %) of the families were keeping leftovers at room temperature, thus increasing the risk of microbial spoilage. This study generated data which helps us in understanding why food secure households may sometimes not be delivering the right quantity of nutrients to young children and in fact to the whole family, thus putting them at risk of micronutrient malnutrition. It highlights the points to be kept in mind while planning nutrition awareness programs to improve household practices and ensure not only maximum nutrient retention but also safety of meals.

References

1. *Ball GMF, Vitamins in Foods. Analysis, Bioavailability, and Stability, CRC Press, Boca Raton, 2006, p. 3.*

2. *Gayathri GN, Platel K, Prakash J, Srinivasan K. Influence of antioxidant spices on the retention of β-carotene in vegetables during domestic cooking processes. 2004. Food Chem 84: 35–43.*
3. *Hussein, A.; Odumeru, J. A.; Ayanbadejo, T.; Faulkner, H.; McNab, W. B.; Hager, H.; Szijarto, L. Effects of processing and packaging on vitamin C and â-carotene content of ready-to-use (RTU) vegetables. Food Res. Int. 2000, 33, 131-136.*
4. *Lee SK, Kader AA. Preharvest and postharvest factors influencing vitamin C content of horticultural crops. PostharVest. Biol. Technol. 2000, 20, 207-220.*
5. *Maskova, E., Rysova, J., Fiedlerova, V., and Holasova, M. (1994). Retencevybrany chvitaminu a minera lnichlatekprikulinarni u prave masa. Potravina rske Vedy 12: 407-416.*
6. *Potter NN 2003. Food Science. 4th Edition. New Delhi: The AVI Publishing Co. Inc., Daya Publishing House.*
7. *Pristouri AG, Badeka MG, Kontominas Effect of packaging material headspace, oxygen and light transmission, temperature and storage time on quality characteristics of extra virgin olive oil. Food Control 21 (2010) 412–418.*
8. *Rocha AMCN, Brochado CM, Kirby R & Morais MMB. Shelf-life of chilled cut orange determined by sensory quality. Food Control 1995, 6, 317-322.*
9. *Santosa J, Mendiolab JA, Oliveiraa MBPP, Ibanezb E, Herrerob M. Sequential determination of fat- and water-soluble vitamins in green leafy vegetables during storage. Journal of Chromatography A, 1261 (2012) 179–188.*
10. *UNICEF. State of the world children: Child survival. New York: UNICEF; 2008. Available at: http://www.unicef.org/sowc08/docs/sowc08.pdf. Accessed on Sept. 23, 2014.*
11. *USDA Table of Nutrient Retention Factors (2003) Available at : www.ars.usda.gov/SP2UserFiles/Place/12354500/Data/retn/pdf*

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Shelf Life Extension of Chicken Ham by Combination of Packaging and Storage Condition

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Abstract

A study was conducted to assess the shelf life of chicken ham packed in laminate of metalized PET/Poly with polyethylene pouches under aerobic and vacuum packaging and kept in refrigerator (4±1°C) and freezer (-18±1°C). The samples were analyzed for moisture, pH, Thiobarbituric Acid (TBA) Value, Tyrosine value, Total Plate Count (TPC), Total Psychrophilic Count (TPSC), Yeast and Mould Count (YMC), flavour and tenderness. pH, TBA value, Tyrosine value, TPC, TPSC and YMC of the samples increased during storage whereas moisture,flavour and tenderness decreased.Chicken hams were acceptable upto 2 weeks and 4 weeks in refrigerated storage in aerobic and vacuum packaging respectively. In the freezer, shelf life of ham was 3 months in aerobic packaging and 5 months in vacuum packaging.

Keywords : Chicken ham, vacuum, freezer, shelf life.

Introduction

It is well known that meat is a perishable product and can only be stored for longer time through proper processing, packaging and storage. Though at present, processing of meat is very little in India, but demand for processed meat is increasing because of our changing life style. Chicken ham is not a common product available in the market, but cured and smoked chicken leg i.e. chicken hamcould be prepared and served as a good ready to eat meat product.

This can be stored for a considerable time through proper packaging and storage to prevent/reduce product deterioration caused by moisture loss, microbial spoilage and chemical changes.

Objective

Objective of the study was to extend the shelf life of chicken hamby adopting combination of packaging method and storage temperature.

Methodology

Source of materials and chicken ham preparation : Leg part of dressed hensfrom the same source and age group were used for preparation of ham. Chicken leg, table salt, turmeric powder, jiggery, monosodium glutamate, benzoate, citric acid, and sodium nitrate were used and hams were prepared by dry curing for 5 days at 4°C (with intermittent massaging of curing mixture). On the sixth day, cured legs were smoked in a smoke chamber (exposed to 65°C to 80°C) for 24 hours (till the products are completely cooked).

Freshly prepared product was analyzed for different parameters and considered as control for the experiment.

Packaging and storage : For storage study, cured and smoked hams were packaged in laminate of metalized (aluminium) PET and low density polyethylene of 200 gauges under two different methods of packaging i.e., aerobic and

vacuum packaging. Ham were stored for studies at the end of 1st, 2nd, 3rd, 4th and 5th week of refrigerated storage (4±1°C) and were kept in freezer (-18 ±1°C) for subsequent analysis on 1st, 2nd, 3rd, 4th, 5th and 6th month.

Analysis : Samples were analyzed for moisture content (AOAC, 1990), pH (Trout, 1992), TBA (Thiobarbituric Acid) value (Tarladgis*et al*., 1960), Tyrosine Value (Strange *et al*., 1977), Total Plate Count (TPC), Total Psychrophilic Count (TPSC) and Yeast and Mould Count (YMC) (APHA, 1984), flavour and tenderness (Keeton, 1983). In the present study six trials were conducted. The data were analyzed by statistical method using General Linear Model of SPSS software package (Snedecor and Cochran, 1994) and Duncan's Multiple Range test (Duncan, 1955).

Findings

The results of the analysis of chicken ham stored at refrigeration temperature (4±1°C) and freezer temperature (-18±1°C) for different storage periods are presented in Table No. 1 and 2 respectively.

Discussion

In case of pH, TBA value, tyrosine value, TPC, TPSC and YMC, the hams showed an increasing trend throughout the storage period in refrigerator and freezer. The moisture content and the scores of sensory parameters like flavor and tenderness of hams decreased during storage with advancement of storage period in both the storage temperatures.

The increment of pH might be due to liberation of alkaline metabolites from action of bacteria. The rate of changes were slower in freezer than refrigerator and in vacuum packed sample than aerobically packed because of the advantageous effect of low temperature and vacuum condition in arresting microbial activity respectively.

Increase in TBA value was due to oxidation of unsaturated fatty acids of ham during storage. The rate of increment in TBA value in freezer was slower due to retarded rate of lipid oxidation in lower temperature. TBA value increased at a slower rate under vacuum because absence of oxygen resulted in delayed lipid oxidation.

Increase in tyrosine value of hams during storage was due to proteolysis in meat by increased bacterial population. The samples under vacuum showed a lower tyrosine value than those in aerobic pouches because anaerobic condition created by vacuum packaging reduced the rate of microbial growth and thus reduced level of proteolysis. Slower change in tyrosine value in freezer was due to retarded microbial growth by low temperature.

Insignificant decrease in TPC, TPSC and YMC during first phase of freezer storage was due to effect of cold shock on microbes by freezer temperature. After that a significant increment of all these values occurred due to adaptability of microbes to freezer temperature. This is also true for refrigerated storage.TPC, TPSC and YMC of samples in freezer storage increased at slower rate than that in refrigerated storagedue to reduction of microbial cell and extension of lag phase of microbial growth caused by cold shock in freezer. Again, the oxygen transmission rate of packaging material decreased with lowering temperature (Patterson *et al.,* 2004), thus freezer temperature reduced growth rate of microbes in the samples to a greater extent. The samples under vacuum showed lower TPC, TPSC and YMC of the product than those in aerobic pouches because vacuum packaging arrested the proliferation of the aerobic microorganisms.

The moisture content and scores of flavor and tenderness of hams decreased during storage in both the storage temperatures. Decrease in flavour and tenderness scores of hams during storage might be due to moisture loss from product, increased lipid oxidation and proteolysis.

Table No.1 : Different parameters of Chicken Ham (Mean±SEM) stored at 4±1°C

Parameters	Type of packaging	0 day	1 week	2 weeks	3 weeks	4 weeks	5 weeks
Moisture	**Aerobic**	61.58^{a} ±0.18	60.11^{b} ±0.17	59.03^{c} ±0.19	57.82^{c} ±0.23	ND	ND
	Vacuum	61.58^{a} ±0.18	61.15^{a} ±0.22	60.36^{b} ±0.18	59.40^{c} ±0.16	58.80^{d} ±0.26	58.15^{e} ±0.24
pH	**Aerobic**	5.84^{b} ±0.03	5.91^{b} ±0.03	6.13^{a} ±0.05	6.31^{a} ±0.05	ND	ND
	Vacuum	5.84^{d} ±0.03	5.85^{d} ±0.03	5.94^{cd} ±0.02	6.04^{bc} ±0.07	6.15^{ab} ±0.04	6.26^{a} ±0.03
TBA	**Aerobic**	0.108^{d} ±0.005	0.228^{c} ±0.01	0.370^{b} ±0.006	0.530^{a} ±0.005	ND	ND
	Vacuum	0.108f ±0.005	0.184e ±0.006	0.270^{d} ±0.008	0.378^{c} ±0.005	0.468^{b} ±0.009	0.584^{a} ±0.004
Tyrosine value	**Aerobic**	0.225^{d} ±0.005	0.330^{c} ±0.008	0.465^{b} ±0.006	0.579^{a} ±0.006	ND	ND
	Vacuum	0.225^{f} ±0.005	0.279^{e} ±0.004	0.343^{d} ±0.008	0.426^{c} ±0.006	0.502^{b} ±0.007	0.603^{a} ±0.007
TPC	**Aerobic**	2.36^{d} ±0.05	3.02^{c} ±0.05	3.75^{b} ±0.05	4.76^{a} ±0.06	ND	ND
	Vacuum	2.36^{f} ±0.05	2.62^{e} ±0.06	2.89^{d} ±0.08	3.37^{c} ±0.05	3.85^{b} ±0.05	4.50^{a} ±0.04
TPSC	**Aerobic**	1.85^{d} ±0.06	2.42^{c} ±0.05	3.18^{b} ±0.07	4.05^{a} ±0.05	ND	ND
	Vacuum	1.85^{f} ±0.06	2.11^{e} ±0.06	2.59^{d} ±0.07	3.19^{c} ±0.05	3.82^{b} ±0.04	4.39^{a} ±0.04
YMC	**Aerobic**	0.32^{d} ±0.04	0.55^{c} ±0.06	0.78^{b} ±0.05	1.23^{a} ±0.02	ND	ND
	Vacuum	0.32^{e} ±0.04	0.34^{e} ±0.05	0.51^{d} ±0.07	0.66^{c} ±0.04	0.81^{b} ±0.05	1.19^{a} ±0.05
Flavour	**Aerobic**	7.80^{a} ±0.22	6.82^{b} ±0.21	5.75^{c} ±0.19	4.15^{d} ±0.31	ND	ND
	Vacuum	7.80^{a} ±0.22	7.20^{ab} ±0.18	6.83^{bc} ±0.31	6.33^{c} ±0.31	5.67^{d} ±0.26	4.10^{e} ±0.25
Tenderness	**Aerobic**	7.50^{a} ±0.19	7.17^{ab} ±0.31	6.60^{b} 0.26	ND	ND	ND
	Vacuum	7.50^{a} ±0.19	7.33^{a} ±0.40	7.00^{a} ±0.26	6.83^{ab} ±0.31	6.17^{b} ±0.17	ND

(Means bearing different superscripts within row differ significantly. ND means not done)

Table No. 2 : Different parameters of Chicken Ham (Mean±SEM) stored at -18±1°C

Parameters	Type of packaging	0 day	1 month	2 months	3 months	4 months	5 months	6 months
Moisture	**Aerobic**	61.58^{a} ±0.18	61.26^{a} ±0.21	60.29^{b} ±0.23	59.21^{c} ±0.18	56.99^{d} ±0.31	ND	ND
	Vacuum	61.58^{a} ±0.18	61.30^{ab} ±0.21	60.78^{b} ±0.24	59.85^{c} ±0.17	58.69^{d} ±0.21	57.67^{e} ±0.32	56.72^{f} ±0.25
pH	**Aerobic**	5.84^{c} ±0.03	5.92^{c} ±0.04	6.06^{b} ±0.04	6.25^{a} ±0.02	6.38^{a} ±0.04	ND	ND
	Vacuum	5.84^{d} ±0.03	5.84^{d} ±0.03	5.94^{d} ±0.07	6.11^{c} ±0.04	6.23^{bc} ±0.08	6.34^{ab} ±0.02	6.38^{a} ±0.02
TBA value	**Aerobic**	0.108^{d} ±0.005	0.152^{d} ±0.009	0.234^{c} ±0.004	0.351^{b} ±0.006	0.510^{a} ±0.008	ND	ND
	Vacuum	0.108^{f} ±0.005	0.142^{ef} ±0.005	0.185^{e} ±0.01	0.261^{d} ±0.008	0.349^{c} ±0.006	0.453^{b} ±0.005	0.560^{a} ±0.008
Tyrosine value	**Aerobic**	0.225^{d} ±0.005	0.259^{d} ±0.005	0.332^{c} ±0.01	0.444^{b} ±0.008	0.563^{a} ±0.005	ND	ND
	Vacuum	0.225^{g} ±0.005	0.259^{fg} ±0.004	0.313^{ef} ±0.009	0.352^{de} ±0.007	0.442^{c} ±0.005	0.532^{b} ±0.006	0.645^{a} ±0.005
TPC	**Aerobic**	2.36^{d} ±0.05	2.51^{d} ±0.04	3.04^{c} ±0.07	3.75^{b} ±0.07	4.36^{a} ±0.05	ND	ND
	Vacuum	2.36^{e} ±0.05	2.23^{e} ±0.08	2.40^{e} ±0.06	2.87^{d} ±0.06	3.24^{c} ±0.05	3.81^{b} ±0.05	4.44^{a} ±0.04
TPSC	**Aerobic**	1.85^{d} ±0.06	2.00^{d} ±0.06	2.35^{c} ±0.08	2.84^{b} ±0.05	3.25^{a} ±0.06	ND	ND
	Vacuum	1.85^{e} ±0.06	1.75^{e} ±0.08	1.91^{e} ±0.06	2.26^{d} ±0.04	2.79^{c} ±0.06	3.20^{b} ±0.06	3.62^{a} ±0.05
YMC	**Aerobic**	0.32^{d} ±0.04	0.36^{d} ±0.07	0.55^{c} ±0.07	0.80^{b} ±0.06	1.28^{a} ±0.10	ND	ND
	Vacuum	0.32^{e} ±0.04	0.27^{e} ±0.06	0.34^{de} ±0.08	0.47^{cd} ±0.07	0.65^{bc} ±0.10	0.81^{b} ±0.04	1.28^{a} ±0.05
Flavour	**Aerobic**	7.80^{a} ±0.22	7.25^{ab} ±0.25	6.60^{b} ±0.31	5.56^{c} ±0.20	4.20^{d} ±0.31	ND	ND
	Vacuum	7.80^{a} ±0.22	7.50^{ab} ±0.34	7.17^{ab} ±0.17	6.83^{bc} ±0.26	6.33^{cd} ±0.33	5.67^{d} ±0.24	4.33^{e} ±0.20
Tenderness	**Aerobic**	7.50^{a} ±0.19	7.25^{a} ±0.26	6.90^{ab} ±0.24	6.41^{b} ±0.19	ND	ND	ND
	Vacuum	7.50^{a} ±0.19	7.33^{a} ±0.33	7.17^{ab} 0.41	6.83^{abc} ±0.33	6.50^{bc} ±0.22	6.17^{c} ±0.17	ND

(Means bearing different superscripts within row differ significantly. ND means not done)

Better maintenance of sensory qualities in freezer storage might be due to lesser degree of dehydration, slower growth rate of microbes and reduced rate of lipid oxidation than those in the refrigerator. Vacuum packaging secured a higher score in terms of sensory quality because anaerobic condition maneuvered some of the factors (viz. dehydration, proteolysis and rancidity) responsible for causing off flavour and toughness of products (Bhoyar*et al.*,1997).

The hams were acceptable in terms of TBA and flavour upto2nd week and 4thweek of refrigerated storage and upto 3rd month and 5th month of frozen storage in aerobic and vacuum packaging respectively.Therefore, the samples were not analyzed for TBA value after these periods. The TBA values > 0.5 mg malonaldehyde/kg of ham had been identified as the level of oxidation towards rancidity as evident through the flavour scores which was below 4.5 (not liked by the panelists) in 9 point hedonic scale. TPC of chicken hams clearly revealed that the count below 4 log cfu/g could be regarded as safer for consumption readily whereas any value of TPC above 4 log cfu/g irrespective of packaging methods and storage temperatures should be rejected.

Conclusion

It can be concluded that vacuum packaging provided 2 weeks and 2 months more shelf life of the hams in refrigerated and freezer temperature than in aerobic packaging. The freezer temperature extended the storage life of hams upto 3rd and 5th month against that of 2 weeks and 4 weeks of refrigerated storage in aerobic and vacuum packaging respectively. The best combination for storing chicken ham was vacuum packaging and freezer temperature. It increased the shelf life of ham 10 times in comparison to aerobic packaging and refrigerated storage (i.e. 5 months vs. 2 weeks).

Recommendations

For extending the shelf life of chicken hamupto 10 times, the products can be stored in metalized plastic laminate package under vacuum and stored in the freezer.

References

1. *AOAC (1990).Official Methods of Analysis. 14th edition. Association Of Analytical Chemists. Washington, DC.*
2. *APHA (1984).Compendium of Methods for the microbiological examination of foods, ed. M.L. Speck, 2ndedn. Washington, DC: American Public Health Association.*
3. *Bhoyar A.M.; Pandey N.K.; Anand S.K. and Verma S.S. (1997).Effect of packaging on refrigerated storage stability of restructured chicken steaks.Indian Journal of Poultry Science.32(3): 259-265.*
4. *Duncan, D.B. (1955).Multiple range and multiple F-tests, Biometrics, 11, 1.*
5. *Keeton, J.T. (1983).Effect of fat and NaCl/ phosphate levels on the chemical and sensory properties of pork patties.Journal of Food Science, 48, 878- 885.*
6. *Patterson, M.K.; Mielnik, M.B.; Eie, T.; Skrede, G. and Nilsson, A. (2004). Lipid oxidation in frozen mechanically deboned turkey meat as affected by packaging parameters and storage conditions. Poultry Science.83: 1240-1248.*
7. *Snedecor, G.W. and Cochran, W.G. (1994).Statistical Methods, 1st edn., East-West Press, New Delhi.*
8. *Strange, E.D., Benedict, R.C., Smith, J.L. & Swift, C.E. (1977). Evaluation of rapid tests for monitoring the alterations in meat quality during storage, I. Intact meat.Journal of Food Protection,40, 843-847.*
9. *Tarladgis, B.G., Watts, B.M., Younathan, M.T. & Dugan, L.R. (1960).A distillation method for the quantitative determination of malonaldehyde in rancid foods.Journal of American Oil Chemical Society,37, 403-406.*
10. *Trout, E.S., Hunt, N.C., Hohnson, D.E., Claus, J.R., Kastner, C.L. & Kropf, D.H. (1992). Chemical, physical and sensory characterization of ground beef containing 5 to 30% fat. Journal of Food Science,57, 25-29.*

Effect of Soaking and Drying on De-coating of Tamarind Seed

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Abstract

In this research communication effort were made to identify appropriate pre-treatment to remove seed coat from tamarind seed and to observe the effect of pre-trement on physicochemical properties of seeds. Three pre-treatment methods were employed with different soaking, boiling and drying temperatures. The result reveals that method III having higher heating temperature and longer drying time has maximum de-coating compared to other methods. The different pre-treatment had a significant effect on physicochemical properties of seeds with varying bed thickness of tray drying.

Keywords : Thickness, soaking and drying

Tamarind **(*Tamarindus indica.*,)** tree is among the large tropical trees belonging to the family of *Fabaceae*, in the genus: *Tamarindus*..It is a very large tree with long, heavy drooping branches, and dense foliage. (Bhattacharya *et.al* 1994). They grow throughout tropical and subtropical regions of Africa, South Asia, South America and Caribbean islands for their fruits. Tamarind fruit contains certain health benefiting essential volatile chemical compounds, minerals, vitamins and dietary fiber. Its sticky pulp is a rich source of non-starch poly-saccharides (NSP) or dietary-fiber such as gums, hemicelluloses, mucilage, pectin and tannins. NSP or dietary fiber in the food increases its bulk and augments bowel movements thereby help prevent constipation.

Tamarind is rich in tartaric acid; it gives sour taste to food besides its inherent activity as a powerful antioxidant. (Anti-oxidant E-number is E334). It, thus, helps human body protect from harmful free radicals. Tamarind fruit contains many volatile phytochemicals such as *limonene, geraniol, safrole, cinnamic acid, methyl salicylate, pyrazine* and *alkylthiazole*s (Kumar and Bhattacharya 2008). Together these compounds account for the medicinal properties of tamarind. In addition, it is also rich in many vital vitamins, including thiamine (36% of daily required levels), vitamin-A, folic acid, riboflavin, niacin, and vitamin-C. Much of these vitamins plays antioxidant as well as co-factor functions for enzyme metabolism inside the body.

Tamarind Seeds consist of 35% Husk and 65 % White Kernel. The white kernel obtained of tamarind seeds are utilized for producing Tamarind Kernel Powder (TKP). It is rich in Protein, Carbohydrates, Fibres and Oils. However, the kernel contains starch and gum which is processed under different steps to transform into powder form. TKP has excellent water absorption property and high viscosity as well. It is also applied in pharma industry for its binding property. Tamarind Kernel Powder is the combination of Galactoxyloglucan polysaccharide (55-65%), lipids (6-10%) proteins (18-20%) and also consists of D-mannose and D-galactose. Tamarind seed powder is valuable but appropriate pre-treatment

to remove its seed coat is yet generalized. The present study was aim to determine appropriate method to get maximum removal of seed coat from the cotyledon of tamarind seeds and effect of boiling on properties of tamarind seeds.

Materials and Methods

Tamarind was procured from local market of Noida (India). Tamarind cover was manually removed and pulp was separated from the seeds. The seeds were cleaned manually and undesired materials namely broken, foreign matter, split and deformed seeds were discarded before the samples were prepared for the experiment.

Methods

Initial moisture content of seeds, was determined by hot air oven method at 105°C (AOAC1995). Three pretreatment methods were employed to remove the seed coat from cotyledon of tamarind seed are as follows :

Method I : Tamarind seed were soaked in equal quantity of distilled water at 32°C for 12 hour, and after that boiling the seeds in 80°C for 1 hour; draining the excess water thereafter drying the seed in tray dryer at 40°C for 24 hour at two bed thickness of 1 cm and 3 cm.

Method II : Tamarind seed were boiled 50°C for 1 hour in equal quantity of distilled water, after the boiling, draining the excess water then seeds were dried in the hot air oven at 50°C for 12 hour at two bed thickness of 1 cm and 3 cm.

Method III : Tamarind seed were boiled in the distilled water at 100°C for 1 hour, after the boiling, draining the excess water then the seeds were dried in the tray dryer at 50°C for 24 hour at two bed thickness of 1 cm and 3 cm. The samples were allowed to equilibrate at room temperature prior to experimentation.The seeds obtain from about three pretreatment methods were subject to physico-chemical analysis.

Physico-chemical analysis of pretreated tamarind seeds

Bulk density

Bulk density of tamarind seed was determined as a ratio of mass to volume. It was determined by the method described by (Mohsenin 1986) and the average of three replications was reported.

Tap density

Tap density was determined by tapping filled measuring cylinder of 100 ml with tamarind seed until no further volume could be add and it was noted, then the sample was weighed (Singh and Goswami, 1996).

Angle of repose

Angle of repose for tamarind seeds was determine by using a tapering hopper made of iron with top and bottom having a dimension of 250mm×250mmx250mm and 20mm×20mm hole in the bottom, respectively. A circular disc (100 mm) was placed below the hopper bottom which allows the seed to flow through during the test. The angle of repose of tamarind seed and powder was calculated as :

$$\vartheta = \tan^{-1}\left(\frac{2H}{D}\right)$$

Where, θ is the angle of repose, H is the height of the cone (cm) and D is the diameter of disc (cm).

Coefficient of Static Friction

Apparatus used for determining static coefficient of friction consisted of a frictionless pulley, rectangular box with ends opened, loading pan and test surfaces viz. plywood, stainless steel and mild steel. The rectangular box was placed on the experimental surface which was filled with known quantity of sample and on the other side weights were added to the pan till the

rectangular box just slides. The experiment was made for tamarind seeds of different moisture contents. The coefficient of static friction was calculated as the ratio of weights added (frictional force) and material mass (normal force) (Balasubramaniam et al, 2012).

Ash (%)

About 5 g of the sample was accurately weighed into a pre weighed silica crucible. It was then carbonized in silica crucible on burner followed by heating at about 550°C for 6 hrs in the muffle furnace to get complete white colored ash allowed them to cool in the furnace. Then the crucible was transferred to a desiccators and weighed as possible to prevent moisture absorption. The ash was calculated using following formula.

$$\% \text{ Ash} = \frac{\text{Wt. of crucible with ash - Wt. of crucible}}{\text{Wt. of sample in g}} \times 100$$

Crude Fat (%)

Fat content in the sample was estimated by Soxhlet extraction method (Ranganna, 1986). Moisture free sample was transferred to thimble which was then fixed into a stand and transferred to a pre-weighed Soxhlet beaker. The beaker was filled with petroleum ether. The beaker was then attached to Soxhlet apparatus and the sample was extracted for 2 hours at 60°C. At the same temperature the ether was evaporated for 2 hours after extraction. At the end of 4 hours the ether left was dried in hot oven at 100°C for 30 minutes. The beaker was then cooled in dessicator and weighed. It gives the amount of ether soluble fat present in the sample.

$$\text{Crude fat (\%)} = \frac{\text{Weight of fat(g)}}{\text{Weight of sample (g)}} \times 100$$

Alcoholic Acidity

The percent acid in the sample was determined by titrating against standard base (IS:1155: 1968). A suitable quantity of sample was weighed in a conical stopper flask and 50 ml of neutral ethyl alcohol was added. Stoppered, shaken and allowed to stand for 24 hrs, with occasional shaking. The alcoholic extract was filtered through a filter paper. 10 ml of combined alcoholic extract was titrated against standard NaoH solution using phenolpthalein as indicator. The % of alcoholic acidity as sulphuric acid was calculated using the formula :

$$\text{Alcoholic acidity} = \frac{24.52 \times V \times N}{W}$$

Where V= volume of the alkali used, N= normality of NaOH, W=weight of the sample

Results and Discussions

Pre-treatment of Tamarind Seed

Three pre-treatment methods were used to remove of seed coat from cotyledon of tamarind seeds the results of pre-trial's are as follows :

Initially three pre-treatment methods were used to remove of seed coat from cotyledon of tamarind seeds were water soaked with different soaking times for each method. After soaking the samples were boiled and dried by tray drying method. The relationship of de-coating recovery and different soaking time of tamarind seeds were studied and following results were observed.

Method I : De-coating recovery with samples soaked for 12 hr min was not satisfactory. Only 37% seed coat was removed it was due to the soaking time was not sufficient for complete absorption of emulsion and the breaking the attachment between coat and cotyledon and due to low temperature drying seed coat bonds couldn't be successful break up.

Method II : De-coating recovery with samples boiled at 45°C for 2 hr min was not satisfactory. Only 45% seed coat was removed it was due to the soaking time was not sufficient for complete

absorption of emulsion and the breaking the attachment between coat and cotyledon.

Method III : De-coating recovery with samples boiled at 100°C for 1 hr min has good results. About 70 % seed coat was removed it was due to the soaking time was sufficient for complete absorption of emulsion and the breaking the attachment between coat and cotyledon. The samples were allowed to equilibrate at room temperature prior to experimentation.

Physical Analysis of Pretreated Seed

The pretreatment to remove coat from the cotyledon also had a significant effect on the physical properties of tamarind seed. The bulk density of the tamarind seed treated by method I had lowest density and method III had highest bulk density from 654 and 736 kg/m^3 for I cm bed thickness whereas their no significant difference in 3 cm bed thickness with bulk density 679 to 785 for I-III methods.

Similarly tap densities were in the increasing trend (690-820 kg/m^3) for 1 cm bed thickness and (690-820 kg/m^3) for 3 cm bed thickness in method I-III respectively. This was due to the increase in volumetric expansion in the sample which was greater than its initial weight.

Angle of repose showed an increasing trend from method I-III polynomial. Angle of repose values increased from (22.74, 24.12 and 25.17) for method I, II and III respectively in 3 cm bed thickness. Coefficient of static friction decreased linearly.

It was found to be highest for plywood followed by MS sheet and SS sheet. The values of coefficient of friction were (0.35, 0.44, 0.48) for mild steel (0.39, 0.48, 0.52) plywood and (0.32, 0.41, 0.44) stainless steel surface for method I,II and III respectively. Altuntas et al (2005) reported a linear decrease in coefficient of friction with moisture content and found to be highest.

Chemical Properties of Tamarind Pretreated Seeds

Ash content for pretreated tamarind seeds for method I, II and III showed decreasing trends. Ash content of method I (1.8), II (2.12) and III (2.35) for 1 cm thickness and (1.49) I, (1.90) II and (2.05) III for 3 cm thickness respectively. It is observed that the highest fat content was found in method I sample (9.13) for 1 cm thickness followed by method II (7.636) for 1 cm thickness whereas lowest fat content was found in by method III (6.45) in 1 cm thickness.

The Alcoholic acidity of various powders varied from 0.00196 to 0.00098 for method I-III in bed thickness of 1 cm. Whereas for 3 cm bed thickness it varied from 0.00175 to 0.00083 for method I-III respectively.

The increase in boiling temperature and time of tamarind seed caused linear decrease in the Alcoholic acidity.

Conclusion

The present research work was on investigation appropriate pre-treatment to remove seed coat from tamarind seed and to observe the effect of pre-trement on physicochemical properties of seeds.

1. De-coating recovery was not satisfactory for method I and II only 37 and 45 % seed coat was removed it was due to the soaking time was not sufficient for complete absorption of emulsion and the breaking the attachment between coat and cotyledon and due to low temperature drying seed coat bonds couldn't be successful break up. Whereas Method III had a maximum de-coating recovery 70%.

2. The different pre-treatment had a significant effect on physicochemical properties of seeds with varying bed thickness of tray drying.

References

1. *AOAC. (1995). Official methods of analysis. In: Williams, S. (Ed.), "Association of Offical Analytical Chemists", Inc., Arlington, Virginia.*
2. *Altuntas, E., Ozgoz, E. and Taser, F. (2005). Some physical properties of fenugreek (Trigonella foenum-graceum L.) seeds. J. Food Eng., 71, 37-43*
3. *Balasubramanian S , Mohite A M, Singh K K, Zachariah T J and Anand T (2012) Physical properties of turmeric (Curcuma longa L.) J. Spices and Aromatic Crops Vol. 21 (2): 171–174*
4. *Bhattacharya, P.K., Bal, S. and Mukherji, R.K. (1994) Studies on the characteristics of some products from tamarind (Tamarindus indica L.) kernels. Journal of Food Science and Technology (India), 31(5): 372-376.*
5. *Kumar C.S, Bhattacharya S. 2008 "Tamarind seed: properties, processing and utilization." Food Science and Nutrition. Jan; 48(1):1-20*
6. *Mohsenin N.N.(1986.) Physical properties of Plant and Animal Materials. 2nd Edn. Gordenand Breach Science Publishers, New York.*
7. *Singh, K.K. and Goswami, T.K. (1996) Physical properties of cumin seed. J. Agric. Eng. Res., 64, 93-98.*
8. *Ranganna, S. (1986). Handbook of Analysis and quality control for fruit and vegetable products, IInd edn. Tata Mc Graw-Hill, New Delhi.*

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Vitamin-D Deficiency : An Emerging Epidemic — Meeting the Challenge

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Abstract

Vitamin D deficiency is pandemic, yet it is the most under-diagnosed and under-treated nutritional deficiency in the world. Indian socio-religious and cultural practices do not facilitate adequate sun exposure, thereby negating potential benefits of plentiful sunshine. Consequently, subclinical vitamin D deficiency is highly prevalent in both urban and rural settings, and across all socioeconomic and geographic strata. Vitamin D deficiency is likely to play an important role in the very high prevalence of rickets, osteoporosis, cardiovascular diseases, diabetes, cancer and infections such as tuberculosis in India. Synthesis of vitamin D in the skin by sunlight exposure is the major natural source of the vitamin. It is required for absorption of calcium, better muscle function and the immune system, brain functioning, better lung functioning and has anti-carcinogenic properties. Deficiency is associated with includes poor bone health, multiple sclerosis, type I diabetes, common cold, tuberculosis and heart disease. In India Vitamin D deficiency is growing because of lack of sunlight exposure. Diet alone is unable to meet the deficiency thus other prevention methods like supplementation and fortification have to be looked into. In this paper, we have discussed the functions of vitamin-D, its prevalence, various deficiency diseases, reasons for deficiency, prevention of vitamin- D deficiency along with strategies to prevent Vitamin D deficiency.

Introduction

Vitamin D has been traditionally known as "anti-ricketic factor or sunshine vitamin". It is a unique nutrient because it can be synthesized endogenously (skin) and it functions as a hormone.[1] It is a fat soluble vitamin and is required to maintain normal circulating calcium and phosphate.

Some extremely important things like nerve conduction, blood coagulation, bone mineralization, insulin balance are directly affected by adequate calcium levels in blood. Vitamin D deficiency (VDD) is a major health problem in both the developed and developing countries across the globe. In India, despite ample availability of sunshine (required for the synthesis of vitamin D endogenously), VDD prevalence has been documented to be in range of 50-90% among all the age groups[2] Till few years back it was thought that vitamin D deficiency is not significant in India because Indians get ample sunshine. However, various studies conducted in different parts of the country have documented a widespread prevalence of VDD in all age groups including toddlers, school children, pregnant women and their neonates and adult.[3, 4, 5-8]

Vitamin D deficiency is probably the most under-diagnosed and under-treated nutritional deficiency in the world. Subclinical vitamin D deficiency is highly prevalent in both urban and rural settings, cuts across all socioeconomic and geographic spectrums. Vitamin D deficiency is likely to play an important role in the very high prevalence of rickets, osteoporosis, cardio-vascular diseases, diabetes, cancer and infections such as tuberculosis in India.[9]

Serum 25(OH)D provides the single best assessment of vitamin D status. 25(OH)D has a half-life of about 3 weeks, making it the most suitable indicator of vitamin D status. A classification to define vitamin D status is as follows: mild hypovitaminosis D: 10–20 ng/ml, moderate hypovitaminosis D: 5-10 ng/ml, and severe hypovitaminosis D: less than 5 ng/ml.[10] Growing body of evidence suggest that serum 25(OH)D cut-off <50 nmol/L or 20 ng/ml may be associated with greater risk of non skeletal chronic diseases.[11, 12]

Established and emerging associations of Vitamin D with various aspects of metabolism and disease management

Calcium Absorption, Skeletal Development, Muscle Formation and Bone Muscle Interaction

Vitamin-D plays a vital role in absorption of Calcium in duodenum. 1, 25-dihydroxyvitamin D_3 [$1,25(OH)_2D_3$] binds to Vitamin-D Receptor (VDR) resulting in increase in expression of several calcium transporter genes, e.g., TRPV5/6, calbindin-D9k, plasma membrane Ca^2 ±$ATPase_{1b}$, and NCX1, thereby enhancing the transcellular calcium transport.[13] It is involved in metabolic pathway involved in muscle formation, thus preventing sarcopenia.[14]

Brain Functioning

Studies reveal that vitamin D can regulate catecholamine levels and protect against specific Alzheimer. Impairment in vitamin D signaling has shown to adversely affect brain development. Low levels of Vitamin D are associated with various psychiatric conditions.[15] A study done on subjects older than 65 yrs with all adjustment of age, gender, body mass index, blood pressure, physical activity, and education, shown that with adequate amount of serum 25(OH)D, 5% better performance in cognitive ability was seen in subjects.[16]

Better Lung Functioning and Asthma management

Vitamin D and marine omega-3 fatty acids may reduce risk for pneumonia, acute exacerbations of respiratory diseases including chronic obstructive lung disease (COPD) or asthma, and decline of lung function.[17] Prevalence of Vitamin D deficiency has seen an increase as a result of people preferring to stay indoors and change in culture. Various studies show a patient's Vitamin D deficiency as a contributing cause to increased asthma symptoms, lower lung function levels, increased airway reactivity, and worsening asthma control.[18]

Anti-Carcinogenic Properties

1,25 D_3, the active metabolite of vitamin D and its analogs have shown antitumor effects *in vitro* and *in vivo* through multiple mechanisms.[19] Sufficient amount of serum 25(OH)D might decrease the bladder cancer risk. 60% lower risk of bladder cancer was associated with serum 25(OH)D concentration ≥74 nmol/L.[20] According to clinical trials vitamin D_3 supplementation helps in reducing progression of low-grade prostate cancer.[21]

Vitamin D and Muscle Strength

Muscle weakness has long been related to vitamin D deficiency. Various studies have been conducted on effect of vitamin D on muscle strength on elderly. Vitamin D deficiency has been associated with proximal muscle weakness, increase in body sway, and an increased risk of falling. Vitamin D deficiency in adults can also cause a skeletal mineralization defect. Few researchers have assessed the functional significance of vitamin D deficiency. A study on effect of 6 months of vitamin D and calcium supplementation on skeletal muscle strength, physical performance, and quality of life in apparently healthy young Asian Indian women was carried out by Goswami et al in 2012.[4] Another study concluded that Vitamin D

deficiency in children will cause growth retardation and classic signs and symptoms of rickets whereas in adults, vitamin D deficiency is associated with osteoporosis and increased risk of fracture.[22]

Vitamin D and Multiple Sclerosis

A study conducted on white men and women found that those with the highest vitamin D blood levels had a 62 percent lower risk of developing multiple sclerosis than those with the lowest vitamin D levels.[23] Taking a high dose of vitamin D3 is safe for people with multiple sclerosis and may help regulate the body's hyperactive immune response.[24]

Vitamin D and Type 1 Diabetes: Evidence that vitamin D may play a role in preventing type 1 diabetes has been shown in a 30-year study that followed more than 10,000 Finnish children from birth: Children who regularly received vitamin D supplements during infancy had a nearly 90 percent lower risk of developing type 1 diabetes than those who did not receive supplements.[25] Other studies also suggest the same.[26]

Vitamin D, the Flu, and the Common Cold

Studies have revealed that children who have vitamin D-deficiency rickets are more likely to get respiratory infections, while children exposed to sunlight seem to have fewer respiratory infections.[27] Adults who have low vitamin D levels are more likely to report having had a recent cough, cold, or upper respiratory tract infection.[28]

Vitamin D and Tuberculosis

Several case-control studies, when analyzed together, suggest that people diagnosed with tuberculosis have lower vitamin D levels than healthy people of similar age and other characteristics.[29]

2.9 VDD and Heart Disease: Studies show that vitamin D deficiency may be linked to heart disease. In a study the vitamin D blood levels of nearly 50,000 healthy men was checked and they were followed up for 10 years. They found that there was twice as much risk in deficient men as in normal men.[30] Several studies have found association between low vitamin D levels and higher risk of heart failure, sudden cardiac death, stroke, overall cardiovascular disease, and cardiovascular death.[31] Vitamin D plays a role in controlling blood pressure and preventing artery damage.[32]

Non-alcoholic fatty liver Disease

Few studies have also correlated Vitamin D deficiency with development of Non-alcoholic fatty liver Disease.[33]

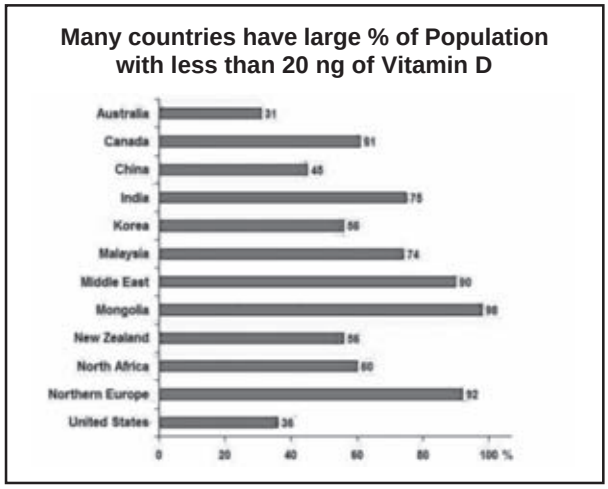
Prevalence of Vitamin D Deficiency in India

Despite ample sunlight in India, deficiency of Vitamin D is present in high numbers across all age and socioeconomic groups. Vitamin D deficiency occurs in infants when the mother is vitamin D deficient.[34] In a study, mean serum 25(OH) D values of subject infants (6.54 ± 5.32 ng/ml) were found to be significantly lower than in infants who didn't get breast milk than those of healthy breastfed infants (9.06 ± 4.78 ng/ml).[35]

VDD amongst young children under the age of 5 years can affect their skeletal growth and development. A community based study in three different regions of Delhi and NCR documented the prevalence of VDD (levels below 14ng/ml) amongst children as 82.9 % and 82% in two regions and 2% in third region..[36] A study conducted amongst children aged 2-60 months reported the prevalence of VDD as 61.4%[37], amongst school girls (of age 6-18 years), reported the prevalence of Vitamin D deficiency as 70% and mean serum 25(OH) D level as less than 12ng/ml[38], amongst school girls aged 6-18 years belonging to both lower and upper

socio economic status and documented the prevalence of biochemical hypovitaminosis D (serum 25-hydroxyvitamin D,50nmol/l) as 90.8% of the population. The prevalence of VDD amongst adolescent girls was found to be 88.6% in another study.[39] A study conducted on 6-17 years schoolgirls from both lower and upper socio economic status reported the prevalence of VDD as 93.7%. However, the prevalence of VDD in lower socioeconomic strata was higher (97.3%) as compared to upper socioeconomic strata (90.9%).[40] A study conducted on obese Indian children and adolescents in the age group of 6-17 years concluded that all study subjects were vitamin D deficient. Studies on pregnant women from southern and northern states of India have reported high vitamin D deficiency levels with values ranging from 67% to 96%. A study shown amongst pregnant women in India, reported that 74% of the mothers had vitamin D deficiency (25OHD < 30ng/ml).[41] Various studies have revealed that a large proportion of adults aged between 18-50 years are suffering with low serum Vitamin D level.

In a study conducted amongst adult male and females residing in both rural and urban areas, the prevalence of VDD estimated in urban population was 62% in male subjects and 75% in female subjects, while the prevalence of Vitamin D deficiency was slightly lower in rural area as 44% in males and 70% in females. This indicates that the prevalence of VDD was more in females as compared to male subjects in both rural and urban areas.[8] A study conducted amongst adults aged 18-40 years of age, documented that 83% of the subjects studied had vitamin D deficiency — 25%, 33%, and 25% had mild, moderate, and severe deficiency, respectively.[42] Studies from Lucknow (Central India) have also shown that 84.3% urban women and 83.6% rural women suffered from vitamin D deficiency.[3] In another study from Kashmir (North India), 58.5% adults have been shown to suffer from vitamin D deficiency.[43] Thus it can be concluded that Vitamin D deficiency is highly prevalent in the Indian population irrespective of gender, age and socioeconomic status.



***Reference** : http://www.vitamindwiki.com/Overview+Deficiency+of+vitamin+D*

Reasons for Deficiency

Many reasons for increased Vitamin D deficiency in India have been documented. These include low vitamin D content of foods, Indians being prominently vegetarians, unaffordable prices of milk and milk products for socioeconomically underprivileged and rampant dilution and/or adulteration of milk and milk products. Although Vitamin D is stable during cooking, its stability is an inverse function of both temperature and time. The practice of boiling of milk repeatedly may reduces the content of any vitamin D. High prevalence of lactose intolerance in India is a major deterrent in milk consumption thereby lowering intake of calcium and vitamin D in people. High phytate content of Indian diets may be another factor affecting Vitamin D status of the individual. Another common factor reducing Vitamin D levels in Indian women is less exposure of skin to sun light, because of cultural and traditional habits like “burqa” or “parda”. Also people are increasingly staying indoors these days.[9] Prevailing misconceptions that only early morning sunlight is good for vitamin D synthesis, even slight exposure to sunlight can initiate skin cancer and fear of skin tanning are

other factors that contribute to low vitamin D status of people of India where sunshine is bountiful.

Prevention

Looking at all these issues, public health measures to identify and control vitamin D deficiency are urgently required.

Dietary adequacy and exposure to Sunlight

Vitamin-D is found in oily fish (for example. herring, salmon, and sardines) as well as in cod liver oil and other fish oils. Egg yolk, butter and liver supply various amounts of vitamin-D depending on the vitamin-D content of the foods consumed by the source animals. But plants are a poor source, so Indian people, many of them strict vegetarians, must get their vitamin-D through exposure to sunlight.[44] Most of the world's population relies on natural exposure to sunlight to maintain adequate vitamin-D nutrition as the sun imposes no risk of vitamin-D toxicity.[45] For most people, exposing face, hands and arms on a clear summer day for 5-10 minute two or three times a week should be sufficient to maintain vitamin-D nutrition. Dark-skinned people require longer exposure to sunlight due to the presence of more melanin in their skin. A study conducted in India showed that the percent conversion of 7-DHC to previtamin D_3 and its photoproducts and formation of previtamin D3 and vitamin D3 was maximal between 11 a.m. to 2 p.m. of the day during the entire year (median 11.5% and 10.2% respectively at 12.30 p.m.[46] Studies done in Pune have shown that toddlers exposed to sunlight (playing outside) for more than 30 min a day exposing more than 40% of their body surface area have a normal vitamin D status (males: 91.6 nmol/L and females: 67.7 nmol/L) which was three times more compared with the toddlers who were indoors for most part of the day.[46] However, Indian skin has got more melanin which interferes with Vitamin D synthesis thus they need minimum 45 minutes to get the required amount of the vitamin. Since most of the people particularly in the urban area stay indoors all the time and prefer to use sunscreens and umbrellas while going out in the sun, it's impossible for Indians to synthesize adequate vitamin. Thus sun exposure is not a viable option for Indians to maintain good Vitamin D status.

Vitamin-D Supplements

Another strategy for treatment of vitamin D deficiency is to treat vitamin D deficiency with 50,000 IU of 25(OH)D weekly for 8 weeks and to prevent recurrence of vitamin D deficiency by maintaining the patient on 50,000 IU of 25(OH)D twice a month. This is effective for up to 6 years without evidence of toxicity.[47] Studies have shown that it is the lower dose of Vitamin D i.e. 40000 IU/week for longer periods that maintains the levels more consistently than a higher dose for shorter periods. Higher doses increase levels initially but they come back to low levels in some time after the supplementation is stopped.[48]

Food Fortification

Fortification of staple foods with vitamin D is the most viable population based strategy to achieve vitamin D sufficiency as Indian's diets are poor in vitamin D, sunlight exposure is less and supplementation is unaffordable. Even in affluent countries like USA and Canada where diets are rich in this vitamin, common foods like milk, cheese, butter and even orange juice and cereal products are fortified. Unlike supplementation fortification doesn't carry toxicity risk to the consumer.[9] Vitamin D fortification can be taken at three levels-mass fortification, required when a large number of persons are have high deficiency putting them at high risk, target fortification, aimed at specific groups like children, pregnant women etc or market driven fortification where manufacturers fortify at their own will but are bound by regulatory limits. Studies have been carried out

on various foods and efficacy studied. The success of fortification strategy depends on the vehicle. In India, fortified laddoos fed to toddlers led to significant increase in the levels of Vitamin D.[49] Fortified milk given to teenagers also showed increasd vitamin D levels. For people with poor socioeconomic background, staple foods like roti, sattu, besan etc can be effective vehicles in delivering Vitmain D doses.[9]

Conclusion

India is a country with abundant sunshine but still a high prevalence of Vitamin D Deficiency (VDD) has been observed amongst all the age groups in the range of 50-90%, and the prevalence is higher in females than in males. Various factors responsible for VDD are dark skin complexion, inadequate exposure to sunlight, vegetarian food habits and unaffordable prices of milk and milk products. As VDD affects all age groups, strategies such as increasing awareness among masses about adequate exposure to sunlight, consumption of foods rich in vitamin D, supplementation and fortification of foods with Vitamin D can be adopted and implemented for prevention and control of VDD throughout the nation. Awareness is the first step and food fortification is the key stair in prevention of such a "pandemic".

References

1. *Al-Othman A, Al-Musharaf S, Al-Daghri NM and Krishnaswamy S, 2012 Effect of physical activity and sun exposure on vitamin D status of Saudi children and adolescents, BMC Pediatrics.*
2. *Mehlawat U., Singh P, Pande S (2014). Current status of Vitamin-D deficiency in India, review article, IPP, Vol 2 (2), 328-335, 2014*
3. *Sachan A, Gupta R, Das V, Agarwal A, Awasthi PK and Bhatia V, 2005 High prevalence of vitamin D deficiency among pregnant women and their newborns in northern India. Am J ClinNutr, 81;1060–4*
4. *Goswami R, Gupta N, Goswami D, Marwaha RK, Tandon N and Kochupillai N, 2000 Prevalence and significance of low 25-hydroxyvitamin D concentrations in healthy subjects in Delhi, Am J ClinNutr, 72; 472-5.*
5. *Arya V, Bhambri R, Godbole MM and Mithal A, 2004 Vitamin D status and its relationship with bone mineral density in healthy Asian Indians, OsteoporosInt, 15; 56-61.*
6. *Harinarayan CV, 2005 Prevalence of vitamin D deficiency in postmenopausal south Indian women. OsteoporosInt, 16; 397-402.*
7. *Marwaha RK, Tandon N, Reddy DRHK, Aggarwal R, Singh R, Sawhney RC, et al. 2005, Prevalence and significance of low 25-hydroxyvitamin D concentrations in healthy subjects in Delhi, Am J ClinNutr, 82; 477-82.*
8. *Harinarayan CV, Ramalakshmi T, Prasad UV, Sudhakar D, Srinivasarao PV, Sarma KV, et al., 2007 High prevalence of low dietary calcium, high phytate consumption, and vitamin D deficiency in healthy south Indians, Am J ClinNutr, 85; 1062-7.*
9. *G. Ritu and Gupta A, 2014, Vitamin D deficiency in India-prevalence, causalities and strategies, Nutrients 2014, 6, 729-775*
10. *Zittermann A, Schleithoff SS, Tenderich G, Berthold HK, Körfer R, Stehle P. Low vitamin D status: a contributing factor in the pathogenesis of congestive heart failure? 2003 J Am CollCardiol. Jan 1;41(1):105-12.*
11. *Holick MF. 2004 Sunlight and vitamin D for bone health and prevention of autoimmune diseases, cancers, and cardiovascular disease. Am J Clin Nutr;80(suppl):1678S–88S.*
12. *Wang, T., Pencina, M., Booth, S., Jacques, P., Ingelsson, E. Lanier, K Vasan, R. (2008). Vitamin D deficiency and risk of cardiovascular disease. Epidemiology, 117, 503-541.*
13. *Wongdee K., Charoenpandhu N. Chapter Thirteen – Vitamin D-Enhanced Duodenal*

Calcium Transport Journal Vitamins & Hormones Volume 98, 2015, Pages 407–440 Hormones and Transport Systems

14. *G. Arik, Z. Ulger Vitamin D and Sarcopenia: Understanding its role in pathogenesis, prevention and treatment Department of Internal Medicine, Division of Geriatric Medicine, Gazi University, Ankara, Turkey*
15. *Darryl W. Eyles, Thomas H.J. Burne, John J. McGrath Vitamin D, effects on brain development, adult brain function and the links between low levels of vitamin D and neuropsychiatric disease Organizational Actions of Hormones in the Brain Journal Frontiers in Neuroendocrinology Volume 34, Issue 1, January 2013, Pages 47–64*
16. *Rolf Jorde, Ellisiv Bøgeberg, Mathiesen, Sigbjørn Rogne, Tom Wilsgaard, Marie Kjærgaard, GuriGrimnes,Henrik Schirmer Vitamin D and cognitive function: The Tromsø Study Journal of the Neurological Sciences volume 335, Issue 1-2, 15 August 2015, Pages 155-161*
17. *Diane R. Gold , Augusto A. Litonjua, Vincent J. Carey, JoAnn E. Manson ,Julie E. Buring, I-Min Lee, David Gordon, Joseph Walter, Georgina Freedenberg, John L. Hankinson, , Trisha Copeland, Heike Luttmann-Gibson Volume 47 Pages 185-195 Journal Contemporary Clinical Trials*
18. *Rance K.2014. The emerging role of Vitamin D in asthma management. J Am Assoc Nurse Pract. May;26(5):263-7.*
19. *Yingyu Ma, Candace S. Johnson, Donald L. Trump Chapter Sixteen — Mechanistic Insights of Vitamin D Anticancer Effects Vitamin D hormone Journal Vitamins and Minerals volume 100, 2016, Pages 395–431.*
20. *YueZhao, ChanghaoChen, WenweiPan, MingGao, WangHe, RenMao, Tianxin Lin, JianHuang Comparative efficacy of vitamin D status in reducing the risk of bladder cancer: A systematic review and network meta-analysis Journal Nutrition19 December 2015.*
21. *Jungmi Ahn, Sulgi Park, Baltazar Zuniga, Alakesh Bera, Chung SeogSong, Bandana ChatterjeeChapter Thirteen – Vitamin D in Prostate Cancer Vitamin D Hormone Journal Vitamins & HormonesVolume 100, 2016, Pages 321–355*
22. *Holick MF. Vitamin D deficiency. N Engl J Med 2007;357:266–81*
23. *Munger KL, Levin LI, Hollis BW, Howard NS, Ascherio A. Serum 25-hydroxyvitamin D levels and risk of multiple sclerosis. JAMA. 2006; 296:2832-8*
24. *A study published by Johns Hopkins physicians in the Dec. 30 online issue of Neurology, the medical journal of the American Academy of Neurology.*
25. *Hypponen E, Laara E, Reunanen A, Jarvelin MR, Virtanen SM. Intake of vitamin D and risk of type 1 diabetes: a birth-cohort study. Lancet. 2001; 358:1500-3.*
26. *Zipitis CS, Akobeng AK. Vitamin D supplementation in early childhood and risk of type 1 diabetes: a systematic review and meta-analysis. Arch Dis Child. 2008; 93:512-7.*
27. *Cannell JJ, Vieth R, Umhau JC, et al. Epidemic influenza and vitamin D. Epidemiol Infect 2006; 134:1129-40.*
28. *Ginde AA, Mansbach JM, Camargo CA, Jr. Association between serum 25-hydroxy-vitamin D level and upper respiratory tract infection in the Third National Health and Nutrition Examination Survey. Arch Intern Med. 2009; 169:384-90.*
29. *Nnoaham KE, Clarke A. Low serum vitamin D levels and tuberculosis: a systematic review and meta-analysis. Int J Epidemiol. 2008; 37:113-9.*
30. *Giovannucci E, Liu Y, Hollis BW, Rimm EB. 25-hydroxyvitamin D and risk of myocardial infarction in men: a prospective study. Arch Intern Med. 2008; 168:1174-80.*
31. *Pilz S, Marz W, Wellnitz B, et al. Association of vitamin D deficiency with heart failure and sudden cardiac death in a large cross-sectional study of patients referred for coronary angiography. J Clin Endocrinol Metab. 2008; 93:3927-35.*

32. *Holick MF. The vitamin D deficiency pandemic and consequences for nonskeletal health: mechanisms of action. Mol Aspects Med. 2008; 29:361-8.*
33. *M. Eliades; E. Spyrou; N. Agrawal; M. Lazo; F. L. Brancati; J. J. Potter; A. A.Koteish; J. M. Clark; E. Guallar; R. Hernaez.2013. Meta-analysis: Vitamin D and Non-alcoholic Fatty Liver Disease, Aliment Pharmacol Ther.*
34. *Lips P, 2010 worldwide status of vitamin D nutrition. The Journal of Steroid Biochemistry and Molecular Biology, 121(1– 2);297–300.*
35. *Mehrotra P, Marwaha RK , Aneja S, Seth A, Singla BM, Ashraf G, Sharma B, Sastry A and Tandon N, 2010 Hypovitaminosis D and Hypocalcemic Seizures in Infancy, Indian Pediatrics, 47; 581-586.*
36. *Tiwari L and Pulilyel J, 2004 Vitamin D Level in Slum Children of Delhi, Indian Pediatrics, 41; 1076-1077.*
37. *Wayse V, Yousafzai A, Mogale K and Filteau S, 2004 Association of subclinical vitamin D deficiency with severe acute lower respiratory infection in Indian children under 5 y. Eur J ClinNutr, 58(4); 563-7.*
38. *Sahu M, Bhatia V, Aggarwal A, Rawat V, Saxena P, Pandey A and Das V, 2009 VDD in rural girls and pregnant women despite abundant sunshine in northern India, ClinEndocrinol (Oxf), 70(5); 680-4.*
39. *Khadilkar A, Das G, Sayyad M, Sanwalka N, Bhandari D, Khadilkar V and Mughal MZ, 2007 Low calcium intake and hypovitaminosis D in adolescent girls. Arch Dis Child, 92(11); 1045.*
40. *Marwaha RK, Tandon N, Agarwal N, Puri S, Agarwal R, Singh S and Mani K, 2010 Impact of two regimens of Vitamin D supplementation on calcium - Vitamin D – PTH axis of schoolgirls of Delhi, Indian Pediatr, 47(9); 761-9.*
41. *Sahu M, Bhatia V, Aggarwal A, Rawat V, Saxena P, Pandey A and Das V, 2009 VDD in rural girls and pregnant women despite abundant sunshine in northern India, ClinEndocrinol (Oxf), 70(5); 680-4.*
42. *Zargar AH, Ahmad S, Masoodi SR, et al., 2007 Vitamin D status in apparently healthy adults in Kashmir Valley of Indian subcontinent, Postgrad Med J, 83(985); 713716.*
43. *Daga RA, Laway BA, Shah ZA, Mir SA, Kotwal SK, Zargar AH et al. (2012) High prevalence of vitamin D deficiency among newly diagnosed youth-onset diabetes mellitus in north India. Arq Bras EndocrinolMetabol. 56:423-8.*
44. *Nutrition by Insel P, Turner RE, Ross D. Second edition. Chapter- 9 ,page number- 377*
45. *B. A. Gilchrest, Sun exposure and vitamin-D sufficiency, American journal of Clinical Nutrition 88(2008):570S-577S*
46. *Vitamin-D status and sun exposure in India; Chittari V Harinarayan, Michael F Holick, Upadrasta V Prasad, Palavali S Vani, Gutha Himabindu. Dermatoendocrinol.2013 Jan 1, 5(1):130-141.*
47. *Michael F. Holick, Neil C. Binkley, Heike A. Bischoff-Ferrari, Catherine M. Gordon, David A. Hanley, Robert P. Heaney, M. Hassan Murad, and Connie M. Weaver Evaluation, Treatment, and Prevention of Vitamin D Deficiency: an Endocrine Society Clinical Practice Guideline Journal of Clinical Endochronology and Metabolism*
48. *Goswami, R.; Gupta, N.; Ray, D.; Singh, N.; Tomar, N. Pattern of 25-hydroxy vitamin D response at short (2 month) and long (1 year) interval after 8 weeks of oral supplementation with cholecalciferol in Asian Indians with chronic hypovitaminosis D. Br. J. Nutr. 2008, 100 526–529.*
49. *Khadgawat, R.; Marwaha, R.K.; Garg, M.K.; Ramot, R.; Oberoi, A.K.; Sreenivas, V.;gahlot, M.; Mehan, N.; Mathur, P.; Gupta, N. Impact of vitamin D fortified milk supplementation on vitamin D status of healthy school children aged 10–14 years. Osteoporos Int. 2013, 24, 2335–2343.*

Soy-oat Yogurt : Preparation and its Quality Evaluation

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Abstract

In the recent years, various researches on soybean and oats has shown efficacy of their use in improving protein quality foods (1). Therefore, this study aims at finding suitability of using soya milk and oats in the production of yogurt with enhanced nutritive properties and sensory characteristics. Yoghurt is made of milk (whole, reduced-fat, low-fat or non-fat) and cream by lactic acid fermentation through the action of Lactobacillus bulgaricus and Streptococcus thermophilus (2). The study involves production of yogurt from different blends of soymilk and oat milk. Commercial yoghurt was the control treatment (A) while other treatment was B (75% soy milk plus 25% oat milk), C (50% soy milk plus 50% oat milk) and D (25% soy milk and 75% oat milk). These yogurt samples were then evaluated for certain parameters like % acidity, % moisture content, ash content, density, freezing point, TSS and pH. Sensory evaluation of the products was also conducted. Based on chemical analysis, moisture content of commercial yogurt produced from 100% soymilk was 13.2% which rose to 28.3% in sample D (25% soy milk and 75% oat milk). However, TSS of samples decreased gradually with values of 4.9°Brix, 4.2°brix, 4.0°brix and 3.50°brix for the samples respectively. On the basis of obtained results it was concluded that a combination of soy milk and oat milk (75:25) could be used for the preparation of dairy free and cholesterol free yoghurt. It was nutritionally over all acceptable and could be considered as a better alternative than dairy yogurt.

Keywords : soy milk, soy-oat yogurt, chemical, TSS, sensory value, yoghurt

Introduction

Yogurt is a Turkish name for a fermented milk product introduced by early nomadic herdsman, especially in Asia, Southern and Eastern Europe (3). Yogurt is a mixture of milk (whole, reduced-fat, low-fat or nonfat) and cream fermented by a culture of bacteria which produces lactic acid, Lactobacillus bulgaricus and Streptococcus thermophillus. There are several bacteria known as probiotics that are used to make yogurt cultures and these act on the naturally occurring sugar lactose in animal milks to produce lactic acid. The characteristic tangy taste we often associate with yogurt comes from lactic acid. It is commercially made from various animal milk like cow buffalo, camel. But, yogurt has been continuously modified to obtain a product with better appeal and nutritional properties. Variations could be done on the basis of bacterial culture used, different or no flavor and most significantly changing the source of milk (animal/plant) (4). Production of yogurt from soy-oat milk is an innovative step for people who are intolerant to lactose or have any kind of ill effects from dairy products. Yogurt is made by adding a culture of acid forming bacteria to milk that is usually homogenized, pasteurized and fermented.

Since legume and cereal both are being used in this beverage, product has balanced nutrition. Omueti and his colleagues in a study in 2000 found similar beverage to be highly digestible

and widely acceptable by both adults and children (5). Soy milk is an aqueous extract of soya beans and is found to look pretty similar to cow milk (6, 7). There has been growing interest in Soy milk as a possible substitute for cow milk and human milk. Over past, it has been a source of food for infants as well as adults suffering from various forms of malnutrition and for individual who has allergies from cow milk. (8). Past studies showed many beneficial aspects of soymilk. Soymilk is an economical substitute for cow's milk and for lactose-intolerant population. soybean proteins is almost equal to animal proteins in nutritive value. Soybean proteins have cholesterol-lowering action thus beneficial for cardiovascular disorders (9). Faraj et.al carried out a study and concluded that Soybean isoflavones have cholesterol -lowering and cardioprotective effects (10). Soy foods have become popular due to its health effects on human health because of their phytochemical content, mainly isoflavones (11). Fermented soymilk is also a good source of bioactive peptides such as anti-ACE, antioxidative, anti-cancer and immunomodulatory (9). Soy-milk-based yogurts, namely, sogurt, have emerged as a popular alternative to traditional dairy-based yogurts due to their reduced level of cholesterol and saturated fat and because they are free of lactose (12). Apart from this, it helps in reduction of heart diseases, diabetes, cancer ando-steoporosis (9).

In a study conducted to determine the effects of consuming soya milk and oat milk on plasma lipids and antioxidant capacity of healthy individuals, it was found out that they resulted in lowered plasma cholesterol and can be used as an alternative to other milk drinks by subjects who would benefit from reduced LDL cholesterol values (13). Oat in the yogurt have certain other benefits as it contains soluble fiber which stays in the stomach longer and helps you feel fuller, longer and thus help us maintain a healthy weight and avoid the health problems associated with overweight. It also helps prevent food allergies. Also, oats are found to have therapeutic value against diabetes, dyslipidemia, hypertension, inflammatory state and vascular injury than other grains which are predominantly insoluble, such as wheat or rice (14).

Materials and Method

Preparation of oat milk

Oat flakes were taken and were soaked for 20-25 min. in clean bowl containing water. After 25 min., they were blended in a mixer (until smooth and clear liquid appears). Blended liquid is then filtered through sieve and after sieving liquid obtained is oat milk.Soy milk were purchased from market, the brand name for soy milk was sofit

Preparation and inoculation of soy-oat milk

1. Soy and oat yoghurt was prepared by mixing soy milk and oat milk in different ratios 25:75, 50:50, and 75:25 and the control yoghurt made from only soy milk (100%).

2. The various mixture of soy and oat milk was pasteurized at 63°C for 15 minutes (LTLT). The different milk samples were not boiled because there was problem of gelatinization in oat milk at a particular temperature. When boil the sample, sample get gelatinized which is not required in yoghurt making.

3. After pasteurization, sample was cooled to 40°C and then inoculated with 2% mixed culture of streptococcus thermophillus and lactobacillus bulgaricus. The mixture is then incubated at between 43°C and 45°C for 16hr until curdling does not takes place.

Results and Discussion

Chemical Analysis

The chemical composition of the samples was determined according to the method of A.O.A.C. (1990). Sensory evaluation was done by 10 semi

trained panellists, the result of which is presented in table 2. The sensory qualities of the yoghurt samples were determined using a 9 point hedonic scale (flavour, taste, consistency, colour and overall acceptability) with 9 indicating like extremely and 1 representing dislike extremely. The nutritional composition of the samples was calculated.

Table 1 : Physico-chemical analysis of yogurt

Parameters	***Soy-milk Yogurt***	***Soy-oat Yogurt (75:25)***	***Soy-oat Yogurt (50:50)***	***Soy-oat Yogurt (25:75)***
% Acidity	0.86	0.51	0.64	0.45
% Moisture content	13.2	13.4	13.3	23.8
Ash content	0.64	0.15	0.31	0.19
Density	1.07	1.12	1.007	1.02
TSS (°Bx)	4.9	4.2	4.0	3.5
pH	4.95	4.90	4.64	4.46

It can be observed from the table that % acidity of whole soymilk yogurt was 0.86 while the least was in yogurt produced from 25% soymilk. However, it showed opposite trend in case of % moisture content. TSS and pH of 100% soymilk yogurt was highest and lowest in case of 25% soymilk yogurt. While, TSS of yogurt produced from 75% soymilk and 25% oat milk and that of 50% both soymilk and oat milk was 4.2 and 4.0 respectively.

Table 2 : Sensory Evaluation of Yogurt

Sample	***Soy-milk Yoghurt (Control)***	***(Soy : oat) Yoghurt (75 : 25)***	***(Soy : oat) Yoghurt (50 : 50)***	***(Soy : oat) Yoghurt (25 : 75)***
Appearance	8.8	8.2	7.5	7.0
Colour	8.6	8.3	8	7.8
Flavour	9	8.6	8	7
Texture	8.9	8.5	8.1	6.6
Overall Acceptability	8.6	8.3	7.8	6.6

Table 2 shows the sensory evaluation of the drink. After soy milk yogurt, Soy: oat milk yogurt in ratio of 75:25 was found to be of highest acceptability as compared to others. Have better scores of colour, flavour, texture. It had the soy flavour and better curdling of all. The texture of soy: oat (75:25) was somewhat closer to the control and also got the highest marks among the three. Overall, soy-oat milk yogurt (75:25) was preferred among others except soy milk yogurt. Figure 1 shows the pictures of different yogurts. It can be observed that soy-oat milk yogurt (75:25) show better curdling and texture than the other two. Hence it is highly acceptable than others.

Figure 1 : Pictures showing Experimental Yogurts

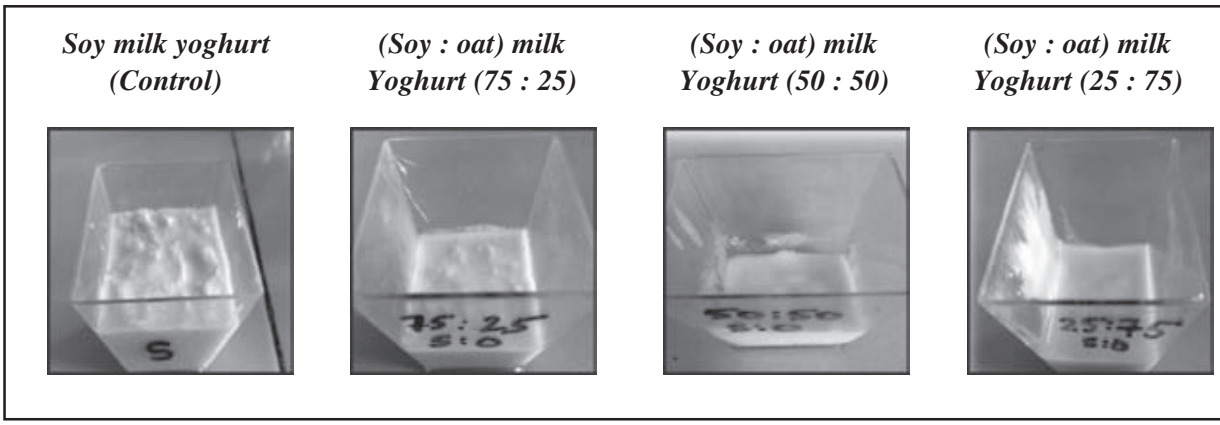

Table 3 : Nutritional composition of soy milk and oat milk

Composition (%)	*Soy Milk (per 100 ml)*	*Oat Milk (per 100 g)*	*S : O (50:50) (per 100 g)*	*S : O (25:75) (per 100 g)*	*S : O (75:25) (per 100 g)*
Energy (Kcal)	344	402	373	387.5	358.5
Total fat (g)	1.6	8.6	5.1	6.85	3.35
Saturated Fat (g)	0.18	2.0	1.09	1.5	0.635
Cholesterol (mg)	0.0	0.0	0.0	0.0	0.0
Total Carbohydrate (g)	18	69.4	43.70	56.55	30.85
Protein (g)	3.2	11.8	7.5	9.65	5.35
Sugar (g)	0.0	0.0	0	0.0	0.0
Total Dietary Fiber (g)	1.0	10.5	5.75	8.125	3.375
Trans fatty Acid (g)	0.0	0.0	0.0	0.0	0.0

Conclusion

This study has revealed that a combination of soy milk and oat milk (75:25) could be used for the preparation of dairy free and cholesterol free yoghurt. It can be consumed by lactose intolerance persons and its nutrient balance makes it a perfect dairy free alternative food. Sensory parameters showed best in case of soy-oat yogurt 75:25.

Thus, we can conclude that since overall acceptability was higher for soy milk and oat milk (75:25) so it was the better product among the others and is the most probable alternative of dairy-based yogurt especially for lactose-intolerant individuals.

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References

1. *Kolapo, A.L. and M.O. Sanni, 2005. Soyabean fortified garri and tapioca. Afri. J. Biotechnol., 6(8): 94-97.*
2. *Tamime AY and Robinson RK. Yoghurt. Science and Technology. J. Food Tech., 198540:87. Program on press, Oxford, England.*
3. *Olakunle Moses Makanjuola, 2012. Production and Quality Evaluation of Soy-Corn Yoghurt. Advance Journal of Food Science and Technology 4(3): 130-134*
4. *Belewu, M. A (2006). A Functional Approach to Dairy Science and Technology. Adlek Publisher, Ilorin, Nigeria*
5. *Omueti, O., E. B. Oguntona, O. Jaiyeola and O.A. Ashaye, 2000. Nutritional evaluation of home- level prepared soy corn milk. A protein beverage. Nutr. Food Sci., 30: 128-132.*
6. *Agure-Dam, C., 1997, Soya bean production and use in Benue State, Nigeria. A publication of the Ministry of Agriculture and Natural Resources. Makurdi, Benue State, Nigeria.*
7. *Dashiel, R.E., 1995. Soya bean Production and Utillization in Nigeria. Paper presented at the National Workshop on Small Scale and Industrial level processing of Soya bean held at IITA, 27th-29th July, Ibadan.*
8. *Considine and Considine, 1997. Processing and Production of Soy beans; Improvement, production and uses. Caldwell, B.E., (Ed.), American Society for Agronomy Inc., USA.*
9. *Shilpa Vij et.al, 2011. Biofunctionality of Probiotic Soy Yoghurt. Food and Nutrition Sciences, 2011, 2, 502-509.*
10. *Faraj, A.; vasanthan, T. 2004.Soybean isoflavones: effects of processing and health benefits Food Rev. Int. 2004, 20, 51– 75*
11. *Sarkar, S.2006. Potential of soyoghurt as a dietetic food Nutr. Food Sci., 36, 43– 49.*
12. *Danji Fukushima,2009. Recent progress of soybean protein foods: Chemistry, technology, and nutrition.*
13. *Önning G et.al, 1998. Effects of Consumption of Oat Milk, Soya Milk, or Cow's Milk on Plasma Lipids and Antioxidative Capacity in Healthy Subjects. Ann Nutr Metab 1998;42:211–220*
14. *Seema Sangwan et.al, 2014. Nutritional and functional properties of oats: An update, Vol. 1, Issue 1, P. 003-014.*
15. *A. O. A. C. (1990). Association of Official Analytical Chemists. Official methods of Analysis. 15th edition. Washington D. C*

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Mycotoxin Contamination in Pseudo Cereals and their Detection Methods — A Review

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Abstract

Now a day the consumption of pseudo cereals is increasing day by day because of high protein content and good nutritional value. But these pseudo cereals, like cereals, nuts and oilseeds are having susceptibility to fungal growth and mycotoxins contamination. Various types of mycotoxins like aflatoxin B1, aflatoxin B2, aflatoxin G 1, aflatoxin G2, ochratoxin, are being determined in them and because of these substances it has become a great concern from the public health point of view. Various methods have been developed for their detection like thin layer chromatography (TLC), ELISA, gas chromatography (GC) or capillary electrophoresis (CE). However, the most popular technique is high performance liquid chromatography (HPLC) with UV/Vis, fluorescence (FL), or mass spectrometry (MS) detection. But recently ultrahigh performance liquid chromatography (UHPLC) coupled with tandem mass spectrometry (MS/MS) has become very popularQuEChERS-based methods have been recently used.

Keywords : mycotoxin, pseudo cereals, health effect, UHPLC, QuEChERC.

Introduction

Pseudocereals are plants that produce fruits or seeds, which are used and consumed as grains, though botanically neither they are considered to be grasses nor true cereal grains, but since they produce starch-rich seeds resembling to cereals because of which they are called pseudo cereals. Nowadays the interest on consumption of pseudo cereals is increasing due to their nutritional properties, such as protein content and quality as well as amino acids balance of amaranth and quinoa or phytochemicals concentration of buckwheat.[1] In addition, pseudo cereals are currently emerging as healthy alternatives to gluten-containing grains in the gluten-free diet necessary for celiac disease. Amaranth (*Amaranthus*), quinoa (*Chenopodium quinoa*) and buckwheat (*Fagopyrumesculentum*) are among the most consumed pseudocereals.
Mycotoxins are secondary metabolites producedmainly by fungi that are toxic to humans and animals. The most important toxigenic fungi belong to the genera *Aspergillus*, *Fusarium*, and *Penicillium*.[2] The most important mycotoxins worldwide include aflatoxins, fumonisins, deoxynivalenol, zearalenone, and ochratoxins.[3]

The presence of mycotoxins in food and feed may affect not only human health but also animal health, as they are responsible for causing different types of adverse effects such as estrogenic, gastrointestinal, and kidney disorders, induction of cancer, and mutagenicity. Furthermore, some mycotoxins are also immunosuppressive and reduce resistance to infectious diseases.[4]

The analytical methods that have been employed for the determination of mycotoxins contamination includes, liquid chromatography (LC) with fluorescence detection using a derivatization step,[5] LC with mass

spectrometry (MS)[6] thin layer chromatography (TLC)[7] or commonly used, gas chromatography mass spectrometry (GC–MS).[8] Although mycotoxin contamination in spelt (*Triticumspelta*) has not been extensively explored, spelt products have been included among others in several studies, as the determination of mycotoxins by enzyme-linked immunosorbent assay (ELISA).[9] Currently there is clearly an increased demand of the feeding industry toward the reduction of mycotoxin levels in cereals, nuts and also in pseudocereals as the demand of pseudocereals are increasing.

Brief Methodology

Taking into account the interest and the scarce data about the determination of mycotoxins in some of the pseudocereals, a developed and validated an analytical method for the simultaneous identification and quantification of 15 mycotoxins (AFB1, AFB2, AFG1, AFG2, OTA, FB1, FB2, T-2, HT-2, CIT, STE, F-X, NIV, DON, and ZEN) in pseudocereals.

Different analytical methods have been proposed for mycotoxin determination in food, such as thin layer chromatography (TLC)[11] ELISA[12], gas chromatography (GC)[13] or capillary electrophoresis (CE).[14] However, the most popular technique is high performance liquid chromatography (HPLC) with UV/Vis, fluorescence (FL),[15-17] or mass spectrometry (MS) detection.[18-20] Recently, ultrahigh performance liquid chromatography (UHPLC) coupled with tandem mass spectrometry (MS/MS) has become very popular, especially for multiclass determination of mycotoxins and for multiresidue determination with other contaminants.[21-24] Because of the complex structure of food particle matrices it is important to have an extraction and clean-up purification step which is required before analysis. Different methods for this clean up purification step have been proposed. The most common methodology implies solid-liquid extraction (SLE) followed by solid phase extraction (SPE) with immunoaffinity columns (IACs), which contain specific antibodies to the analyte of interest.[25] However, IACs are expensive and highly complex purification systems which has low recoveries for some mycotoxins and their use in multiclass analysis is limited because of their high selectivity.[26] As a consequence, simpler, more efficient, multiclass, and environmentally friendly extraction systems are demanded. Among the different proposals, the so-called QuEChERS (quick, easy, cheap, effective, rugged, and safe which is becoming increasingly popular treatment.

QuEChERS is a fast and inexpensive method widely used in the last years, mainly for the extraction of pesticides and presents some advantages such as its simplicity, minimum steps, and effectiveness for cleaning up complex samples.[27-28] It comprises two steps : (i) an extraction based on partitioning via salting-out, involving the equilibrium between an aqueous and an organic layer; (ii) a dispersive SPE (dSPE) for further clean-up using combinations of MgSO4 and different sorbents, such as C18 or primary and secondary amine (PSA). QuEChERS-based methods have been recently reported for the extraction of different mycotoxins in cereal and pseudo cereals and there products.[29-30] Taking advantage of UHPLC-MS/MS characteristics, we optimized a separation method that allows the determination of 15 mycotoxins in only four minutes. The studied mycotoxins are included in Regulation (EC) number 1881/2006 or considered as dangerous by the IARC.[31]

Analysis of Cereals and Pseudo Cereals

Cereals and pseudo cereals, now gaining popularity are a commodity of great interest, highly prone to microbial contamination because of their chemical composition. Matrices of concern are pseudocereals, such as amaranth, quinoa, and buckwheat. Though botanically they are not true cereal grains, they produce starch-

rich seeds consumed like cereals. Pseudocereals are also susceptible to fungal growth and therefore to mycotoxin contamination. Taking into account the interest and the scarce data about the determination of mycotoxins in some of the above mentioned matrices, a method was developed it was developed and validated for the simultaneous identification and quantification of 15 mycotoxins (AFB1, AFB2, AFG1, AFG2, OTA, FB1, FB2, T-2, HT-2, CIT, STE, F-X, NIV, DON, and ZEN) in pseudocereals, spelt, and white, red, and brown rice. As a sample treatment we proposed a simple salting out assisted solid liquid extraction (i.e. a QuEChERS-based extraction). No further clean-up was required, although matrix effect was higher than (20%) for some mycotoxins (aflatoxins, DON, and NIV). Thus matrix-matched calibration was applied. This methodology has proved to be a suitable and efficient choice for multiclass mycotoxin determination in these matrices, with LOQs below the contents currently regulated. It provides good recoveries (between 60.0% and 103.5%) and precision (RSD lower than 12% in all cases), allows extraction time reduction, and is environmentally friendly.[32]

Conclusion

As there is increased demand of the pseudo cereals world widely, the concern for the detection of mycotoxin is these have become an important issue. Various methods have been developed for detection of mycotoxin contaminants. UHPLC-MS/MS analytical methods for multiclass determination of mycotoxins based on QuEChERS and for sample treatment have been developed. These proposed methods are being used widely for the determination of mycotoxins not only in pseudo cereals but also in various other food commodities. They showed as general advantages in their efficacy, simplicity, versatility, and accuracy, as well as their low impact on the environment, shorter analysis time, and the relatively low-cost, compared with conventional IAC method. But as we know that though these methods have several advantages but sometimes the results may not always be correct.

References

1. *Schoenlechner, Siebenhandl, & Berghofer, 2008*
2. *Pitt and Hocking, 1999164. Pitt , J. I. and Hocking, A. D. 1999. Fungi and Food Spoilage, 593 Gaithersburg, Maryland: Chapman and Hall. Second edition*
3. *Pittet, 1998166. Pittet*
4. *European Food Safety Authority (EFSA), 2012S. Marin, A. J. Ramos, G. Cano-Sancho, and V. Sanchis, "Mycotoxins: occurrence, toxicology, and exposure assessment," Food and Chemical Toxicology, vol. 60, pp. 218-237, 2013.,).*
5. *Sugita-Konishia et al., 2010)*
6. *Kumagaiet al., 2008; Spanjer et al., 2008; Veršilovskis et al., 2008*
7. *Bresler, Vaamonde & Brizzio, 1991; Bresler, Vaamonde, Degrossi, & Fernandez-Pinto, 1998; Kumagai et al., 2008*
8. *Krysiska-Traczyk et al., 2007; Schollen berger et al., 2005*
9. *Solarska, Marzec, Kuzdraliski & Muszyska, 2012) and by LC-MS (Juana, Ritieni, &Mañes, 2012; Maul et al., 2012; Serrano, Font, Ruiz, & Ferrer, 2012; Suchowilska, Kandler, Sulyok, &Krska, 2010; Sulyok, Krska, &Schuhmacher, 2007*
10. *Beltrán, Ibáñez, Sancho, & Hernández, 2009; Garrido-Frenich et al., 2011; Zachariasova et al., 2010*
11. *D. Heperkan, F. K. Guler, and H. I. Oktay, "Mycoflora and natural occurrence of aflatoxin, cyclopiazonic acid, fumonisin and ochratoxin A in dried figs," Food Additives and Contaminants, vol. 29, pp. 277-286, 2012*
12. *J. S. Dos Santos, C. R. Takabayashi, E. Y. S. Ono et al., "Immunoassay based on monoclonal antibodies versus LC-MS: deoxynivalenol in wheat and flour in*

Southern Brazil," Food Additives & Contaminants A, vol. 28, no. 8, pp. 1083-1090, 2011

13. *S. C. Cunha and J. O. Fernandes, "Development and validation of a method based on a QuEChERS procedure and heartcutting GC-MS for determination of five mycotoxins in cereal products," Journal of Separation Science, vol. 33, no. 4-5, pp. 600-609, 2010*
14. *N. Arroyo-Manzanares, L. Gamiz-Gracia, A. M. G. Amiz-Gracia, J. J. Soto-Chinchilla, A. M. Garcia-Campana, and L. E. Garcia Ayuso, "On-line preconcentration for the determination of aflatoxins in rice samples by micellar electrokinetic capillary chromatography with laser-induced fluorescence detection," Electrophoresis, vol. 31, no. 13, pp. 2180-2185, 2010*
15. *L. Campone, A. L. Piccinelli, R. Celano, and L. Rastrelli, "Application of dispersive liquid-liquid microextraction for the determination of aflatoxins B1, B2, G1 and G2 in cereal products," Journal of Chromatography A, vol. 1218, no. 42, pp. 7648-7654, 2011*
16. *N. Arroyo-Manzanares, A. M. Garcia-Campana, and L. Gamiz, Gracia, "Comparison of different sample treatments for the analysis of ochratoxin A in wine by capillary HPLC with laserinduced fluorescence detection," Analytical and Bioanalytical Chemistry, vol. 401, p. 2987, 2011.*
17. *N. Arroyo-Manzanares, L. Gamiz-Gracia, and A. M. Garcia Campana, "Determination of ochratoxin A in wines by capillary liquid chromatography with laser induced fluorescence detection using dispersive liquid-liquid microextraction," Food Chemistry, vol. 135, no. 2, pp. 368-372, 2012.*
18. *J. Rubert, C. Soler, and J. Manes, "Application of an HPLC-MS/MS method for mycotoxin analysis in commercial baby foods," Food Chemistry, vol. 133, pp. 176-183, 2012.*
19. *I. Sospedra, J. Blesa, J. M. Soriano, and J. Manes, "Use of the modified quick easy cheap effective rugged and safe sample preparation approach for the simultaneous analysis of type Aand B-trichothecenes in wheat flour," Journal of Chromatography A, vol. 1217, no. 9, pp. 1437-1440, 2010.*
20. *P. Li, Z. Zhang, X. Hu, and Q. Zhang, "Advanced hyphenated chromatographic-mass spectrometry in mycotoxin determination: Current status and prospects," Mass Spectrometry Reviews, vol. 32, no. 6, pp. 420-452, 2013.).*
21. *M. Zachariasova, O. Lacina, A. Malachova et al., "Novel approaches in analysis of Fusarium mycotoxins in cereals employing ultra performance liquid chromatography coupled with high resolution mass spectrometry," Analytica Chimica Acta, vol. 662, no. 1, pp. 51-61, 2010.*
22. *M. M. Aguilera-Luiz, P. Plaza-Bolanos, R. Romero-Gonz alez, J. L. Martnez-Vidal, and A. Garrido-Frenich, "Comparison of the efficiency of different extraction methods for the simultaneous determination of mycotoxins and pesticides in milk samples by ultra high-performance liquid chromatography-tandem mass spectrometry," Analytical and Bioanalytical Chemistry, vol. 399, no. 8, pp. 2863-2875, 2011*
23. *P. Perez-Ortega, B. Gilbert-Lopez, J. F. Garcia-Reyes, and A. Molina-Diaz, "Generic sample treatment method for simultaneous determination of multiclass pesticides and mycotoxins in wines by liquid chromatography-mass spectrometry," Journal of Chromatography A, vol. 1249, pp. 32-40, 2012*
24. *J. O'Mahony, L. Clarkea, M. Whelan et al., "The use of ultrahigh pressure liquid chromatography with tandem mass spectrometric detection in the analysis of agrochemical residues and mycotoxins in food-challenges and applications," Journal of Chromatography A, vol. 1292, pp. 83-95, 2013*

25. *G. S. Shephard, "Determination of mycotoxins in human foods," Chemical Society Reviews, vol. 37, pp. 2468-2477, 2008)*
26. *Natalia Arroyo-Manzanares, José F. Huertas-Pérez, Ana M. García-Campaña, and Laura Gámiz-Gracia Department of Analytical Chemistry, Faculty of Sciences, University of Granada, Campus Fuentenueva s/n, E-18071 Granada, Spain, 2014*
27. *S. J. Lehotay, M. Anastassiades, and R. E. Majors, "QuEChERS, a sample preparation technique that is 'catching on': an up-todate interview with the inventors," LC-GC North America, vol. 28, no. 7, pp. 504-516, 2010.*
28. *M. Anastassiades, S. J. Lehotay, D. Stajnbaher, and F. J. Schenck, "Fast and easy multiresidue method employing acetonitrile extraction/partitioning and 'dispersive solid-phase extraction' for the determination of pesticide residues in produce," Journal of AOAC International, vol. 86, no. 2, pp. 412-431, 2003*
29. *A. Desmarchelier, J. M. Oberson, P. Tella, E. Gremaud, W. Seefelder, and P. Mottier, "Development and comparison of two multiresidue methods for the analysis of 17 mycotoxins in cereals by liquid chromatography electrospray ionization tandem mass spectrometry," Journal of Agricultural and Food Chemistry, vol. 58, no. 13, pp. 7510-7519, 1021.*
30. *L. Vaclavik, M. Zachariasova, V. Hrbek, and J. Hajslova, "Analysis of multiple mycotoxins in cereals under ambient conditions using direct analysis in real time (DART) ionization coupled to high resolution mass spectrometry," Talanta, vol. 82, no. 5, pp. 1950-1957, 2010*
31. *"Commission regulation (EC) No. 1881/ 2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs," Official Journal of the European Union, pp. L364/5-L364/24, 2006., International Agency for Research on Cancer (IARC), http:// www.iarc.fr.)*
32. *N. Arroyo-Manzanares, J. F. Huertas-Perez, A. M. Garcia Campana, and L. Gamiz-Gracia, "Simple methodology for the ´ determination of mycotoxins in pseudo-cereals, spelt and rice," Food Control, vol. 36, no. 1, pp. 94-101, 2014*

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Health Buddy – Mobile based Nutritional intake Tracking Application for Young College Students

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Abstract

With developing technology, changing lifestyles and busy schedules, people often tend to neglect their health. This has led to an outcry about health related issues among all age groups. A healthy body is a combination of good eating habits and nutritional intake through a balanced diet. For a lay man it is difficult to keep a track of their diet, calculating its nutritional value and maintaining their daily health record. This paper addresses the above mentioned practical problem, Health buddy the mobile application, has been constructed in such a way that it will not only help to keep track of everything they eat but will also give them suggestions of what they need to include or exclude from their diet along with daily exercise requirements, interesting food facts and myths, and useful health tips.

Introduction

Health is a dynamic phenomenon, due to its changing nature. Hence, it persists in being one of the chief concerns among all the age clusters. In the contemporary terms a healthy diet is defined as something that allows one to maintain their health whilst their busy schedule. Maintaining a healthy diet is the practice of making choices about what to eat with the intent of improving or maintaining good health. Usually this involves consuming necessary nutrients by eating the appropriate amounts from all of the food groups, including an adequate amount of water. For around 20% of the planet's population, lack of food and malnutrition are the main impediments to healthy eating. Generally, a healthy diet is said to include sufficient calories to maintain a person's metabolic and activity needs, but not so excessive as to result in fat storage.

The key objective of this project is to develop an android based mobile application to apprise people about their food intake pattern by tracking their daily intake and to maintain their calorie and nutrient need via graphical representation of the results. Target group for this application would be college going students, the most appropriate choice in today's scenario to spread awareness about the need to maintain a good health status.

The section 2 of this paper enumerates various mobile and desktop applications as well as websites that we studied and analysed before starting to build our version of a health application.

Section 3 gives details of the application that we are proposing, including its technical objectives and salient features. Section 4 is a description of the methodology that we've followed thus far in the development of the app. Various technical diagrams have also been included in the next section (Section 5) to present, in graphical form, various stages of the development process. Section 6 concludes the paper and the future aspects of the application are enlisted in the last section, Section 7.

Related Work

We have reviewed a number of apps available in the market to assess the features and services offered by them. Among these were mobile applications like Health Infinity[1], Google Fit[2], and Health Manager[3], desktop applications like Microsoft's Health and Fitness[4] and websites like www.eatthismuch.com[5], www.fooducate.com[6], and www.freedieting.com[7].

Health Manager focuses on regulating the activities that will directly affect the user's health like eating habits, water consumption, and exercise routines. Health Infinity tracks, analyses and summarizes user's weight, foods, activities, sleep, heart rate, blood pressure and squats why measuring their BMI, number of steps they take daily, and tracking their sleep patterns. Google fit on the other hand is concerned only with tracking a person's fitness routines and their impact on his/her health. Microsoft's Health and Fitness is a desktop application that provides workout routines, health plans (uncostumized), diet tips in forms of articles and videos. The websites mentioned above give daily health tips, recipes of trending and healthy food dishes, and recommends the amount of calories a user must consume on a daily basis to achieve their health targets.

After this review we concluded that our application should combine the exercise and diet suggestions and provide them to users in form of short and easy to understand texts. Further we decided to use the traffic light approach to notify the users if their meals had an excess, shortage, or an optimum amount of micro-nutrients like iron and calcium.

Proposed Application

Health Buddy, the Android based health application aims at providing diet and exercise related recommendations to its users along with helping them to track their nutritional intake. This application will create health awareness among its users and its continuous usage may lead to gradual improvement in their diet behaviour[8]. The application will also update its users with health tips thereby dejecting food fallacies. Depending upon height and weight of the individual, BMI will be calculated which will suggest RDA (Recommended Dietary Allowances) for various nutrients and recommend an increase or decrease in calorie consumption and extent of physical exercises.

Technical Specifications

The specific technical objectives of the project are :

1. Collection of food composition data for cooked dishes according to standard serving sizes.

2. Nutrient data collection of packaged foods through analysis of nutritional labelling.

3. Classification of foods on the basis of Traffic light approach — green for good foods, amber for medium and red for bad.

4. Collecting data on different types of physical exercise and the energy expenditure while performing them.

5. Development of the application which will include-. Calculation of BMI and waist to hip ratio, suggestion of recommended nutrient intake, and calculation of nutrient intake of user on the basis of data entered i.e. name and amount of a particular food eaten and calculation of energy expenditure on the basis of data on physical exercise as user input.

6. Recommendation of ideal food choices for the user on the basis of data generated.

Features of the Application

The general features of the application will be :

1. Providing health tips to users at the click of a button.

2. Studying the effect of the user's lifestyle on his/her nutritional intake. For example: Analysing the adverse effect of junk food on the health of teenagers.

3. Specifically studying the nutritional intake habit of college going students.

4. It will provide nutritional and exercise tips to users of the app.

5. Creating a user friendly interface to make health management easier for users.

Methodology

We are taking an incremental approach of software engineering and nutrition information.

Detailed description of incremental approach

1. Study and analysis of IOS, Android and Windows health apps available in the market.

2. After studying the requirements and objectives of the target app, we designed a questionnaire with an aim to analyze the eating habits of college going students.

3. Conducting a manual as well as online survey using google forms to collect the required data.

4. Studying and collecting information on the nutritional contents of various food items (including packaged and cooked food stuffs) commonly available in college canteens.

5. Identification and finalization of tables required for the database, theoretical formulas to calculate the waste to hip ratio and BMI, and other data required for the app.

6. Generating DFDs and ER diagrams for the application.

7. Designing screens on paper and analysing control flow through the application as a whole.

8. Learning technical details of Android application development by on-hands experience on softwares like Android Studio, Eclipse, and database language — SQLite.

9. Generating XML codes for the screens of the mobile app.

10. Populating the various tables of the database with their respective information.

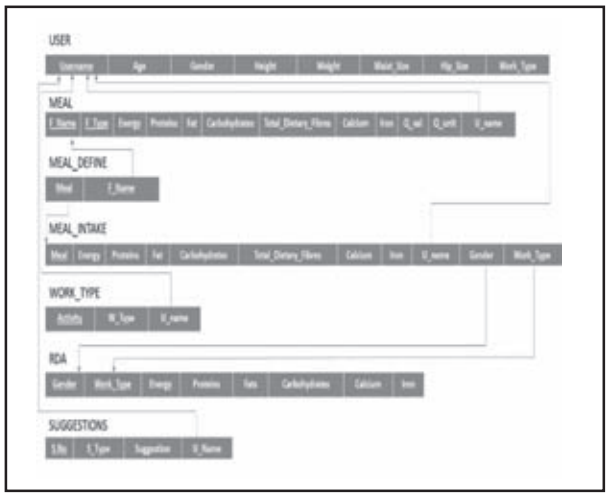
Diagrams Related to the Application

Following are the various diagrams related to the development phase of the mobile application[9].

Database Schema

A database schema is the skeleton structure that represents the logical view of the entire database. It defines how the data is organised and how the relations among them are associated [10].

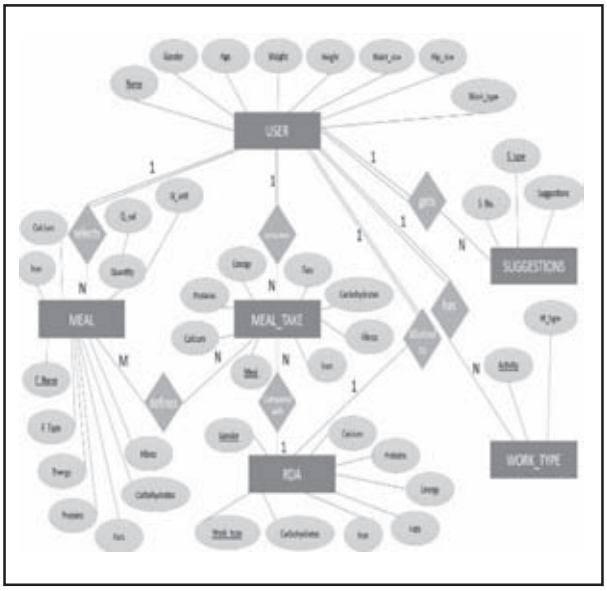
Figure 1: Database Schema



ER Diagram

An entity relationship diagram (ERD) shows the relationships of entity sets stored in a database [11].

Figure 2 : ER Diagram



DFDs (Data Flow Diagrams)

A data flow diagram (DFD) is a graphical representation of the "flow" of data through an information system, modelling its process aspects. A DFD is often used as a preliminary step to create an overview of the system, which can later be elaborated [12].

Figure 3 : Level 0 DFD

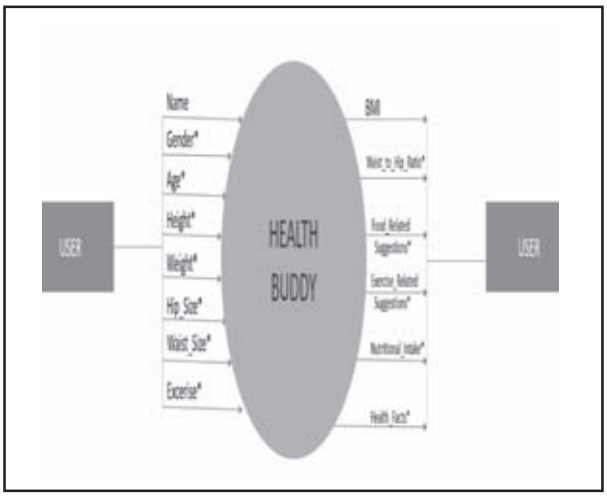
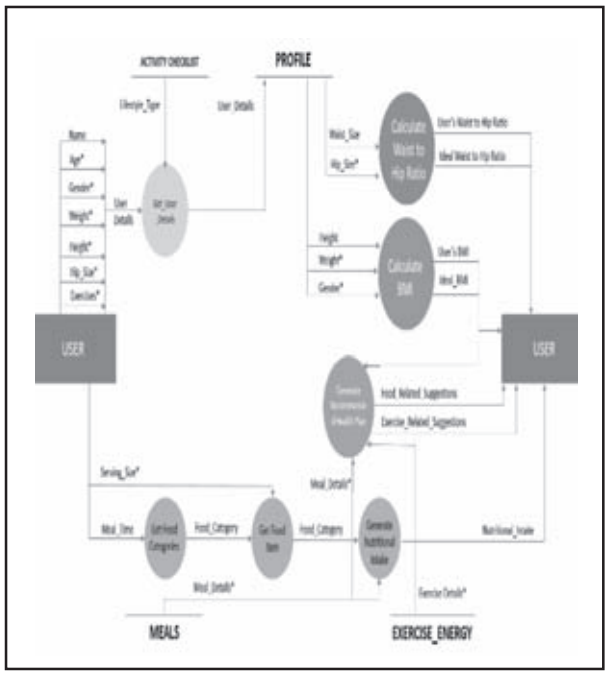


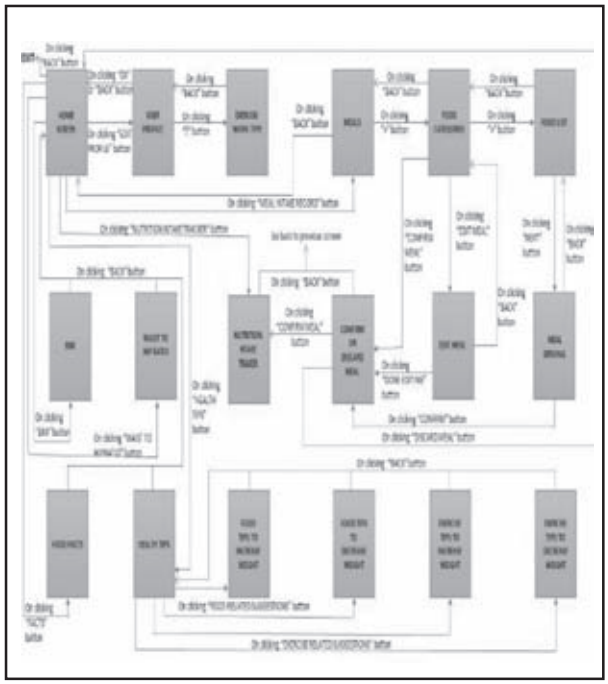
Figure 4 : Level 1 DFD



Screen Flow Diagram

Screen flow diagram illustrates the flow of screens in the functional parts of the site or the software. It shows in detail the sequence in which forms, pop-up windows and confirmation windows are presented[13].

Figure 5: Screen flow diagram



Conclusion

This project of building a health application for Android ecosystem has been funded by Delhi University Innovation desk (for session 2015-2016) and has been undertaken by the faculty and students at Shaheed Rajguru College of Applied Sciences for Women, University of Delhi.

Health Buddy, the Android application aims at providing the users a friendly, easy and a customized interface to keep track of their daily nutritional intake. It equips the user with an easy to use mobile application so as to manage ones health on a day to day basis in an interactive manner. The graphical representations of conclusions derived from user's meal intake adds to the user-friendliness of the app. Some of the unique features of the application includes the traffic light approach, pictorial representation of the calorie intake of the user, and providing customized health tips to them based on their current health status. The application will take into special account the calcium, iron and dietary fibre of the foods.

Future Approach

Once the application is developed, the following features will be incorporated to extend its functionalities.

1. The application will be customized so as to target a larger audience.

2. The application would also take into account the Sodium and Potassium intakes of an individual and their impact on the user's health.

3. We will provide the feature of user login in our application to enable multiple users to access their accounts through a single mobile phone.

4. The application will be configured to work on a cloud which will make it light and more efficient.

5. The application will access information (including the menus and recipes) on the nearby restaurants and cafes and provide the nutritional details of their dishes to the users.

References

1. *https://play.google.com/store/apps/detailsid=com.droidinfinity.healthplus&hl=en-healthInfinity*
2. *https://play.google.com/store/apps/details?id=com.google.android.apps.fitness&hl=en-Google Fit*
3. *https://play.google.com/store/apps/details?id=com.androidapps.healthmanager&hl=en-Health Manager*
4. *http://www.msn.com/en-in/health*
5. *https://www.eatthismuch.com*
6. *http://www.fooducate.com/*
7. *http://www.freedieting.com/tools/calorie_calculator.html*
8. *Development of an Android based mobile application to track nutritional intake of young college students.*
9. *Fundamentals of Database Systems 5th edition. Ramez Elmasri and Shamkant B. Navathe. Publication Pearson*
10. *http://www.tutorialspoint.com/dbms/dbms_data_schemas.htm*
11. *https://www.smartdraw.com/entity-relationship-diagram/;*
12. *https://en.wikipedia.org/wiki/Data_flow_diagram*
13. *http://katehorne.com/screenflow*

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Physiochemical Properties and Sensory Evaluation of Cookies prepared with Non-nutritive Sweetener

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Abstract

Use of alternative sweeteners can help manage weight and normal blood glucose level. Cookies are prepared with high amount of sugar, fat and refined flour which is not only high in calories and have a high glycemic index (GI) but are also low in fibre. Therefore, development and standardization of low glycemic index and high fibre cookies using wheat flour, oats, bakery shortening, choco chips, almonds and a non nutritive intense sweetener was done. Physiochemical analysis of the raw materials and the finished product was done. Cookies were analyzed for diameter, height, spread ratio, hardness, moisture content and water activity. Sensory analysis with QDA using semi- trained panellists was done to establish acceptability of the product.

The formulated cookies were well accepted by the semi- trained panelists as well as the diabetics who were randomly selected for the study. The overall appearance, texture and flavour of the cookies (30g) was moderately liked by the panelists as indicated in the qualitative descriptive analysis. Thus, the cookies offer a healthy alternative not only for the diabetics but also for the people suffering from non communicable diseases such as obesity, CVD, dental carries etc

Key words : Cookies, diabetes, non- nutritive sweetener.

Introduction

According to World Health Organization in 2008, worldwide more than 1.4 billion adults were overweight. Of these 500 million were obese (WHO, 2013). Overweight and obesity are well known risk factors for diabetes and cardiovascular diseases. India has been recently declared as the 'diabetic' capital of the world. One in every five persons in India suffers from diabetes and other related disorders. Type II diabetes accounts for 95% of all cases, which can be managed through diet modification, especially the type of carbohydrates consumed. People suffering from diabetes are advised to restrict their use of sugars. Use of alternative sweeteners can help manage weight and normal blood glucose level.[1]

Cookies hold an important position in snack food industry due to variety in taste, crispness and digestibility. Cookies are made in a variety of style using an array of ingredients including sugars, spices, chocolates, butter, peanut butter, nuts or dried fruits.(Abdul .W, 2010). They are considered ideal for nutrient availability, palatability, compactness and convenience. They are low in moisture content, comparatively free from microbial spoilage and have a long shelf life. However, cookies are prepared with high amount of sugar, fat and refined flour which is not only high in calories and have a high glycemic index (GI) but are also low in fibre. Their regular intake may predispose to overweight and obesity.

Nowadays, cookies made from oats are becoming increasingly popular because of their

enhanced functional properties. Oats are rich in dietary fibre, specifically, β-glucan, which is a soluble fibre, known to reduce blood cholesterol level by increasing the excretion of bile in the body.[2] In addition to this it is also high in proteins, minerals such as iron and magnesium and pantothenic acid (B5). (Marquart & Caben, 2005)

The health and wellness concept has added a new dimension to the consumers who are becoming increasingly aware of relationship between diet and health. Energy reduced foods are used to mitigate overconsumption of energy. This is leading to an increasing demand for products with reduced energy especially those that use sweeteners as substitutes for sucrose.[3] Substituting sugar with low calorie sweeteners may be an efficacious weight management strategy.[4] Kroger[5] (2006) comprehensively reviewed the low calorie sweeteners and sugar substitutes and reported that low calorie sweeteners enables food manufacturers to formulate a variety of good-tasting sweet foods and beverages that are safe for teeth and lower in calorie content than sugar-sweetened foods. The range of low calorie sweeteners available to the food industry is expanding. It is essential for the food manufacturer, however, to have exact knowledge of both sweetness and other sensory properties of various sweeteners in relation to different sucrose concentrations and in relation to the food matrix, since replacement of sucrose to produce energy reduced foods should not cause significant changes in the sensory characteristic of the product.[6]

The use of artificial sweeteners posses a technological challenge to the food processor as there are some basic differences between them and the carbohydrate sweeteners. Non-nutritive sweeteners are usually not carbohydrate based and therefore have different chemical and physical properties. They also differ in flavour characteristics. Non-nutritive sweeteners are defined as substances that have less than 2% of the caloric value in an equivalent unit of sweetening capacity. Substitution of artificial sweeteners for sucrose may facilitate the maintenance of nutritionally balanced diet by satisfying a diabetic person's desire for sweets and assistance in the control of calorie intake.[7] Therefore, there is a need for variety of sugar substitutes to manage diabetes and also to develop low calorie foods.

Few studies are conducted to incorporate sugar substitutes like sucralose[8] in traditional foods and others. Sucralose has excellent product stability even under high temperatures and it can be used in a broad range of food products. A large number of studies have proven that sucralose is safe for human consumption. Sucralose does not break down in the gastrointestinal tract or accumulate in fatty tissues (McLean et al., 2000). Zoulas et al (2000) studied the effect of sugar replacement by polyols and acesulphame K on the quality aspects of low fat cookie and further reported the supplementation with acesulphame- K increased sweetness and improved perceived flavour and general acceptance of cookies. Acesulphame- K has high degree of stability when exposed to heat; this makes it a versatile sweetener with potential use in a wide range of foods and beverages.[9]

Therefore, the present study was undertaken to provide consumers with healthy food choices and help prevent the onset and management of non communicable diseases such as diabetes, cardiovascular diseases, dental caries etc.

Objectives

The aim of the study was :

- To develop and standardize low calorie, low glycemic index cookies using non nutritive sweetene; and
- To evaluate the physiochemical and sensory quality attributes of cookies using quantitative descriptive analysis to assess the consumer preference and acceptance.

Materials and Methods

Raw Material Source and Analysis

Whole wheat flour and rolled oats were procured from the local Delhi market. Bakery shortenings which were trans fat free was obtained from Cargil Foods Delhi, India. Stevia (steviol glycoside) (canderel) was selected on the basis that it is an organic sweetener, obtained from the leaves of *stevia rebaudiana bertoni*. Vanilla essence, baking powder, almonds, and dark chocolate were also procured from the local market of Delhi. All raw materials were analyzed for physical and chemical quality as per AOAC (1998) procedures to ensure good quality of the finished products.

a. *Physical Analysis* : Wheat flour and oats were analysed physically on the basis of its colour, feel/ texture and insect infestation.

b. *Chemical Analysis* : Determination of moisture content, ash content, water absorption power, gluten content, sedimentation value was done for wheat flour and moisture content and total ash for oats was done respectively.

Cookie Formulations

Short dough cookies were prepared by creaming bakery shortening with stevia (steviol glycoside) a non- nutritive sweetener and vanilla essence until pale and fluffy using planetary mixer (Moulinex, masterchef compact) at speed 2 for 5 minutes. Refined flour was sifted with baking powder and salt and then stirred until well mixed. Rolled oats, chocolate chips and almonds were incorporated. Standardized amount of water was added and the dough was kneaded for 5 minutes. The cookie dough was wrapped in a plastic wrap to prevent moisture loss and kept in the refrigerator for an hour. Before baking, the dough was tempered to room temperature (21°C) and scooped with an ice cream scooper before being dropped on the baking sheets to be baked for 30 minutes in a pre heated oven at 180°C. The cookies were allowed to cool for 1 hr at ambient temperature and then individually packed in resalable 100 g pouches. All the samples were stored in an air tight plastic container and stored inside a dark cabinet at room temperature (22-24°C) until sensory and instrumental evaluations were performed.

Physical evaluation of cookies

Cookie Diameter, Height and Spread Ratio

Cookie diameter (cm) was measured by laying six cookies edge to edge with the help of scale and then rotating them by 90° and re-measuring. The average diameter of the cookies was the average of the two readings divided by six. Cookie height (cm) was determined by stacking six cookies on top of one another, restacking and re-measured. The average height of the cookies was the average of the two readings divided by six. Spread ratio which is defined as a ratio of average diameter to average height of the cookies was then calculated.

Instrumental Analysis

Cookie Texture : A texture analyser (TA-XT Plus), Stable Microsystems, UK equipped with a 50 kg load cell was used for cookie texture evaluation. Cookies were evaluated for hardness within 24h. The cutting strength was measured using HDP/BS blade of texture analyzer. The individual samples of biscuits were placed on the platform and the blade was attached to the crosshead of the instrument. The TA settings selected were pre- test speed: 2mm/s, test speed: 3mm/s, post- test speed: 10mm/s and distance 5mm. The absolute peak force of the resulting curve was considered as cutting strength of the biscuit.

Water Activity : Water activity (A_w) of cookie samples was measured with a water activity meter (Aqua Lab model DTE) Decagon Devices Inc., Pullman, WA. It was calibrated with sodium

chloride standard solution (6 molal, at 25°C, A_w = 0.7549, Decagon devices). A 30 mm diameter round plug was punched from the centre of each cookie and crumbled inside the sample cup, and inserted into the meter chamber. The A_w was measured using the chilled- mirror method at sample temperature set to 25 ± 0.2°C. The measurements were replicated three times.

Sensory Acceptability Tests

Panel Training

Forty five students were randomly selected based on their willingness to participate in the sensory training and study. The panel members were Food Technology students pursuing graduation at Bhaskaracharya College of Applied Sciences, University of Delhi, New Delhi, India. The panelists were between 18- 20 years old and were regular consumers of cookies. They were given a series of psychometric tests which included; recognition threshold, sensitivity test and PTC test. Fifteen students were included the semi trained panel based on their sensitivity and only tasters were selected. In the preliminary session panelists were trained for sensory evaluations; care was taken to avoid physiological errors and bias. They were then trained for threshold study and Quantitative Descriptive Analysis (QDA).

Sensory Profile

A group of fifteen semi trained panelists participated in the evaluation. QDA was selected for sensory analysis as it gives full information of sensory attributes and was used for profiling of cookies. Category scales consists of a series of word phrases structured in ascending or descending order of intensity were used to measure the specific attributes (e.g. sweetness, after taste, flavour etc.). For the purpose of analysis, successive digits are later assigned to each point represented on the scale, usually beginning at the end representing zero intensity. The sensory attributes evaluated in this study were appearance, colour, texture, flavour, and overall acceptability of cookies. Session was conducted at room temperature in a sensory room at mid morning, about 4h after breakfast. Cookies were served on plates to the panelists, and sensory evaluation score cards were provided to them. The procedures for sensory evaluation were explained to the panelists before sensory testing commen-\ced. They were asked to read through the instructions and meaning of each attribute to be tested was explained. They were given time to clarify any doubts to avoid misinterpretation. Water at room temperature was provided to rinse the mouth between evaluations. Mean scores of panelists for cookies was calculated.

Results and Discussions

In this study use of non nutritive sweetener for the development of cookies was investigated. The cookies are low in calories, high in fibre and have a high GI. This technology has been developed at lab scale keeping in mind the consumer's interest in health and functional foods.

The chemical analysis of the raw material used for the preparation of the cookies is tabulated as under.

Physical Evaluation of Cookies

Cookie Diameter : Cookie spread occurs as sugars dissolve during baking. Sucrose is not completely dissolved prior to baking, so the undissolved sugars will dissolve during baking, which allows greater spread to occur. Cookies made with non nutritive sweetener were found to have an average diameter of 4.91cm.This could be attributed to lack of sugar content and high fibre content from oats and bran in the cookies. Cookies made with 100% sucrose have been reported to have an average diameter of 5.5 cm.[11]

Cookie Height : Gluten development contributes to an expansion in height of baked products, but cookies don't increase dramatically in height,

Table 1 : Sensory Attributes of Cookies using Quantitative Descriptive Analysis

Appearance Visible Choco chips — Amount of chips visible from few too many. Colour intensity — Intensity of brown colour, from buff (light brown to dark brown) Uniformity of colour — Uneven to even Surface cracks — Visible surface cracks on cookie- from none to many.
Aroma Chocolaty — from none to strong Baked flavour — Pleasant aroma of baked cookies from none to strong
Flavour Sweet — The sweet taste of the tongue, from low (5%) to high (25%) Chocolaty — The taste of chocolate morsel on tongue from none to strong Oaty — The taste of oatmeal, from none to strong
Texture Dryness — The amount of saliva absorbed by sample, from moist to dry Hardness — Force required to break a sample into two pieces in mouth, from soft to hard Graininess — Amt of sample particles in the mouth after chewing, from none to many Denseness — Compactness of cross section after first bite, from airy to dense Crumbliness — At first bite, sample stay in big pieces (not crumbly), or sample breaks into crumbs (very crumbly)
Aftertaste Sweet — Sweetness lingering in the mouth after swallowing, from none to strong Chocolaty — Chocolate flavour lingering in the mouth after swallowing; the aftertaste of chocolate morsel, from none to strong Metallic — Metal like flavour lingering in the mouth after swallowing from none to strong

Table 2 : Chemical Analysis

	Wheat Flour	***Oats***	***Fat Analysis***	
Moisture Content	12.29 %	11.32%	Free fatty acids as oleic acid	0.05%
Ash content	1.16%	0.54%	Peroxide value	0.76
Acid Insoluble Ash content	0.13%			
Water Absorption Power	60%		Iodine Value	44.68
Sedimentation value	30ml		Melting point	40.5˚C
Gluten content (wet)	2.373g			

because sugar preferentially attracts water over gluten proteins. Therefore, the amount and type of sugar in the formulae can affect the height of cookies. Similar observations were made by Kissel etal (1973) and Vetter et al (1984). The mean height of cookies made with non nutritive sweetener was 2.58 cm as compared to those made with 100% sucrose which was reported to be 1.25cm. This is because of lack of hygroscopic nature of non nutritive sweetener, stevia which does not compete for water and allows for greater hydration of gluten and thus more height to the cookies. Handa etal (2012) Also the shortening used for cookies had nitrogen flushing which could be responsible for the increased height.

Cookie Spread Ratio : Cookie spread represents a ratio of diameter to height. Thus, sugar's effects on the diameter (sugar dissolution) and height (inhibiting gluten development) are combined into a single parameter. Cookies having higher spread ratio are considered most desirable (Finney et al, 1950). The spread ratio of high fibre oatmeal cookies made with non nutritive sweetener was 1.90. These findings are also supported by Sudha et al. (2007) study in which the incorporation of different sources of bran showed opposite relations with spread ratio.

Cookie Texture : Development of cookies that stay soft throughout distribution and onto the consumer's shelf has been pursued for many years. Cookies become sensorily dry to taste and crumbly even when packaged to prevent loss of moisture. Cookie firming involves sucrose recrytallization and the resulting redistribution of moisture to the other components, which then leads to a firmer, drier texture. Thus inhibiting/ reducing sugar crystallization cookie hardening can be prevented. Cookies made with 100% sucrose reported higher hardness as indicated by higher mean peak force of 7139 g. (Handa, 2012). The cutting strength of cookies made with stevia had lower hardness with a mean peak force of 3073.3g which is considered a desirable characteristic as depicted in the Figure 1.

Water Activity : Cookies are although dry product in terms of moisture, its water activity is crucial to predict both the stability and safety of this product in terms of microbial growth. The lowest aw at which the vast majority of food spoilage occurs is 0.90, although some moulds and yeasts grow above 0.61 (Fontana, 2001). The average aw of cookies with non nutritive sweetener was found to be 0.59 at 26°C. The aw of cookies was found to be slightly higher as compared to cookies made exclusively with sucrose because of its high fibre content. It has been reported by Manley (2000) that the soluble fibre, β-glucan which is present in oats has the ability to hold water at higher temperatures associated with baking.

Sensory Acceptability Tests

The results of the descriptive analysis of the cookies are shown in fig: 2. The overall acceptability was found to be 60% by the panelist for cookies with stevia, having a mean score of 5.7 on a 9 point hedonic scale. The cookies were reported to have a brown colour, chocolaty flavour, and sweetness without lingering after taste of the sweetener. The texture was found to be acceptable but grainy because of the presence of wheat bran and rolled oats. Crumbliness which is a desirable property of cookies was reported to be 6.33 on a nine point scale. The visual appearance of the cookies with non nutritive sweetener was also liked moderately.

Conclusions

The study revealed that cookies can be successfully formulated using a non nutritive intense sweetener which are not only low in calories and has a low GI but is also high in fibre. The overall appearance, texture and flavour of the cookies was moderately liked by majority of the panelists i.e 60% as indicated in the qualitative descriptive analysis. Thus, the sugar free cookies have good consumer acceptability. They offer a healthy alternative not only for the diabetics but also for the people suffering from

Fig. 1 : Curves depicting the Cutting Strength of Cookies

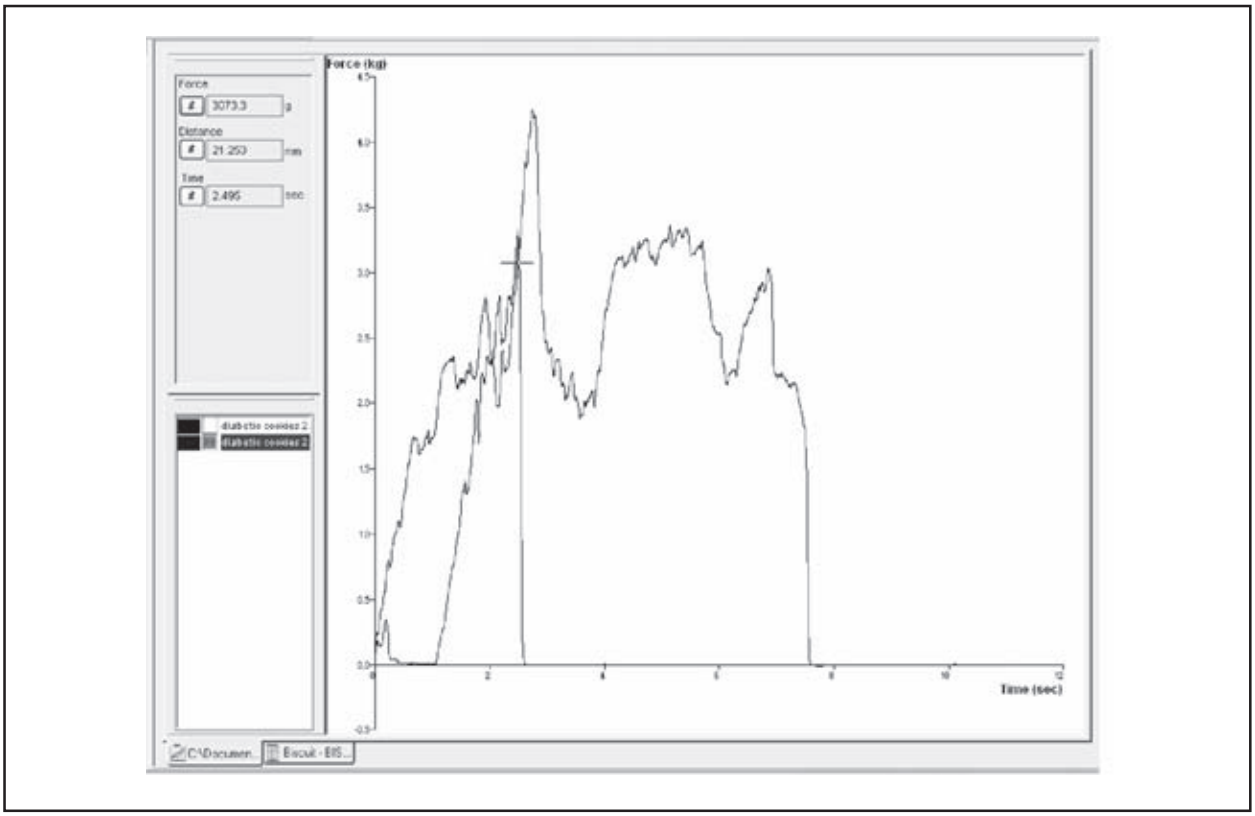
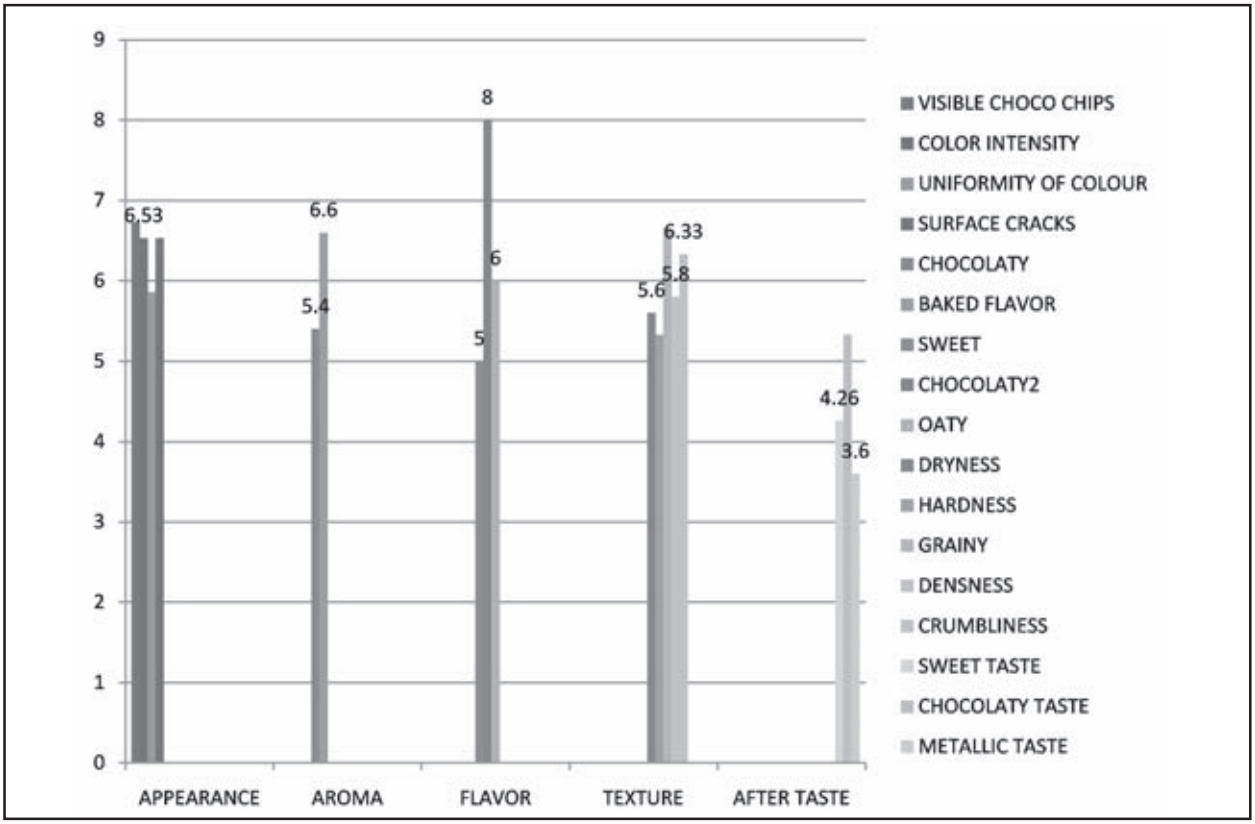


Fig. 2 : Quantitative Descriptive Analysis of Cookies



non communicable diseases such as obesity, CVD, dental carries etc.

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References

1. *Hunty. ADL, Gibson S, etal (2006) A review of the effectiveness of aspartame in helping with weight control. Nutr. Bulletein 31(2): 115-128.*
2. *Jenkins and Kendal (2002) Soluble fibre intake at a close approved by the US FDA for a claim of health benefits. Serum lipid risk factor cardiovascular disease assessed in a randomized controlled crossover trial. The Am.J.Clin.Nutr.75:834-839.*
3. *Trevizam, Moraes and Bolini (2010) Different sweeteners in beverages prepared with instant and ground coffee: ideal and equivalent sweetness. J Sens Stud 25:215-225*
4. *Anderson et al. (2012) The use of low- calorie sweeteners by adults: impact on weight management. J Nutr 142:1163S-1169S*
5. *Kroger M et al (2006). Low calorie sweeteners and other sugar substitutes: a review of safety issues. Compr Rev Food Sci. Food Saf 5 (2):35-47*
6. *Cardello et al (1999) Measurement of the relative sweetness of stevia extract, aspartame and cyclamate/ saccharin blend as compared to sucrose at different concentrations. Plant Foods Hum Nutr 54:119-130*
7. *Chattopadhyay S. Etal (2011) Artificial sweeteners – A review. J. Food Sci Tech.*
8. *Binnis NM (2003) Sucralose- all sweetness and light. Nutr Bulletin 28(1): 53-58.*
9. *Arora et al (2011) Assessment of stability of binary sweeteners blend (aspartame x acesulphame-K) during storage in whey lemon beverage. J Food Sci Techno. Doi:10007/s13197-011-0386-0*
10. *Stone H, Sidel, 1998 Quantitative Descriptive Analysis, developments, applications and the future. Food Technol 52(8): 48-52*
11. *Handa. C & et al, 2012. Physiochemical properties and sensory evaluation of fructoligosaccharide enriched cookies. 49(2) 192-199*

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Isolation and characterization of *Streptococcus mutans* and *Streptococcus sobrinus* from dental caries to determine its inhibition by bacteriocins of lactic acid bacteria

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Abstract

Dental caries is one of the most common diseases in the world, second only to the common cold and can lead to pain, infection and tooth loss and in severe cases, even death.[1] In s study, the prevalence of dental caries was 64.2% among anganwadi children and 61.0% among day care children. Girls had slightly higher mean deft score, mean number of decayed teeth, filled teeth and lower missing teeth as compared to boys. Therefore, high caries experienced in this study revealed that there is a great need to plan and conduct oral health promotion initiatives and treatment activities for preschool children.[2] Mutans streptococci (Streptococcus mutans and Streptococcus sobrinus) are the most important bacteria in pathogenesis of dental caries due to many epidemiological, experimental and animal studies.[3] Bacteriocins from lactic acid bacteria have demonstrated as food preservatives or as therapeutics for veterinary or medical uses.[4] Lacticin 3147, a bacteriocin produced from Lactococcus lactis subsp. lactis shows inhibitort effect against organisms like Clostridia spp, Listeria monocytogenes, Staphylococcus aureus, Streptococcus dysgalactiae, Enterococcus faecalis, Propionibacterium acne and Streptococcus mutans.[5] In the present study, the bacteriocin produced by lyophilized reference culture of Pediococcus pentosaceus PP34 has been used to determine its anti-microbial activity against dental caries causing organisms Streptococcus mutans and Streptococcus sobrinus. These organisms have been isolated from caries infected teeth on selective media- TYCSB media. The microscopic, cultural, biochemical and molecular characterization of the isolates has been conducted to confirm the strains upto species level. The bacteriocin produced by lactic acid strain of Pediococcus pentosaceus PP34 shows inhibitory effect against the isolated strains of Streptococcus mutans and Streptococcus sobrinus. Therefore, the bacteriocins from lactic acid bacteria can be fortified to various food products so that the selective product itself becomes a weapon against dental cavities in humans.

Keywords : Bacteriocins, Lactic acid bacteria, mutans Streptococci

Objectives

- Isolation and screening of organisms causing dental caries (*Streptococcus mutans* and *Streptococcus sobrinus*).
- Determination of inhibition of the isolated strains by bacteriocins of standard culture of bacteriocin producing *Pediococcus pentosaceus* PP34 (Lactic acid bacteria).

Methodology

Collection of Sample : Samples of caries infected teeth were collected from various dentists. The teeth were preserved in sterile phosphate buffered saline (PBS) (HiMedia, India) until used. These were then subjected to microbiological analysis for isolation of *Streptococcus sobrinus*.

Isolation of Streptococcus mutans and Streptococcus sobrinus : Suitably diluted exudate from caries infected tooth was spread plated on selective media- TYCSB agar (composition by Wan *et al*, 2002)[6] and the plates were incubated at 37°C for 65 h. They were observed periodically for microbial growth. The

pure cultures of this suspected *Streptococcus* spp. was streaked on the slants of these selective media so as to obtain pure culture of the isolates.

Microbial and Biochemical identification of isolates : Several identification tests were performed. The microbial staining include- Negative staining and Gram staining. Some confirmatory biochemical tests, selective for *Streptococcus mutans* and *Streptococcus sobrinus* spp. were performed, which includes :

- *Catalase test* : Few drops of hydrogen peroxide (30% H_2O_2) were gently poured on microbial growth to observe for presence or absence of effervescence.

- *Rapid differentiation test for Streptococcus mutans* : Few drops of test solution — 10% mannitol & 4% TTC-2,3,5- triphenyl-tetrazolium chloride (from Hi-media, Mumbai, India) was gently poured on the microbial growth. The colonies were observed for the appearance of pink colour.

- *Utilization of different carbohydrate sources* : The isolates of bacteria were plated on Brain Heart infusion agar (from Hi-media, Mumbai, India) containing 0.02% phenol red colour. Four different carbohydrates including salicin, sucrose, inulin and sorbitol in the form of sterilized disks of 0.05 mg were placed on plates and incubated at 37°C for 48 h. The change in colour from red to yellow gave positive result for carbohydrate fermentation and vice-versa.

Molecular identification : To confirm the isolates upto species level, the bacterial genomic DNA was isolated by the method previously described. The DNA bands were measured by electrophoresis electrophoresis on 1.5% agarose gel and stained with ethidium bromide. The DNA is further subjected to Polymerase chain reaction to detect *Streptococcus mutans* and *Streptococcus sobrinus*. The same procedure was followed as used previously.[7]

Reference culture: The lyophilized culture of *Pediococcus pentosaceus* PP34 was inoculated in MRS broth (from Hi-media company, Mumbai, India) and incubated at 37°C for 24 h. The microbial growth was streaked on the plates of selective media — MRS agar so as to obtain pure culture.

Preparation of culture supernatant : The reference culture *Pediococcus pentosaceus* PP34 was subjected to centrifugation at 10,000 rpm for 20 minutes at 4ºC in a refrigerated centrifuge. The culture supernatants so obtained were sterilized by passage through a 0.22 µm Millex GV filter (Millipore) and stored at -18°C untill assay of bacteriocin activity.

Anti-microbial assay against Streptococcus mutans and Streptococcus sobrinus : Spot-on-lawn assay technique was done in order to determine the bacteriocin activity. The isolated strains of *Streptococcus mutans* and *Streptococcus sobrinus* were used as indicator organisms and plated on TYCSB agar media. Five µl of the culture supernatant (crude bacteriocin solution) of the *Pediococcus pentosaceus* PP34 was put as spot on the dried agar surface of each isolate of *Streptococcus mutans* and *Streptococcus sobrinus*. The plates were incubated at 37°C for 24 h. The plates were subsequently examined for clear zones around the wells which indicated growth inhibition due to bacteriocin activity.

Results and Discussion

Cultural characterization and microscopic identification of Isolates : The total isolates obtained were 60 in number**.** In each culture two types of colony was observed i.e. colony (a) and (b). In some cultures colony (Y) and (E) were also found. Colony (a) had creamish colour, punctiform, entire margin and flat elevation; jelly like appearance. Colony (b) had white colour,

punctiform, entire margin and raised elevation; opaque appearance. Colony (Y) had yellow colour, raised elevation, entire margin, punctiform and opaque appearance. Colony (E) had creamish colour, entire margin, punctiform, opaque appearance and colony embedded into agar. Microscopic analysis showed all the isolates in cocci shape. Some of the cells were present in chains and some were scattered singly. The cells were violet in colour i.e. all the cells were Gram positive.

The colonies of *Streptococcus mutans* strains formed mutiberry-shaped colonies growing deep into the agar, while the very hard colonies of *Streptococcus sobrinus* were usually surrounded by extracellular polysaccharides. *Streptococcus mutans* is a Gram-positive, non-motile, non-spore forming, catalase- negative, facultative anaerobic and cocci shaped bacteria.[8]

Biochemical examination of isolates : The 60 isolates obtained were subjected for catalase test and the results are shown in Table 1. After catalase test, the 27 isolates which showed positive test for catalase, were discarded and not used for further study. The remaining 35 isolates were subjected to further examination and the results are shown in Table 2. After examination by sucrose fermentation, some of the isolates were discarded as they gave negative result for sucrose fermentation. Thus, out of 35 isolates, 14 isolates were remaining to be applied for detection. Therefore, further analysis for carbohydrate fermentation was done for salicin, sorbitol and inulin with remaining isolates. Out of 14 isolates, 4 isolates gave negative result for salicin fermentation. For further confirmation, rapid differentiation test for confirmation of *Streptococcus mutans* was done. Thus, out of 14 isolates, 7 isolates gave positive result for the test.

Streptococcus mutans ferment of wide range of carbohydrates sucrose, mannitol, melibiose, raffinose, cellobiose sorbitol, lactose, salicin trehalose and inulin.[9] It is demonstrated that

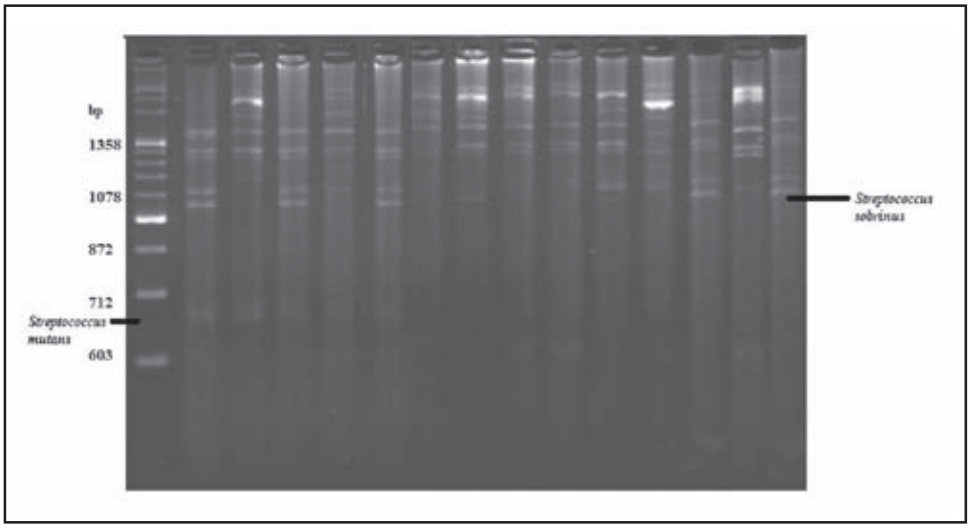
Table 1 : Isolation of Streptococcus mutans and Streptococcus sobrinus from caries infected teeth

S. No.	*Samples of Dental Plaques*	*Designation of isolates*	*Catalase test*
1.	Adult male	1(a)	-
		1(b)	+
2.	Adult female	2(a)	-
		3(a)	-
		4(a)	-
		5(a)	-
		2(b)	-
		3(b)	+
		4(b)	+
		5(b)	-
		6(b)	+
3.	Adult male	6(a)	-
		7(a)	+
		8(a)	-
		9(a)	-
		10(a)	-
		11(a)	+
		12(a)	-
		13(a)	-
		7(b)	+
		8(b)	-
		9(b)	+
		10(b)	+
		11(b)	+
		12(b)	+
		13(b)	+
4.	Adult female	14(a)	-
		15(a)	-
		16(a)	-
		17(a)	+
		18(a)	+
		19(a)	-
		20(a)	-
		21(a)	-
		14(Y)	+
		15(Y)	+
5.	Adult female	22(a)	+
		23(a)	-
		24(a)	+
		25(a)	+
		26(a)	-
		27(a)	+
		28(a)	+
		29(a)	-
		16(b)	+
6.	Adult female	30(a)	+
		31(a)	+
		32(a)	+
		33(a)	-
		17(E)	-
		18(E)	+
		19(E)	-
		20(E)	+
7.	Adult male	21(b)	-
		22(b)	-
		23(b)	-
		24(b)	-
		34(a)	+
		35(a)	-
8.	Adult male	36(a)	-
		25(b)	-
9.	Adult male	37(a)	+
		26(E)	-

Table 2 : Biochemical Examination of Isolates

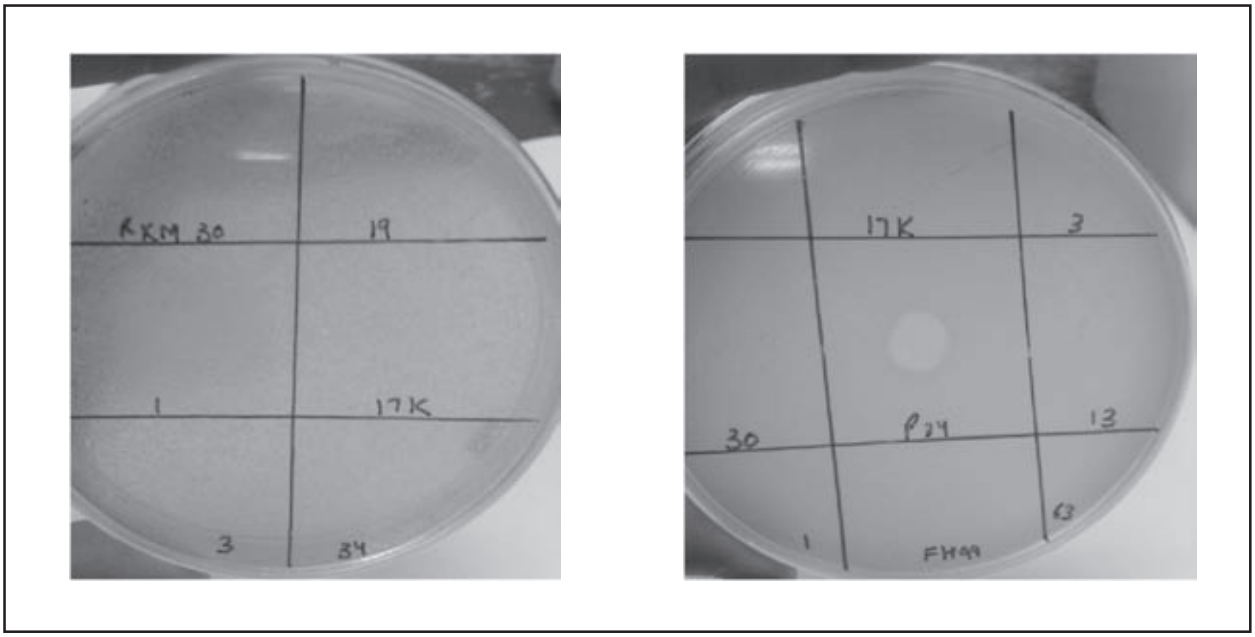
S. No.	*Isolates*	*Carbohydrate Fermentation Test*				*Rapid Differentiation Test*	*Anti-microbial assay*
		Sucrose	*Salicin*	*Sorbitol*	*Insulin*		
1.	1(a)	-	x	x	x	x	x
2.	2(a)	-	x	x	x	x	x
3.	3(a)	-	x	x	x	x	x
4.	4(a)	-	x	x	x	x	x
5.	5(a)	-	x	x	x	x	x
6.	6(a)	-	x	x	x	x	x
7.	8(a)	-	x	x	x	x	x
8.	9(a)	-	x	x	x	x	x
9.	10(a)	+	+	-	+	+	+
10.	12(a)	-	x	x	x	x	x
11.	13(a)	+	+	+	+	+	+
12.	14(a)	+	+	+	+	+	+
13.	15(a)	-	x	x	x	x	x
14.	16(a)	-	x	x	x	x	x
15.	19(a)	-	x	x	x	x	x
16.	20(a)	-	x	x	x	x	x
17.	21(a)	-	x	x	x	x	x
18.	22(a)	+	-	-	-	-	-
19.	23(a)	+	+	+	+	+	+
20.	26(a)	-	x	x	x	x	x
21.	28(a)	+	+	+	+	+	+
22.	29(a)	+	-	-	-	-	-
23.	33(a)	+	+	+	-	+	-
24.	35(a)	+	+	+	-	+	+
25.	36(a)	+	+	+	-	+	+
26.	2(b)	-	x	x	x	x	x
27.	5(b)	-	x	x	x	x	x
28.	8(b)	-	x	x	x	x	x
29.	17(E)	-	x	x	x	x	x
30.	19(E)	+	-	-	-	-	-
31.	21(b)	-	x	x	x	x	x
32.	22(b)	-	x	x	x	x	x
33.	23(b)	+	+	-	+	-	-
34.	24(b)	+	+	+	+	-	-
35.	25(b)	+	-	-	-	-	-

Figure 1 : PCR amplification showing Lane 1 (from left) as DNA marker



Lanes 2-6 (from left) as Streptococcus mutans and Lanes 11-15 (from left) as Streptococcus sobrinus

Figure 2 : Anti-microbial assay showing Zone of Inhibition



all the mutans streptococci group that were isolated from humans are capable to ferment mannitol, sorbitol and inulin sugars except for *Streptococcus sobrinus* and *Streptococcus cricetus*[2]. A rapid differentiation test between colonies belonging to mutans streptococci group from that of other streptococci was done on MS-agar media. Results indicated that thirty five isolates were stained with dark pink colour and considered to be positive result.[2]

Molecular identification : The molecular identification was done by polymerase chain reaction which confirmed the isolates as *Streptococcus mutans* and *Streptococcus sobrinus.*

Out of 14 isolates, the bands of 5 isolates appeared at 700 bp and the bands of 5 isolates appeared at 900 bp respectively. The bands of remaining 4 isolates did not show any bands.

In an experiment, with the primers used, *Streptococcus mutans* and *Streptococcus sobrinus* produced single DNA fragments of 517 and 712 bp, respectively.[7]

Anti-microbial assay against Streptococcus mutans and Streptococcus sobrinus : Out of 13 isolates of *Streptococcus* spp., the zone of inhibition was formed against 6 isolates, indicating inhibition of *Streptococcus mutans* and *Streptococcus sobrinus* by bacteriocin of lactic acid bacteria i.e. *Pediococcus pentosaceus* (Table 2 and Figure 2).

Lacticin 3147, a bacteriocin produced from *Lactococcus lactis subsp. lactis* shows inhibitort effect against organisms like *Clostridia* spp, *Listeria monocytogenes*, *Staphylococcus aureus*, *Streptococcus dysgalactiae*, *Enterococcus faecalis, Propionibacterium acne* and *Streptococcus mutans*.[4]

Conclusion

Salient findings of the study suggest that out of 14 isolates of *Streptococcus* spp., 4 isolates were confirmed as *Streptococcus sobrinus* and 7 isolates as *Streptococcus mutans*.

The bacteriocin produced by reference strain *Pediococcus pentosaceus* PP34, showed inhibitory effect against 3 strains of *Streptococcus mutans* and 3 strains of *Streptococcus sobrinus*.

Therefore, the bacteriocins from lactic acid bacteria can be applied to various food products which have capability to inhibit dental cavities in humans.

Thus, these bacteriocins will help in preventing cavities in consumers from the bacteriocin fortified food sources.

References

1. *Mathews S & Mathew GV (2014). War inside the mouth, J Dent Med Sci, 13: 23-25*
2. *Singhal DK , Acharya S, Thakur AS (2015). Dental Caries Experience Among Pre-School Children Of Udupi Taluk, Karnataka, India, J Oral Health Comm Dent, 9(1): 5-9*
3. *Nada HA, Mudallal Al, Essam FA, Jumaily Al, Nidhal AA & Shaibany WA (2008), Isolation and Identification of Mutan's Streptococci bacteria from human dental plaque samples, J Al-Naharain Uni, 11(3): 98-105*
4. *Dhewa T (2012). Screening, production purification and potential use of bacteriocins from lactic acid bacteria of meat and dairy food origin, Int Con Nut Food Sci 39: 35-41*
5. *Parada LJ, Caron RC, Medeiros A & Soccol RC (2007). Bacteriocins from Lactic acid bacteria: purification, properties and use as a Biopreservatives, Int J Braz, 50(3): 521-542*
6. *Wan AKL, Seow WK, Walsh LJ & Bird PS (2002). Comparison of five selective media for the growth and enumeration of Streptococcus mutans, J Aus Dent, 47(1): 21-26*
7. *Franco CT, Amoroso P, Marin MJ & Vila AF (2007). Detection of Streptococcus mutans and Streptococcus sobrinus in Dental Plaque samples from Brazilian Preschool children by polymerase chain reaction, J Braz Dent, 18(4): 329-333*
8. *Sunder KK (2012). Prevalence of dental caries, oral hygiene status and treatment needs in physically handicapped children attending various special schools of Davangere District, Indian J Public Health Res Dev, 1: 159-167*
9. *Sherbiny MEG (2014). Control of growth Streptococcus mutans isolated from saliva and dental caries, Int J Curr Microbiol App Sci 3(10):1-10*

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Formulating Low-Calorie Dairy Foods : Challenges and Opportunities

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Abstract

Sweetmeat consumption has been popular and intrinsic to Indian culture, traditions, and religions from ancient times. The majority of sweets and desserts are prepared by combining sugar and milk in multiple ways. India is home to the second largest number of adults and children living with diabetes in the world. Diabetes is rising alarmingly in India and caused one million deaths in 2015. Along with decreasing physical activity, the increasing trend of sugar consumption assumes significance in increasing "epidemic" of type 2 diabetes, obesity and cardiovascular diseases. A relatively large section of the population is compelled to restrict or eliminate sugar especially sweets consumption to control diabetes and obesity. Therefore replacing sugar and fat with low-calorie substitutes in dairy foods especially traditional sweets and beverages may be an effective strategy for weight and diabetes management. An artificial/ non-nutritive/ low-calorie sweetener is a food additive that duplicates the effect of sweet taste but usually has less food energy. The present article reviews the challenges associated with the replacement of sugar with artificial sweetener while formulating low-calorie foods. In view of changing food laws and rising demand, the opportunities for developing low-calorie/ sugar-free traditional dairy foods are also explored.

Keywords : Low-calorie, Artificial sweetener, Sensory quality, Texture, Milk products, Traditional sweets.

Introduction

Among the different products delivering essential nutrients to the body, milk and milk products occupy a central place in the diet of populace especially vegetarians. Indian religious offerings mostly contain *panch-amrits* (five elixirs) namely milk, *dahi, ghee* (clarified butter), honey, and basil leaves. One or more of the ingredients listed in Table 1 are combined with sugar in various forms to prepare traditional Indian sweets (Table 2). However, the majority of them are prepared by combining sugar and milk in multiple ways. Any auspicious occasion in India is celebrated with consumption of sweets. Also, it is customary to "sweeten the mouth" after every meal. Sweets are offered and gifted in all happy moments, social gatherings, celebrations and almost every festival is incomplete without sweets. It is considered mandatory to offer sweets to the gods on religious occasions, and the same are distributed to public as *prasad*. For e.g. it is believed Lord *Ganesha*, who is worshiped first on all Hindu religious occasions, is fond of *ladoos* (made by frying a batter of gram flour in *ghee* in small pearl-size drops and then mixing with sugar syrup, this mixture is given a round shape) (Gulati and Misra 2014). These indicate the importance of sugar and milk and milk products not only as food items but also as intrinsic to the Indian way of life. While sugar is of considerable cultural and hedonic relevance in India, nutritionally it provides only "empty" calories (1 g of sugar gives 4 kcal).

The consensus dietary guidelines for Indians in 2011 recommend less than 10% of total calories

Table 1 : Common ingredients used to prepare sweets in India

Milk based	Milk, *khoa, chhanna*, cream, butter, *ghee* etc.
Cereals	Grits and flour of wheat, rice, barley etc.
Pulses	Green gram, bengal gram, black gram etc.
Spices	Cardamom, saffron, coriander etc.
Others	Various fruits, vegetables, nuts, flavours, colors, essences, fragrances etc.

Table 2 : Some traditional Indian sweets and dairy products fondly consumed in India

Traditional Dairy Products	
Heat-acid coagulated products	***Heat-dessicated milk-based products***
Paneer	*Khoa/mawa*
Chhana	*Gulab jamun*
Rasgulla	*Lalmohan*
Rasmalai	*Burfi*
Rajbhog	*Kalakand*
Khirmohan	*Milk Cake*
Sandesh	*Peda, Rabri*
Pantua	*Kulfi, Khurchan*
Chhana- murki	*Basundi, Kheer*
Chamcham	*Kalajamun*
Other Sweets	
Balushahi, Doda, Emarti, Gajar pak, Gunjhia, Halwa, Jalebi, Kheer kadam, Laddoo, Malpua, Mysore pak, Panjiri, Petha, Pinni, Soan papdi etc.	

Table 3 : Recommendations on sugar intake for Indians (Misra et al 2011)

1. Free sugars should be less than 10% of total calories/day, including all added sugars, honey, syrups, and fruit juices.
2. Alternatives to sweetened beverages can be water, skimmed buttermilk, tender coconut water, and low fat milk.
3. Indian sweets, puddings, ice creams, sweetened biscuits, cakes, pastries, and baked goods are high in added sugars and should be restricted.
4. Encourage reading of food labels to determine sugar content. Some of the names in the ingredients list for the presence of added sugars include brown sugar, corn syrup, dextrose, honey, malt syrup, sugar, molasses, and sucrose.

Table 4 : Some examples of nutritive and non- nutritive sweeteners

Nutritive / Caloric / Low Intensity Sweeteners
Sucrose, glucose, dextrose, honey, lactose, high fructose corn syrup, crystalline fructose, maltose, invert sugar, jaggery etc. (Provide calories and acted upon by microorganisms and enzyme causing dental caries and rise in blood glucose levels)
Non-nutritive / Low-calorie / High Intensity Sweeteners
Aspartame, alitame, neotame, saccharin, acesulphame-k, sucralose, stevioside, tagatose, sugar alcohols/ polyols (also termed as sugar replacers), isomalt, cyclamate etc. (Calorific value is lower and sweetness intensity is very high in some cases. They may not affect blood glucose levels)

from free sugars per day (Table 3) (Misra et al 2011). According to the Diabetes Atlas 2015 published by the International Diabetes Federation, 415 million adults have diabetes worldwide and by 2040 this count is expected to escalate to 642 million. India is home to the second largest number of adults and children living with diabetes in the world. Diabetes is rising alarmingly in India and caused one million deaths in 2015. It greatly increases the risk of heart disease and stroke. In fact, most people with diabetes die of some form of heart or blood vessel disease like coronary heart disease, which leads to heart attack, or high blood pressure and some other consequences. It is claimed that one of the reasons for the cardiovascular disorder is diabetes that affects cholesterol and triglyceride levels (Hore et al 2002).

Most of the people do not consider sugar as an ingredient to be avoided. However, a fairly large section of the population is compelled to restrict or eliminate sugar specially sweets consumption to control diabetes and obesity.Therefore substituting sugar and or fat with low-calorie substitutes in dairy foods especially traditional sweets and beverages may be an effective strategy for weight and diabetes management.

Challenges

An artificial/ non nutritive/ low-calorie sweetener is a food additive that duplicates the sweet effect of sugar in taste, but usually has less food energy; some also have very high sweetness intensity compared to sucrose. Table 4 gives a list of the various nutritive/caloric and non-nutritive or high potency sweeteners discussed worldwide. Table 5 compares various physicochemical properties of high intensity sweeteners permitted to be used in India.

In response to consumers concerns about the calorie content of sugar-sweetened beverages, food companies are able to prepare products with zero calorie high potency sweeteners and hence providing the sweetness of sugar with a non-calorie alternative ingredient. However, replacement of caloric sweeteners, e.g., sucrose, corn syrup, glucose with high potency sweetener generally introduces a number of difficult sensory and technical challenges (Kemp 2009). Food texture becomes especially important as customers look for food products containing reduced fat and calories but are not willing to accept lower eating quality.

In dairy beverages like flavoured milks and *lassi,* sensory challenges include reductions in mouthfeel and viscosity to water-like feel. The caloric sweeteners also contribute to beverage stabilization by thickening, binding, and film-forming. The viscosity of milk is a vital characteristic with regard to overall satisfaction. Whole milk has a creamy and heavy mouthfeel while low-fat milk usually has a lighter and watery consistency. These differences in texture are caused by the milk fat (Phillips et al 1995). To provide consumers with the same drinking experience as sugary beverages, it is necessary to add texture back to the formulation.

In confectionery products and traditional sweets, sugar does more than providing sweetness; it provides bulk, color by browning reactions, lowers water activity, binds moisture, acts as humectant (e.g. *burfi*) and binder (e.g. *laddoos, kalakand*) and modifies/ provides texture. Similarly fat gives a characteristic creamy and rich mouthfeel. High intensity sweeteners can't perform other physical functions of sugars except sweetness. Therefore, in the preparation of sugar free/ low-calorie sweets, the use of polyols or other polymeric bulking agents is necessary to obtain desirable texture and body (Chetana et al 2010). Reduction of fat and replacement of sugar adversely affect the consistency/viscosity and sensory attributes especially body and mouthfeel of milk based products necessitating the addition of texture modifier. Besides being used as a fat replacer and rheology modifier, inulin could be added as a functional ingredient due to its prebiotic and health promoting effects (Mittal 2009).

Table 5 : Comparison of various physicochemical properties of HIS sweeteners permitted in India (WHO 2007, George et al 2006)

Property	***Aspartame***	***Acesulfame-K***	***Saccharin***	***Steviol glycoside***	***Sucralose***
Chemical Nature	Methyl ester of a dipeptide	Derivative of oxathiazin	Derivative of oxathiazol	Diterpenoid glycoside	Chlorinated disaccharide
Sweetness intensity` (w.r.t. sucrose)	200 – 300	200	400 - 500	200-300	600 - 800
Stability	Unstable to Heat, Stable at low temperature	Heat Stable	Heat Stable (upto 80°C in aqueous medium)	Heat Stable	Heat Stable
pH (Max. Stability)	3.0 – 5.0	6.5 – 7.5	7.0 – 8.5	2.0-10.0	5.0 – 6.0
Solubility in water (20°C)	Very less 10g/l	Very Good 270g/l	Less (Na Saccharin: 100g/l)	Good	Very Good 283g/l
ADI (mg/kg body wt./day)	50	15	5	2	5
Aftertaste	Sweet	Little Bitter	Bitter, Metallic	Bitter, Cool Increases with concentration	Sweet
Specific Limitations	Poor Solubility; Instability; Aftertaste; Causes foaming	Unpleasant Aftertaste	Unpleasant Aftertaste	Persistent Aftertaste	Lingering Aftertaste

Saccharin and acesulfame-K have a metallic aftertaste and thin mouthfeel. Although sucralose imparts sugar-like sweet taste but some lingering sweet aftertaste is reported by Mittal and Bajwa (2012). Aspartame is unstable around neutral pH and slow to dissolve in cold water. Loss of aspartame was found less in *lassi* compared to flavoured dairy drinks, while losses were higher at 25°C than 8°C (Kumar 2000). However, Gawande et al (2015) reported that aspartame did not degrade in *kalakand* during seven days storage at 6-8°C establishing its stability in such products. No commercial natural low-calorie sweetener has the potential to match the sensory delivery of sucrose. Stevioside and thaumatin exhibit a delay in elating sweetness

and deliver menthol cooling aftertaste (Hore et al 2002).

The level of sweetness is one major factor to be considered while using sweeteners. Food formulators keep searching for an ideal level of sweetness in food and beverage products. Some other vital considerations while working with sweeteners and sweetener combinations are: (i) texture of the food, (ii) impact on the appearance of finished product, (iii) aftertaste, (iv) flavor enhancement or masking capabilities, (v) levels of cooling, (vi) stability during storage and processing, (vii) ability to get brown (Maillard reaction, caramelization), (viii) the lessening or elimination of problems encountered in processing, and (ix) calorie or dietetic considerations (Pszczola 2003).

Opportunities

Milk is an ingredient that is consumed globally. The current interests, processing- and research-wise are the healthful and therapeutic aspects of milk and milk products. As per Food Safety and Standards (Food Products Standards and Food Additives) Regulations 2011 (part II), use of four artificial sweeteners aspartame, acesulfame-K, sucralose and saccharin has been allowed in sweets like *halwa, jalebi, khoya burfi, peda, gulab jamun* and other similar milk based sweets in India.

The technological limitations of some high-potency sweeteners can be decreased by blending them. While studying the effects of acesulfame-K, aspartame, sucralose, cyclamate, saccharin and neohesperidine-dihydrochalcone (Meyer and Riha 2002; Saelzer 2004) either singly or in combination on the flavour of various beverage systems, better results were obtained with blends than with individual sweeteners. Therefore, significant benefits can be obtained by customizing sweetener blends for use in beverages. A sweet taste enhancer or a flavor enhancer may improve the taste of other artificial sweeteners. Tannic acid with sucralose and D-tagatose with aspartame are useful to reduce the duration of their sweet aftertaste. Similarly, bitter aftertaste of stevioside can be suppressed by using erythritol or xylitol (Hore et al 2002).

Ghayal et al (2015) successfully formulated dietetic *rabri* by replacing sugar with aspartame. *Rabri*, a popular heat dessicated dairy dessert is otherwise high in fat and sugar. The milk fat thereof was partially replaced by inulin to improve consistency. 50% sugar was replaced with as low as 0.05% stevia extract powder by Giri et al (2014) for making dietetic *kulfi* which was at par with control in sensory quality. Development of low-calorie *gulab jamun* by Renuka et al (2010) indicated potential of fructo-oligosaccharides (FOS) as a low-calorie and healthier alternative for sucrose in preparation of Indian sweet meats.

Low-calorie sweeteners sorbitol and isomalt were used by Navneetha et al (2008) to prepare sugar-free *burfi* which possessed the same sweetness and other sensory attributes of control. Sorbitol was also used by Chetana et al (2010) with and without aspartame to develop *burfi* close to its sugar counterpart in sensory scores and texture. Similarly Arora et al (2007) used high-intensity low-calorie sweeteners saccharin, acesulfame-K, sucralose and aspartame to replace sucrose in the manufacture of *burfi*. Such *burfi* was found acceptable in various textural attributes in comparison to the control with sucrose.

In developing low-calorie milk drinks, Mittal and Bajwa (2012) substituted sugar and fat with sucralose and inulin respectively. It resulted in a substantial reduction in the calorific value of milk drinks. They reported that addition of inulin to the sugar substituted low-fat milk drinks improved viscosity and developed fat-like mouthfeel which otherwise sensed watery. Low-fat *lassi* and flavoured dairy drinks were also prepared by Kumar (2000) using aspartame and fat replacers. Some fruits like mango, papaya, banana, peach, etc are pulpy and have high consistency. This property could be exploited

to compensate for the loss of consistency and attaining the desired mouthfeel in sugar replaced and watery beverages along with drawing the benefits of certain health promoting ingredients like vitamins, fiber present in them. Taking this into consideration Bajwa and Mittal (2015) developed low-calorie functional milk drinks by incorporating mango pulp as a source of dietary fiber and sucralose as a sweetener.

Notification dated 23rd November 2015 published in the Gazette of India amending Food Safety and Standards (Food Products Standards and Food Additives) Regulations 2011 also allowed the use of steviol glycoside as per the prescribed limits to prepare a variety of products including yogurt, dairy-based drinks and desserts. Such changes in the food laws and enhanced interest in development 0f low sugar low fat dairy products open up a vast untapped market of low calorie food products including traditional dairy foods.

Conclusion

In view of alarming condition of diabetes and obesity, consumers are demanding a greater variety of low-calorie products as they strive to make healthier food choices. Replacing the sugar-loaded beverages, sweets and snacks with the healthier low calorie or low sugar or low-fat counterparts can be a good alternative. Five low-calorie sweeteners namely aspartame, acesulfame-K, saccharin, sucralose and steviol glycoside are permitted in India, each with an acceptable daily intake (ADI), for use in various foods. These low-calorie sweeteners can provide palatability and satisfy the desire of sweet taste without adding calories in the Indian diet. The dairy industry has radically adapted itself to the changing scenario. In pursuit of sugar replacement, the use of high-potency artificial sweeteners to develop low-calorie dairy products has a high potential.

Past decades have seen a surge in the development of some indigenous sweets like *burfi, kalakand, rabri, gulab jamun* and beverages like flavoured milk drinks, dairy drinks, *lassi* etc. using an array of sugar and fat replacers in the country. This field of low-calorie milk products development needs more investigations to combine the technology of unexplored traditional Indian sweets with low-calorie sweeteners and fat substitutes. Thereby reducing calories and satisfying our ever longing sweet tooth in a healthy way. Collaborative research to develop innovative ingredients and applications thereof are needed for making such traditional products readily available in the market providing a wide range to the dietetic and diabetic plate.

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References

1. *Arora S, Singh V P, Yarrakula S, Gawande H, Narendra K, Sharma V, Wadhwa B K, Tomer S K, Sharma G S 2007. Textural and microstructural properties of burfi made with various sweeteners. J Texture Studies 38: 684-697.*
2. *Bajwa U, Mittal S 2015. Quality characteristics of no added sugar ready to drink milk supplemented with mango pulp. J Food Sci Technol 52 (4): 2112-2120 (DOI 10.1007/s13197-013-1184-7).*
3. *Chetana R, Ravi R, Yella Reddy S 2010. Effect of processing variables on quality of milk burfi prepared with and without sugar. J Food Sci Technol 47 (1): 114-118.*
4. *Food Safety and Standards (Food Products Standards and Food Additives) (Amendment) Regulations, 2015, Notification dated 23rd November 2015 available online http://fssai.gov.in/Portals/0/Pdf/Gazette_Notification_Steviol.pdf (accessed on 27 February 2016).*
5. *Food Safety and Standards (Food Products Standards and Food Additives) Regulations*

2011 (part II) www.fssai.gov.in (accessed on 27 February 2016).

6. *Gawande H M, Arora S, Sharma V, Wadhwa B K 2015. Aspartame: safety and stability in kalakand. J Food Sci Technol 52 (4): 2373-2379.*
7. *George V, Arora S, Sharma V, Wadhwa B K, Sharma G S, Singh A K 2006. Sweetener blends and their applications – a review. Indian J Dairy Sci 59 (3) : 131-138.*
8. *Ghayal G, Jha A, Kumar A, Gautam A K, Rasane P 2015. Effect of modified atmospheric packaging on chemical and microbial changes in dietetic rabri during storage. J Food Sci Technol 52 (3): 1825-1829.*
9. *Giri A, Rao H G R, Ramesh V 2014. Effect of partial replacement of sugar with stevia on the quality of kulfi. J Food Sci Technol 51 (8): 1612-1618.*
10. *Gulati S, Misra A 2014. Sugar intake, obesity and diabetes in India. Nutrients 6: 5955-5974 (DOI:10.3390/nu6125955).*
11. *Hore S K, Ashish S, Korde J P, Patel M 2002. Present status of sugar-free sweeteners : A review. Indian J Nutr Dietet 39 : 410-419.*
12. *International Diabetes Federation Diabetes Atlas – 7th ed. 2015. www.diabetesatlas.org (accessed on 28 February 2016)*
13. *Kemp SE 2009. Developments in sweeteners for functional and speciality beverages. In: Paquin P (ed) Functional and speciality beverage technology. Woodhouse Publishing Ltd, New Delhi, pp 39-41*
14. *Kumar M 2000. Physico-chemical characteristics of low-calorie lassi and flavoured dairy drink using fat replacer and artificial sweeteners. M.Sc. thesis, NDRI (Deemed University), Karnal, India.*
15. *Meyer S, Riha W E 2002. Optimizing sweetener blends for low-calorie beverages. Food Technol 56 : 42-45.*
16. *Misra, A, Sharma R, Gulati S, Joshi S R, Sharma V, Ibrahim A, Joshi S, Laxmaiah A, Kurpad A, Raj R K 2011. Consensus dietary guidelines for healthy living and prevention of obesity, the metabolic syndrome, diabetes, and related disorders in Asian Indians. Diabetes Technol Ther 13: 683–694.*
17. *Mittal S 2009. Development of low calorie functional milk drinks. M. Sc. Thesis, Punjab Agricultural Univerisity, Ludhiana, India.*
18. *Mittal S, Bajwa U 2012. Effect of fat and sugar substitution on the quality characteristics of low calorie milk drinks. J Food Sci Technol 49 (6): 704-12 (DOI 10.1007/s13197-010-0216-9)*
19. *Navaneetha R, Roopa K S, Natarajan A M 2008. Quality of khoa-burfi prepared using different low calorie artificial sweeteners. Indian Food Ind 27: 41-52*
20. *Phillips L G, McGiff M L, Barbano D M, Lawless H T 1995. The influence of fat on the sensory properties, viscosity and colour of low fat milks. J Dairy Sci 78:1258-1266.*
21. *Pszczola DE 2003, Sweetener + Sweetener enhances the equation. Food Technol 57 (11): 48-61.*
22. *Renuka B, Prakash M, Prapulla S G 2010. Fructooligosaccharides based low calorie gulab jamun: studies on the texture, microstructure and sensory attributes. J Texture Studies 41 (4): 594-610.*
23. *Saelzer K 2004. New customized sweetening systems for tea and coffee. Innovations Food Technol 22 : 38-39.*
24. *WHO Technical report series – Steviol glycosides (CTA) 2007. 69th report of the Joint FAO/WHO Expert Committee on Food Additives, Geneva, Switzerland*

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Development of Soy Fortified Traditional Snacks

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Abstract

Soy foods have long been important in Asian diets, where they are valued for their nutrient content and culinary versatility. For health conscious Indians, soy foods are among the variety of healthful options for meeting protein needs. Soy foods are reported to have lower risk of coronary heart diseases, osteoporosis, certain cancers & help alleviate menopausal symptoms. Four products viz. Multigrain soy bar, Soy vermicelli, Soy phirni & Guava soy bar were developed to prototype form and studied for their sensory acceptability and shelf-life study. These products could be easily formulated using locally available raw materials at a reasonable cost and the good organoleptic characteristics combined with high protein make these products suitable for common man &especially for school children, adolescents, pregnant & lactating females. These products are value added, rich in nutrients and are accepted easily by the common people. Moreover, these products can help alleviating malnutrition and in improving the nutritional status of millions of impoverished undernourished kinds.

Keywords : Defatted soy flour (DSF), fortification, malnutrition, soy foods, shelf-life.

Introduction

Increasing awareness of consumer health & interest in value added foods to achieve a healthy lifestyle has resulted in the need for food products with versatile health benefits properties. Soy foods are good source of high quality protein, vitamins (folate) & minerals (Das *et al* 2012) In addition they provide variety of phytochemicals conferring health benefits. Soybeans are specially rich in isoflavones, a health promoting phytochemicals (Awasthi *et al* 2011). It is essential that science and traditional knowledge should go together to find mutually beneficial results. With this objective four soy based products viz. multigrain soybar, soy vermicelli, soy firini and guava soy bar were developed to prototype form, their formulation standardized and are tested for their sensory characteristics and shelf life study. These products possess the benefit of soy and can be used to enhance nutrition to school children (Mishra et al 2013; Bisla et al 2012).

The composition of white flour (Maida) and Defatted soy flour (DSF) are given at Table 1.

Methodology

The present work involves fortification of various traditional Indian products with soy to improve their nutritive value by developing economic and convenient techniques. The work includes fortification of traditional products with soy flour and soy milk. The selected traditional products are vermicelli, multi grain bar, guava bar and frozen dessert (phirni). The products are selected for fortification because of their popularity and use in the Indian market (especially for children) and ease of fortification. Following methodology was used :

1. ***Procurement of raw material*** : The raw material for the products selected were procured from local market and were analysed for their quality and suitability for the product development.

2. ***Method of Preparation*** : The recipe of each product was standardized using traditional standard method by altering one ingredient at a time using laboratory taste panels adopting five point hedonic scale as a helping tool. The standardized methodology of various selected products are given below :

   Multigrain Soy Bar : Wheat flour, DSF, puffed rice & peanuts were mixed after being roasted respectively. The mixture was added with 65° brix syrup, liquid glucose, hydrogenated fat & dark chocolate as per the recipe. The mixture was thoroughly blended & spread on tray in uniform layer. The product was baked at 160-170° for 15 min followed by cooling, cutting & packaging.

   Guava Soy bar: Guavas were washed, peeled & diced into small pieces. These were pulped by steaming & mixed with DSF & water as per the recipe. After it is cooked to half the volume, sugar, SMP,liquid glucose and butter were added. The mix was cooked till 80° brix & spread on trays (1 cm thick). The product was cut into bar, cooled & packaged.

   Soy Phirini : Soaked rice were ground coarsely, mixed with & cooked till thick consistency. The mix was added with sugar and cardamom powder. The product was cooked to dissolve sugar & to bring a thick consistency of phirini. The prepared phirni is packaged in earthern ware pot/bowl, covered with cling wrap & cooled. Soy milk was prepared using method described by Bisla et al (2012).

   Soy Vermicelli : White flour, DSF & semolina were mixed to make tight dough which after resting time of 10 minutes was extruded to form vermicelli. The extruded vermicelli were dried at 60°C for 20 min. the product was cooled & packaged in high density polypropylene packaging.

Table 1 : Composition of White Flour (Maida) and Defatted Soy Flour (DSF)

Constituents	*White Flour*	*DSF*
Moisture %	10.26	5.74
Protein %	8.8	56.0
Crude Fat %	0.91	0.68
Ash %	0.42	7.12
Crude fiber %	0.27	3.20
Carbohydrates %	79.34	27.30
Pigments (ppm)	2.87	13.58
Gluten %	8.2	nil
Calcium mg/100g	26.96	339.02
Phosphorus mg/100g	139.42	625
Iron mg/100g	3.05	43.48
Reducing Sugars %	0.80	1.37
Non reducing sugars %	1.57	2.85

***Source** : Singh, R. et al (1991)*

3. ***Chemical Analysis*** : The developed products were analysed for moisture, protein, fat and ash content as per the methods described by AOAC (1984).

4. ***Sensory Analysis*** : All the products except phirni were packaged in high density polypropylene (HDPP) sachet & were stored at 20 degree celcius for the shelf-life study. Phirini was packed in traditional earthern pots and was kept under refrigeration. These products were analysed for changes in their organoleptic characteristics (appearance, colour, texture, taste, aroma & Overall acceptability) by the laboratory taste panels using 5 point hedonic scale & also for

changes in critical chemical parameters at regular interval.

Results & Discussion

Results of the present study showed that the Indian traditional foods under study could be successfully fortified with defatted soy flour or soy milk to increase their nutritive value in terms of quality proteins, minerals, vitamins & phytochemicals without altering their sensory aspects and acceptability. These soy enriched traditional foods could be prepared easily and could be used as mid-day meal for children and for local community as they possess good sensory appeal and nutritive value. These soy enriched foods can prove to be the brahmastra, being within the easy access to the common masses & by alleviating malnutrition within their economic limits (Mishra *et al.*,2013).

The proximate analysis of developed soy products are depicted in Table 2. Addition of DSF to the recipes has increased the protein and ash content of all the products. Similar results were found & reported by Awasthi et al (2012) & Chauhan & Santosh Kumari (1990) However the initial moisture content of products was high due to high water binding capacity of DSF in the recipe.

Sensory analysis of soy enriched products depicted in Table 3 revealed that defatted soy flour (DSF) could be successfully incorporated in these recipes except soy phirni at a level of 10-15% without altering any sensory attribute. In case of soy phirini, soy milk could be added to the level of 50 % giving the product a good flavour and consistency. Similar results were obtained by Saxena *et al.* (2011).

Results of sensory evaluation confirmed that except for phirni which had a shelf life of one week under refrigeration, all other products could be stored for more than 6 months satisfactorily. However, the shelf-life of these dry products could be further increased by packaging them under vacuum packaging.

Conclusion

It is therefore concluded that the developed products belonging to the category of

Table 2 : Proximate Composition of Soy Fortified Food

Parameter	*Moisture content (%)*	*Protein content (%)*	*Fat content (%)*	*Ash content (%)*
Multi Grain Soy Bar	15.35	4.46	1.45	1.46
Guava Soy Bar	13.6	3.23	4.01	0.92
Soy Vermicilli	6.2	10.80	0.82	1.36
Soy Phirni	45.8	7.3	6.02	0.96

Table 3 : Sensory Attributes of Soy fortified foods.

Product/Parameter	*Appearance*	*Colour*	*Texture*	*Flavour*	*OAA**
Multi Grain Soy Bar	4	5	4	4	4
Guava Soy Bar	4	4	4	4	4
Soy Vermicelli	5	5	5	5	5
Soy Phirni	5	5	4	5	4

** OAA — Overall Acceptability*

convenience foods possess following key features :

1. Protein rich cereal bar prepared from DSF, wheat flour, puffed rice and peanuts is a ready to eat crunchy snack, has an attractive chocolate brown colour with high protein content. The product, though a delight for children, is liked by all age group people.

2. Guava soy bar is a new flavoured bar prepared from fruit pulp and DSF rich in vitamin C and proteins, respectively. The product is a ready-to-use snack, utilizing excess of perishable guavas and thereby, increasing the percentage of processed products.

   The product carries good sensory appeal and is a delight for all age group people.

3. Vermicelli is a popular and convenient, ready to cook food item, falling under category of extruded product. The product was prepared with an objective to produce nutritive (protein and mineral rich) and palatable product preferred by children. Nutritive value of Soy vermicelli was increased by using composite flour (wheat flour,defatted soy flour, semolina) in definite proportion. Addition of defatted soy flour (DSF) at 20% has increased the protein content without affecting the sensory and textural attributes.

4. Soy Phirni is a nutritious, palatable frozen dessert, prepared by blending soy and tonned buffalo milk in a particular ratio and cooking with rice and sugar to a thick consistency.

   The product had good sensory appeal and better nutritive value due to soymilk. The product keeps best packed in earthern pot with cling wrap over it and stored under refrigeration.

References

1. *AOAC, Association of Official Analytical Chemists (1984). Official Methods of Analysis. (14th edn), Washington, DC.*
2. *Cereal based functional food of Indian subcontinent: a review, Arpita Das & Utpal Ray chaudhuri & Runu Chakraborty, J Food Sci Technol (Nov.-Dec 2012) 49 (6):665–672.*
3. *Development and evaluation of soy fortified biscuits. Singh, R. 1991. Ph.D Thesis submitted to G. B. Pant University of Agriculture & Technology, Pantnagar.*
4. *Development of Banana-soy Sesame Based Weaning Food for Malnourished Children, Atul Anand Mishra, R.N. Shukla, Prakash Chandra Guggi and Sugandha Singh, International Journal of Agriculture and Food Science Technology. ISSN 2249-3050, Volume 4, Number 3 (2013), pp. 221-226.*
5. *Development of ice creams from Soybean milk & Watermelon seeds milk and Evaluation of their acceptability and Nourishing potential, Gita Bisla, Archana, Poornima Verma and Sheel Sharma, Advances in Applied Science Research, 2012, 3 (1):371-376, ISSN: 0976-8610.*
6. *Development of nutrient dense supplementary products for children by using locally available cereals, soy flour, bengal gram leaves and cow pea leaves Bisla G, Archana and Pareek S, Asian Journal of Plant Science and Research, 2012, 2 (4):396-402, ISSN : 2249-7412.*
7. *Development of soy fortified high protein and high calorie supplementary biscuits, Induja awasthi, Pornoor siraj, Maitrayee tripathi and Vandana tripathi, Indian J.Sci. Res 3(1): 51-58, 2012.*
8. *Evaluation of sensory acceptability and storage stability of frozen carrot based dessert, Tanushree Maity Saxena & P. S. Raju & A. S. Bawa, J Food Sci Technol, Dec 2011.*
9. *Evaluation of Wheat-defatted soy flour blends for chapatti making quality. Chauhan GS & Santosh Kumari. Beverage & Food World, 17: 40-42, 1990.*

To Compare the Efficiency of UV, Chlorination and RO Treatment given to Water

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Abstract

Water is one of the most prone commodities that gets contaminated and hence can be responsible for some of the water borne diseases in the living being. So it becomes important to make water safe for consumption. For making it safe it is important to know about the extent of contamination and microbial load in the water. By knowing the extent of contamination in water, we can decide the treatment to be given to it which make it safe and is also economical. The treatment that will be used should also not be having any side effect upon consumption of such water. Some of the treatments that are being given to water are chlorination treatment, reverse osmosis treatment, UV treatment, distillation, by activated carbon, ion exchange method, ozonation, copper zinc system, etc. One of the microbiologicalmethods to get an idea of load of microbes in water is MPN method (most probable number method). In this test we use BCP lactose broth and add water samples to this broth with different volumes (10 ml, 1ml and 0.1 ml) and incubate it at 35 degree for 48 hours. The acid and gas production can be seen in these tubes and the microbial load can be assessed.

Introduction

Water is one of the most essential component on earth. All plants and animals must have water to survive. If there was no water there would be no life on earth. With two thirds of the earth's surface covered by water and the human body consisting of 75 percent of it, it is evidently clear that water is one of the prime elements responsible for life on earth. Water circulates through the land just as it does through the human body, transporting, dissolving, and replenishing nutrients and organic matter, while carrying away waste material. Further in the body, it regulates the activities of fluids, tissues, cells, lymph, blood and glandular secretions.An average adult body contains 42 litres of water and with just a small loss of 2.7 litres he or she can suffer from dehydration, displaying symptoms of irritability, fatigue, nervousness, dizziness, weakness, headaches and consequently reach a state of pathology. Water has many uses in drinking, irrigation purposes and it is used as a cooking medium also. Disease-causing germs and chemicals can find their way into water supplies. When this happens the water becomes polluted or contaminated and when people drink it or come in contact with it in other ways they can become very sick.

Water is made safe for drinking purpose by treating it with chlorine, UV radiation and reverse osmosis technique.

Chlorination : Chlorine is used as a disinfectant. A leading advantage of chlorination is that it has proven effective against bacteria and viruses; however, it cannot inactivate all microbes. Some protozoan cysts are resistant to the effects of chlorine.

In cases where protozoan cysts are not a major concern, chlorination is a good disinfection method to use because it is inexpensive yet effective in disinfecting many other possibly

present contaminants. The chlorination process is also fairly easy to implement, when compared to other water treatment methods. It is an effective method in water emergency situations as it can eliminate an overload of pathogens relatively quickly. Chlorine gas, calcium hypochloride, sodium hypochloride are the species used.

Mode of Action — Chlorine inactivates a microorganism by damaging its cell membrane. Once the cell membrane is weakened, the chlorine can enter the cell and disrupt cell respiration and DNA activity (two processes that are necessary for cell survival).

The Process — Pre-chlorination is when chlorine is applied to the water almost immediately after it enters the treatment facility. In the pre-chlorination step, the chlorine is usually added directly to the raw water (the untreated water entering the treatment facility), or added in the flash mixer (a mixing machine that ensures quick, uniform dispersion of the chlorine. *Chlorination* may also be done as the final step in the treatment process, which is when it is usually done in most treatment plants. . Chlorinating filtered water is more economical because a lower CT value is required. This is a combination of the concentration (C) and contact time (T).

Residual chlorine is the remaining amount of chlorine in water after the utilization of chlorine in disinfection of water. It should be low in amount otherwise can cause many problems.

Reverse Osmosis : Reverse Osmosis, a water treatment method known for removing salt from seawater, is also used to purify drinking water by forcing untreated water molecules through a semi-permeable membrane or filter. The membrane blocks contaminants and the impurities are subsequently expelled from the environment. The result is pure, clean drinking water. The primary objective of pretreatment is to make the feed water to the RO compatible with the membrane. Pretreatment is required to increase the efficiency and life expectancy of the membrane elements by minimizing fouling, scaling and degradation of the membrane.

The Process — As the pure water passes to the saline water side, four things occur :

(1) the water on the saline side becomes less concentrated;

(2) the level of the solution on the saline side increases;

(3) the water on the fresh side becomes more concentrated; and

(4) the water level on the fresh water side decreases.

These occurrences result in increasing the chemical potential of the solution on the saline side of the membrane and decreasing the potential on the fresh water side. The flow of pure water from the fresh to the saline side will continue until a chemical potential equilibrium condition between the two sides is obtained . At this point, the flow of pure water stops. This is called "osmotic equilibrium". It follows that if the pressure on the saline side were now to be increased, the flow could be reversed. That is, flow across the membrane could be directed from the saline side to the fresh water side. This is called "reverse osmosis".

UV Treatment : Ultraviolet (UV) is a safe, clean, easy-to-maintain method of assuring that water is free of bacteria. UV Water Purification uses Ultraviolet light to kill micro-organisms that may be in the water. UV systems can destroy 99.99% of harmful microorganisms without adding chemicals or changing your water's taste or odour.

Advantages

1. Chemical free — provides purification without the addition of harmful chemicals.

Avoids the potential of generating harmful chemical disinfection by products.

2. Taste and odor free
3. More effective than chlorine.
4. Compact and easy to maintain.

The Process — UV-C rays (photons) penetrate microorganisms and becomes absorbed by the DNA of the pathogen in the water being treated. The DNA is altered in such a way that the pathogen cannot reproduce and is essentially killed and cannot cause infection. This process of DNA modification is called inactivation. *The degree of UV inactivation of pathogens is directly proportional to the UV dose applied to the water.*

Methodology

Preparation of Media

Dissolve the stated amount of the dehydrated medium in distilled water toobtain the double-strength or single-strength presumptive medium. Dispense the requisite volume into culture tubes containing an invertedDurham tube, and cap the culture tubes.Sterilize in an autoclave or pressure cooker at 115°C for 10 minutes (or inaccordance with the manufacturer's specifications). It is particularly important that media containing disaccharides, e.g. lactose, are not autoclaved athigher temperatures. The sterilized medium may be stored at room temperature (approx. 25°C) or, ideally, at 2-8°C. Media should in any case be warmed to room temperature before use to ensure that all components have dissolved. In addition, since several dyes are light-sensitive, the solution should be protected from exposure to light.

For Presumptive Test

Collect water sample from tap, Aqua guard and RO treated water.

Label 5 double-strength lactose broth tubes "10" and 5 single strength broth tubes "1" another 5 tubes "0.1".

Mix the water sample by thoroughly shaking.

Aseptically inoculate each "10" tubes (LB2X0 with 10-ml of water sample using 10 ml sterile pipette.

Using a 1-ml pipette, aseptically inoculate the five tubes (LB1X) with 1 ml of water sample. Using a 0.1-ml pipette, aseptically inoculate the five tubes (LB1X) with 0.1-ml of water sample. Incubate all the 15 inoculated tubes aerobically at 35°C for 48 hours.

For Confirmatory Test

Inoculate brilliant green lactose bile broth tubes with the inoculum from all the lactose broth positive presumptive tubes.

Incubate all the inoculated tubes at 35?c for 48 hours.

For Complete Test

Streak the two EMB agar plates from positive tubes with the sterile inoculating needle.

Result and Interpretation

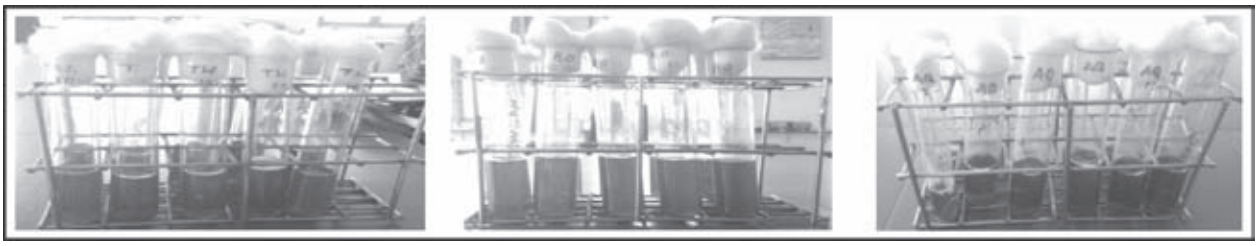
We tested water quality of three different samples (Tap water, RO water, Aqua guard water) by using MPN Technique to confirm the presence of coliform.

There was no gas and color production in all the tubes which were inoculated with three different samples of water.

So, it was confirmed that the test for coliform was negative.Therefore it indicates that there is no contamination with sewage water in all the three samples.

The treatments given are effective. Hence, we concluded these water samples are safe for consumption and are not associated with any water borne diseases.

Table 1 : Result of Presumptive Test for Chlorination, RO and UV treatment of Water



Sample	*0.1 ml*		*1 ml*		*10 ml*	
	Acid	*Gas*	*Acid*	*Gas*	*Acid*	*Gas*
Tap Water	Negative	Negative	Negative	Negative	Negative	Negative
	Negative	Negative	Negative	Negative	Negative	Negative
	Negative	Negative	Negative	Negative	Negative	Negative
	Negative	Negative	Negative	Negative	Negative	Negative
	Negative	Negative	Negative	Negative	Negative	Negative
RO Water	Negative	Negative	Negative	Negative	Negative	Negative
	Negative	Negative	Negative	Negative	Negative	Negative
	Negative	Negative	Negative	Negative	Negative	Negative
	Negative	Negative	Negative	Negative	Negative	Negative
	Negative	Negative	Negative	Negative	Negative	Negative
Aquaguard Water	Negative	Negative	Negative	Negative	Negative	Negative
	Negative	Negative	Negative	Negative	Negative	Negative
	Negative	Negative	Negative	Negative	Negative	Negative
	Negative	Negative	Negative	Negative	Negative	Negative
	Negative	Negative	Negative	Negative	Negative	Negative

References

1. *Aneja K R 2005. Water Microbiology, in Experiments in microbiology Plant Pathology and Biotechnology, New Age International (P) Ltd, Publishers, New Delhi.4th edition, pp 355-370.*
2. *Standard methods for the examination of Water and Wastewater, 13th Ed. New York. American Public Health Association, 1971*
3. *www.health.gov.au/internet/publications/publishing.nsf/Content/ohp-enhealth-manual-atsi-cnt-l~ohp-enhealth-manual-atsi-cnt-l-ch6~ohp-enhealth-manual-atsi-cnt-l-ch6.1*
4. *www.laleva.cc/environment/water.html*
5. *www.desware.net/Sample-Chapters/D05/00-019.pdf*
6. *www.water-research.net/index.php/water-treatment/tools/chlorination-o-water*
7. *www.cdc.gov/healhywater/drinking/public/chlorine-disinfection.html*
8. *www.fsis.usda.gov/wps/wcm/connect/8872ec11-d6a3-4fcf-86df-4d87e57780f5/MLG-Appendix-2.pdf?MOD=AJPERES*

To Investigate Microbiological and Nutritional profile of Traditional Indian Mattha

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Abstract

Mattha (chaanch) is a traditional fermented diluted drink most commonly consumed in different regions of India. Research was conducted on fermented dairy products such as curd as a source of beneficial microorganisms (probiotics).Therefore the present scientific investigation envisaged to study the microbiological and nutritional profile of traditional fermented drink by studying the prevalence and biochemical characterization of probiotic species and nutrient analysis of the fermented drink. Process of curd setting was standardized and Mattha was prepared by diluting curd with potable water in a 40:60 ratio (curd: water). Inoculum for curd setting, water used for dilution purpose and pasteurized skim milk used for curd setting were analyzed for chemical and microbiological quality. Fresh Mattha prepared was kept for fermentation and small amount of this fresh batch was used as inoculum to set curd for next day. Next day the curd set was again diluted and kept for fermentation. Till 7 days Mattha was prepared and fermented by adding to previous day batch. Final product was obtained with a sharp acidic flavour. The sensory characteristic of product was evaluated by 15 panelists and had a good overall acceptability of 80%. Microbiota of inoculum, curd and Mattha till 7 days of fermentation was identified. Probiotic species found in fermented mattha were Lactobacillus fermentum, Lactobacillus rhamnosus, Lactobacillus fermentum, and Lactobacillus helveticus, on first day, 2nd day, 3rd day and 4th & 5th day respectively in the probiotic range of 10^6-10^8 log cfu/ml. Non probiotic species identified on 6th and 7th day were Corynebacterium species and Bacillus species respectively. Probiotic species found in inoculum and fresh curd set were Lactobacillus helveticus and Lactobacillus rhamnosus respectively.

Keywords : Mattha, probiotics, biochemical characterization, inoculum

Introduction

The health potential of food has been linked to nutritionally rich diet, making consumers more concerned about impact of diet on health in totality instead of individual components. As rightly said by Hippocrates 'LET food be thy medicine and medicine be thy food', is certainly the tenet of today. With the growing interest in self-care and integrative medicine coupled with our health-embracing baby boomer population, recognition of the link between diet and health has never been stronger. The growing consumer demands for the convenient healthy diet and increased preference for natural ingredients has led to a growth in functional beverage/food. As a result, the market for functional foods or foods that promote health beyond providing basic nutrition, is flourishing with the rapidly expanding arena of probiotics that beneficially affect an individual by improving intestinal microbial balance (Boby and Suvarna, 2005).

Milk, a wholesome food provided by nature to the mankind with all essential nutrients in it has an emotional and cultural importance in the society and forms an important constituent of balanced diet for human beings with well documented health benefits. The first recorded probiotic was fermented milk for human

consumption. After that, probiotics became popular with animal nutrition. The role of fermented milk in human diet was known even in Vedic times. But, the scientific interest in this area boosted after the publication of the book entitled *The Prolongation of Life* by *Ellie Metchnikoff* in 1908. He suggested that people should consume fermented milk containing lactobacilli to prolong their lives as evident in Bulgarian peasants who were subjected to the experiments on longevity and had consumed large quantities of sour milk. The pathological reaction might be removed and life expectancy could be enhanced by implanting lactic acid bacteria from Bulgarian yogurt. Since then, researchers started investigations relating to the role of lactic acid bacteria in human and animal health (Boby and Suvarna, 2005). In Indian conventional diet, also fermented milk products such as Dahi, Chaanch/Mattha is consumed since Vedic times as health benefits of these conventional products are well known. But very few scientific studies have been conducted to establish their probiotic nature.

According to WHO, Probiotics are live microorganisms, which when administered in adequate amounts confer a health benefit on the host. Probiotic microorganisms are found in many food products especially in the fermented foods. Therefore lactic acid bacteria and other probiotic microorganisms can be isolated from fermented dairy products such as Dahi, Mattha etc. In view of the above facts, the present scientific investigation envisaged to study microbiological and nutrient profile of Chaanch/ Mattha (spiced or plain butter milk), an Indian traditional fermented milk beverage, consumed in Haryana and UP as a digestive drink after feast.

The objective of this research is to isolate and identify the microbiological strains in the fermented drink and assessing the probiotic nature by biochemical characterization and nutritional profile by analyzing vitamin content.

Materials and Methodology

Materials : Traditional Mattha was prepared at lab scale following the traditional practice of Haryana and UP. Inoculum for curd setting was collected from different sources such as Local market, confectionery shop, and traditional source i.e. from Haryana where the above traditional practice is followed. Skim milk used for curd setting was procured from mother dairy outlet. All the equipments used such as utensils used for Mattha preparation and earthen pot used for curd setting was cleaned with MCD water. Bottles used for storage of Mattha were sterilized in autoclave at 121°C at 15psi. All other reagents were of analytical grade.

Mattha Preparation : Skim milk was boiled to 100°C and then cooled to 40-50°C and inoculum was added to the hot milk which was then kept overnight for curd setting. Problems in curd setting were observed due to evaporative cooling in earthen pot. To overcome this problem, earthen pot was covered with cloth or cotton to provide insulation and hence facilitate the curd setting. With frequent trials setting period was found to be 9-10 hours. Curd set was then diluted with water in 40:60 ratios (inoculum: water as per Codex Alimenterius Commission/WHO, 2011). Small amount of this fresh Mattha was then used as inoculum to set the curd for next day which was then again diluted, and this fresh Mattha was then added to the previous day stock and kept for fermentation and in this way drink was fermented till 7 days. This final product was then stored in refrigerator in air tight sterilized bottles for microbiological, chemical and nutrient analysis.

Chemical and microbiological analysis : The pH and Titrable acidity were determined according to AOAC methods (AOAC, 1984). Microbiological counts were determined according to the procedure given in IS: 5402-2002, IS: 5402(part I)-2012 for total plate count, IS: 5401(part I)-2002 for coliforms count, IS: 5403-1999 for yeast and mould count, IS: 12899-

2005 for Lactic Acid Bacteria, and IS: 1622-1981 for coliforms detection in water. Biochemical tests were carried out by picking up the representative colonies and classified by gram staining. MRS agar, potato dextrose agar, violet red bile agar, and plate count agar were procured from Hi-media laboratories.

Methodology : Bacterial colonies were enumerated using colony count method followed by sub culturing to get pure colonies. Further Genus identification was done by gram staining and biochemical confirmation by catalase test. Bergey's Manual of Determinative Bacteriology (1974) was followed for non-probiotic genus identification. Species identification for probiotic genera was done by determining the sugar fermentation profile of isolates (Holt et al, 2004). Nutrient estimation (Vitamin B_3, Vitamin B_6, and Vitamin B_{12}) was carried out by standardized HPLC methods (Hudson et al, 1984). Sensory evaluation of fermented Mattha was done by 15 M.Sc. (Food & Nutrition) students as panelists using 5 pointer hedonic scale given by Larmond, 1974.

Results and Discussions

Raw Material Analysis : Water used to prepare Mattha was found to be of acceptable microbiological quality in accordance with IS: 10500-2012. Inoculum procured from different sources were tested for microbiological quality and as per the standard methods, inoculum procured from Haryana was found to be within probiotic range (Table 2) as stated by Shah,2000 and ICMR guidelines, 2011 while for inoculum procured from local market and confectionary shop Lactic Acid Bacteria (LAB) count was not detectable.

Therefore inoculum from Haryana household was used for further Mattha preparation. Pasteurized skim milk procured from mother dairy outlet for curd setting was found to be of acceptable microbiological quality as per standards. Fresh curd set using skim milk had LAB count within the range of probiotic dose and was found to be of acceptable microbiological quality in accordance with standards (Table 2).

Chemical Analysis: Table 1 shows that pH decreased from 4.49 on Ist day to 4.09 on 7th day and titrable acidity increases from 0.45% on 1st day to 0.774% on 7th day. However marginal decrease in titrable acidity was observed on 4th and 6th day with simultaneous increase in pH.

Table 1 : Chemical analysis of Inoculum, fresh curd and Mattha

Sample	*pH*	*Titrable acidity (% lactic acid)*
Inoculum	3.99	1.314
Fresh curd	4.11	1.143
Fresh Mattha (1st day)	4.49	0.45
2nd day Mattha	4.09	0.648
3rd day Mattha	3.95	0.855
4th day Mattha	4.05	0.756
5th day Mattha	4.01	0.765
6th day Mattha	4.08	0.729
7th day Mattha	4.02	0.774

Microbiological Analysis : From the table 2, it can be seen that for mattha the total plate count was increasing and coliforms count was not-detectable throught the period indicating good hygiene practices were followed and maintained throught the process.

Yeast and mold count was not-detectable on Ist day but then it starts increasing day by day. With increase in yeast and mold count and decrease in pH, favorable for Yeast and mold growth and strive for nutrients LAB count starts diminishing and loses its viability at low pH as reported in the literature. Similar results were reported by Yoon et al, 2006 where, Lactobacillus casei was

Table 2 : Microbiological Analysis of Inoculum, fresh curd and Mattha

Sample	*Total plate count (log cfu/ml)*	*Coliforms count (log cfu/ml)*	*Yeast and mold count (log cfu/ml)*	*Lactic acid bacteria count (log cfu/ml)*
Inoculum (Haryana)	6.1×10^5	ND	8.18×10^2	1.25×10^6
Fresh Curd	5.85×10^5	ND	ND	8.7×10^6
Fresh Mattha (1st day)	2.8×10^5	ND	ND	3.2×10^7
2nd day Mattha	1.5×10^6	ND	2.32×10^2	3.45×10^6
3rd day Mattha	2.83×10^6	ND	5.18×10^4	4.4×10^6
4th day Mattha	5.5×10^6	ND	8.63×10^5	5.5×10^6
5th day Mattha	7.5×10^6	ND	7.8×10^6	1.87×10^6
6th day Mattha	1.19×10^7	ND	1.29×10^7	1.67×10^7
7th day Mattha	7.0×10^7	ND	1.42×10^7	1.43×10^7

** average of three determinations; ND : Not-Detectable*

unable to survive the low pH and high acidity conditions in fermented cabbage juice at 4°C and loss the viability completely after 2 weeks of cold storage.

Biochemical characterization of isolated lactobacillus species was done by comparing sugar fermentation patterns of isolated species with those given for Lactobacillus species in the Bergey's Manual of Determinative Bacteriology (Holt et al, 2004) as given in Table 3. Non probiotic species identified on 6th and 7th day were Corynebacterium spp. and Bacillus spp. respectively.

Table 3 : Sugar fermentation pattern of Lactobacilli isolated from curd and Mattha samples

Isolates	*Fermentable sugars*										*Organism*
	A	*C*	*F*	*L*	*M*	*Mn*	*Mo*	*Rf*	*Sr*	*Su*	
Inoculum	-	-	+	+	+	-	-	-	-	+	Lb.helveticus
Fresh curd	-	-	+	+	+	+	+	+	-	+	Lb.rhamnosus
Fresh Mattha (1st day)	V	V	+	+	+	+	-	+	-	+	Lb.fermentum
2nd day Mattha	-	V	+	+	+	+	+	+	-	+	Lb.rhamnosus
3rd day Mattha	-	-	+	+	+	+	-	+	-	+	Lb.fermentum
4th day Mattha	-	-	+	+	-	-	+	-	-	+	Lb.helveticus
5th day Mattha	-	-	+	+	-	-	+	-	-	+	Lb.helveticus

A=Arabinose; C=Cellulose; F=Fructose; L=Lactose; M=Maltose; Mn=Mannitol; Mo=Mannose; Rf=Raffinose; Sr=Sorbitol; Su=Sucrose; (+) = able to ferment; (-) = not able to ferment; v: variable fermentation; Lb. = Lactobacillus

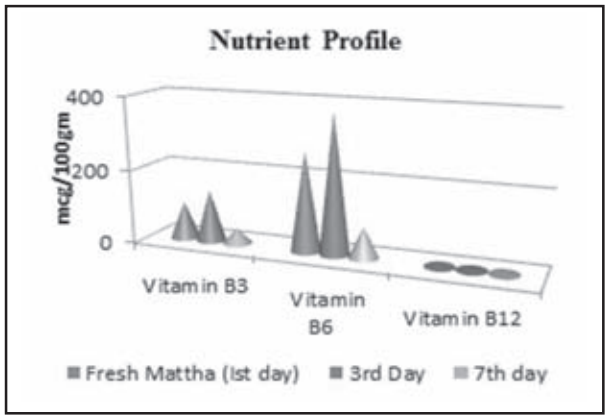
Sensory Evaluation : The overall acceptability of the product tested by 15 Panelists for appearance, color, flavour, aroma and consistency using 5 point hedonic scale was found to be 80%.

Nutrient analysis : From table 4 and graph given below in Figure 1 it can be seen there was an increase in nutrient content after 3 days of fermentation due to metabolic activity of LAB as reported in Literature (Hugenholtz, 2007) but on further fermentation after 7 day the content has decreased drastically which can be due to growth of other non-probiotic species which may have utilized these nutrients for their growth.

Table 4 : Nutrient Profile of Mattha

Sample	*Vitamin B_3 mcg/100gm*	*Vitamin B_6 mcg/100gm*	*Vitamin B_{12} mcg/100gm*
Fresh Mattha	99.04	269.78	1.65
3rd Day	138.66	375.70	2.15
7th day	41.170	82.56	0.987

Figure 1 : Nutrient profile of mattha



Summary and Conclusion : So above findings shows that probiotic species found in fermented mattha were Lactobacillus fermentum, Lactobacillus rhamnosus, Lactobacillus fermentum and Lactobacillus helveticus, on first day, 2nd day, 3rd day and 4th & 5th day respectively. Non probiotic species identified on 6th and 7th day were Corynebacterium spp. and Bacillus spp. respectively. Thus it can be concluded that in order to have health benefits in terms of nutrient content mattha should be fermented for maximum 5 days unlike traditional practice of 7 days, as probiotic species were found till 5th day after that non probiotic or pathogenic microrganisms start growing and hence suppress the nutrient value by utilising the nutrients. Thus furthermore human studies can be carried out to establish the scientific fact to prove this traditional drink a health benefit drink and different strains of microorganisms growing can be identified.

References

1. *AOAC 1984. Official Methods of Analysis. 13th edition, Association of Official Analytical Chemists (edited by William S.), 276-319.*
2. *Bergey DH, Buchanan RE and Gibbens NE 1974. Bergey's manual of determinative bacteriology. 8th ed. Williams and Wilkins Co., Baltimore, 576-593.*
3. *Boby U.V and Suvarna U.V 2005. Probiotics in human health: A current assessment. Current Science, Volume. 88, NO. 11, 10 June.*
4. *FAO/WHO; Rome, 2011. Codex Alimenterius Commission: Milk and Milk Products (second edition).*
5. *Food safety and standard authority of India 2006, 3rd edition. Commercial law publisher (INDIA pvt. Ltd.) New Delhi, 483-484.*
6. *Hudson T.S, Subramanian S, Allen R.J 1984. Determination of pantothenic acid, biotin and vitamin B12 in nutritional products. J. Assoc.Off. Anal. Chemists, 67: 994-698.*
7. *Hugenholtz J 2008. The lactic acid bacterium as a cell factory for food ingredient production. International Dairy Journal, 18:466–475.*
8. *ICMR guidelines for evaluation of Probiotics in Food, 2011.*
9. *Indian Standards. Methods of sampling and microbiological examination of water 1981.*

Bureau of Indian Standards, New Delhi. IS: 1622.

10. *Indian Standards. Method for yeast and mould count of foodstuffs and animal feds 1999. Bureau of Indian Standards, New Delhi. IS: 5403.*
11. *Indian Standards. General guidance for the enumeration of coliforms 2002. Bureau of Indian Standards, New Delhi. IS: 5401 (part 1).*
12. *Indian Standards. General guidance for the enumeration of microorganism-colony count technique at 300 C 2002. Bureau of Indian Standards, New Delhi. IS: 5402.*
13. *Indian Standards. Dairy Products -Yoghurt, Enumeration of Specific Lactic Acid Bacteria-Method of Test 1989 (R2005). Bureau of Indian Standards, New Delhi. IS: 12899.*
14. *Indian Standards. Drinking water specifications 2012. Bureau of Indian Standards, New Delhi. IS: 10500.*
15. *J.G.Holt, N.R. Kreig, P.H.A. Sneath et al. 2004. Bergey's Manual of Determinative Bacteriology.*
16. *Kyung Young Yoon, Edward E. Woodams, Yong D 2006. Hang Production of probiotic cabbage juice by lactic acid bacteria Bioresource Technology, (12) 97:1427–1430.*
17. *Shah NP. Symposium 2000. Probiotic bacteria: selective enumeration and survival in dairy foods. Journal of Dairy Science, 83:894-907.*

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Thermal Techniques for Minimal Processing of Foods

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Abstract

Minimally processed products have been defined as "any fruit or vegetable, or any combination thereof, which has been physically altered from its original form, but has remained in its fresh condition". The thermal treatments, non-thermal treatments, low temperature storage, applying new packaging techniques, and treatment with natural antimicrobials alone or in combination are commonly used for minimally processed foods. Conventional heat processing tends to reduce product quality and freshness, to some extent, as the price for extended shelf-life.The commonly used thermal minimal processing techniques in industry are microwave heating, ohmic heating, radio frequency heating and infrared heatingwhere electromagnetic radiations are used as a source of heat, whereas sous-vide processing include cooking in vacuumed plastic pouches at precisely controlled temperature. The objective of the review is to compile the principal, applications, merits and demerits of these techniques.

Keywords : Minimal processing, ohmic, infrared, radio frequency, microwave, sous-vide

Introduction

Fresh-cut fruits and vegetables are gaining popularity in the market as they fulfill modern consumers' demands ofhealthy, palatable and convenient to prepare plant foods.[1] Minimally processed foods can be kept safe with partial or minimal preservationtreatment.[13] A food needs to meet the nutritional requirements as well as should have acceptable quality attributes.[1] Moreover, consumers have become more critical of the use of synthetic additives to preserve foods or enhance characteristics such as color and flavor.[19] In this regard, minimal processing is seen to satisfy the producer as well as the consumer.

The aims of minimal processing are to make thefood safe chemically and microbiologically; to retain the desired flavor, color and texture of the food products and to provide convenience to the consumers.[13] Fruit and vegetable industry defines minimally processed products as "any fruit or vegetable, or anycombination thereof, which has been physically altered from its original form, but has remained in its fresh condition".[3]

Food industry is actively researching on processing of fruit and vegetable products that meets consumer's needs for 'quick' and convenient products and preserve their nutritional value, retain a natural and fresh color, flavor and texture, and contain fewer additives such as preservatives.[1]

The advantages of minimal processing are easy and quick preparation of meals; low severity of the processing methods; maintenance of quality as fresh or close to the fresh prepared meals or products and prevention of products' nutritive losses.[13] The thermal treatments, non-thermal treatments, low temperature storage, applying new packaging techniques, and treatment with

natural antimicrobials alone or in combination are commonly used for minimally processed foods.[13]

Thermal Methods

Ohmic Heating

Principle : In Ohmic heating, heat is internally generated by applying alternating electrical current throughthe electrodes at both ends of a food system which acts as a conductor of electricity and serves as an electrical resistance.[2][10] The heating rate is directly proportional to the square of the electric field strength, the electrical conductivity, and the type of food which is heated.[2] Ohmic heating becomes more effective at higher temperatures because the electrical conductivity increases with temperature.[16] The heating effect is influenced by themoisture content and concentration of ions in the food.[10] Ohmicheating is a high-temperature short-time method (HTST). In about 90 seconds, 80% solids food product can be heated from room temperature to 129°C.[2]

Applications : Ohmic heating can be applied to foods such as fruits and vegetables, juices, meats, seafood, soups, crèmes, and pasta dishes.[8] Various applications exist forohmic heating like blanching, evaporation, dehydration, fermentation, extraction, sterilization, pasteurization, heating of foods.[10] It can also be used for sterilization purposes to produce foods such as ready-prepared meals and high-acid foods such as tomato-based sauces which are high quality shelf-stable foods.[8]

Advantages : Food materials are heated volumetrically due to internal heat generation. Particulate temperatures similar or higher than that of liquid temperatures can be successfully achieved in ohmic heating.[2] As there are no hot surfaces for heat transfer, there is low risk of product damage due to burning resulting in minimal mechanical damage and better nutrient and vitamin retention.[11][2] 90% of the electrical energy is converted into heat and thus, energy efficiency is high. Ease of process control due to instant switch-on and shut-down. It is used successfully to produce quality viscous products and can be applied to foods containing various combinations of particulates.[2] Also, high temperatures can be achieved efficiently.[11]

Microwave Heating

Principle : Materials absorb microwave energy and heating occurs.[17] Microwave heating of food materials takes place because of dipolar and ionic operations. The dipolar molecules which are permanently polarized try to realign themselves in the direction of the electric field when an oscillating electric field is incident on the water molecules. The realignment causes internal friction of molecules due to high frequency electric field and results in the volumetric heating of the material.[17] The dielectric properties and penetration depth affect microwave heating.The penetration depth is decided by the dielectric constant and the loss factor of food.[19][11]

Applications : Microwave heating can be applied in various processing methods like pasteurization, sterilization, tempering, dehydration, blanching, and cooking.It can also be used in baking, coagulation, coating, gelatinization, puffing, and roasting.[8]

Microwave Blanching

Blanching is a major step in the processing of fruits and vegetables and is done before freezing, frying, drying and canning. The objective of blanching is to inactivate the enzymes that may cause color, flavor and textural changes and toassurereduction of the negative effects.[12]

Over conventional heating methods, microwave blanching is beneficial because of speed of operation, energy efficiency, precise process controls and quick start-up and shut-down times,

no additional water is required. Leaching of vitamins and other soluble nutrients is reduced.[12] Color, flavor and sensory characteristics of the product are enhanced.[9] The very high frequencies used in microwave heating are responsible for quick energy transfers and high heating rates.[12]

Microwave Pasteurization and Sterilization

Microwave heating is ideal for pasteurization and sterilization because process is fast and requires less come-up time to the desired temperature.[9] MW sterilization operates in the temperature range of 110-130°C. Pasteurization is a mild heat treatment which operates between 60°C and 82°C.[8] Mostly, milk and fresh fruit juices are pasteurized whereminimum processing is requiredto eliminate health-associated problems.[9]

Microwave Thawing and Tempering

The reversal of the freezing process is referred to as thawing.[12] In microwave tempering the temperature of the product is increased from storage temperature to a temperature just below freezing point.[9] Tempering comprises the initial phase of complete thawing.[12] The microwave tempering can be done for a large amount of frozen products in few minutes. The largest application of microwave heating of food is tempering of meat.[9]

Microwave Baking and Cooking

In MW heating there is a fast and uniform temperature rise in the product which results in quick inactivation of enzymes, prevent the starch from extensive digestion, and release sufficient carbon dioxide and steam to produce a uniform porous texture.[8] In microwave baking, sufficient brown color on the bread surface and crust formation is not possible. Also the food lacks crispness becausethe air surrounding the food product is cold and water which evaporates from food gets condensed on contact with cold air.[17] Thus, Microwaves in baking are used in combination with conventional baking; and the problems are avoided.[12] Sausage cooking is also one of the applications of microwave heating. It has been used for (pre)cooking of poultry, meat patties and bacon[12]. In sausage cooking through microwave heating drip loss of water, fat, nutrients, and flavor are reduced.[9] Another characteristic of this method is the valuable byproduct namely high quality rendered fat, which is used as food flavoring.[12]

Microwave Dehydration

Higher drying rates can be achieved as the problems of high heat transferand conduction resistances are countered by microwave energy. These high drying rates lead to lower shrinkage.[12] Maintenance of puffed character of the dried product and preservation of color, flavor, sensory attributes and nutritional value is the advantage of this process.[8][12] Microwave drying is faster and more energy-efficient in contrast with conventional drying.[8] The main cause for the use of microwaves in drying is the acceleration of the processes.[12]

Advantages : Over conventional heating techniques MW has various merits namely :[20]

- The time required for processing is less.[20]
- Larger pieces can be heated in a shorter time and with a more even temperature distribution.[12]
- The product is of betterquality because of uniform heating and retention of color and appearance as well as nutrients and vitamins are well preserved.[9][20]
- There is low cost in system maintenance.[9]

Disadvantages : In order to get good results, they need a high input of engineering intelligence, a lot of knowledge or experience and the need for electrical energy, which is its most expensive form.[12]

Infrared Heating

Principle : Infrared energy is a form of electromagnetic radiation which are emitted by hot objects.[5] When IR waves hit a material, the waves are absorbedand get converted into heat and the temperature of the material rises.[19] The rate of transfer of heat is influenced by the surface temperatures and properties of the heating and receiving material, the shapes of the emitting and the receiving bodies.[5]

Advantages and Applications : The heat transfer capacity is high and there is direct penetration of heat into the food, the process is fast and heating of surrounding air is avoided.[8] IR heating has gained popularity for rapid drying, baking and cooking of foods of even geometry.[19]

Sous Vide Processing

Principle : In this technology, food is processed by vacuum packaging in heat-stable, highbarrier or air-impermeable multi-laminate plastics.[8] The raw material is packed in multi-layer plastic under vacuum, and cooked in water, by air/steam mixtures at temperatures below 100°C, removing oxygen. It is then cooled rapidly to +3°C.[19] It is useful for foods with partially cooked ingredients which may be combined with raw foods and require low-temperature storage until it is heated prior to serving.[8]

Advantages : Sous-vide processing has the following merits :

- It requires no cooking in oils or fats and maximum amounts of vitamins and minerals are retained by preserving the natural taste.[6]
- Chances of post-processing contamination and problems due to oxygen are reduced.[19]
- Adds value to basic raw materials such as fish by producing chilled preparedmeals.
- Cutting food costs by reducing materials for enhancing flavors.
- Retention of moisture in packaging leads to lower weight loss.

Disadvantages :

- Capital costs of equipment for preparation, vacuum packing, pasteurization, chilling and storage is high.
- Risk of food poisoning is high if sous-vide packs are subjected to temperature abuse.[5]

Radio Frequency Heating

Principle : Radiofrequency (RF) heating is another form of dielectric heatingat frequencies between 1 and 300 MHz, which can be used for rapid heating of solid and semi-solid foods.[8] Electromagnetic energy is transmitted through the food which is placed between an electrode and the ground. The high frequency energyused, allows transfer of energy over air gaps and through non-conducting packaging materials.[19] RF heating is accomplished as a combination of dipole rotation and electric resistance heating which results from the movement of the dissolved ions.[15]

Applications : Various applications are blanching, thawing, drying, heating of bread/ baking, meat processing, pasteurization, and sterilization.[8]

Baking

In baking the moisture is removed, particularly at the end of the process when conventional heating is inefficient.[19] The most widely used applications of RF heatingis post baking of biscuits.[14] In a study, heated loaves of wrapped, sliced white bread and wrapped Boston bread for 20 to 59 seconds (reaching 52 to 66°C) in a 3 kW installation at frequencies ranging from 14 to 17 MHz, no mold growth was seen in samples heated to 60°C[15]. The same process can be used in cereal, pastry and bread products. [19]

Drying

RF drying is used for post-bake drying of cookies, crackers and pasta. RF heating can help even out the moisture distribution after baking.[18] RF drying applications in the food industry include the drying of food ingredients (e.g. herbs, spices, vegetables) and potato products.[19] In RF drying, where the heat is from within, there is no hot, dry outer layer. RF heating has great capacity to get the center hot enoughbecause of the even penetration of energy.[4]

Thawing and Tempering Frozen Foods

RF dielectric heating has been more commonly applied to thawing of frozen foods than to RF cooking and heating.[4] Thawing meat by RF decreases drip losses. There is minimal drip loss in case of seafood products.[7] The thawing time is less and the quality is better because of minimal discoloration and loss of flavor.[15]

Advantages : The advantages are as follows :

- RF can be easily applied to both solid and liquid foods.
- In RF the penetration power is more.[20]
- The use of RF heating for baking anddrying applications leads to improved moisture levelling and correspondingly higher quality final products.
- Shorter process lines and improved control.
- Improved energy efficiency.[19]

Disadvantages : Demerits of Radio frequency heating are :

- There are higher equipment and operating costs.[20]
- It is assumed that factors such as product dielectric properties, size, shape, position between the RF electrodes and the electrode configuration may lead to non-uniform heating of food.[14]
- The lack of in-depth information on area such as its impact on all aspects of product quality is another factor of concern.[14]

Conclusions

Minimal processing is gaining importance because of its ability to increase the shelf-life of foods without changing its fresh like qualities. It aims at making the food safe and brings convenience to the consumers. Thermal and non-thermal techniques are used to minimally process foods. Thermal technique include ohmic heating, microwave heating, infrared heating, radio frequency heating, sous-vide processing etc. The most common applications of thermal techniques are blanching, pasteurization, sterilization and dehydration. All the techniques have their own advantages and disadvantages. Ohmic heating is used to produce quality viscous products and high particulate temperature can be achieved successfully. In microwave heating, larger pieces can be heated in less time but it is expensive and requires skill. Infrared heating allows high heat transfer rates and the heating of surrounding air is avoided. In sous-vide processing cooking in oil or fats is not required and chances of oxidation are reduced but can cause food poisoning in case of temperature abuse of the pack. RF heating can be applied to both solid and liquid foods to produce quality final products but some factors may lead to non-uniform heating.

Food product is heated volumetrically by these techniques and does not give any kind of cooked or burnt flavor.Thus,minimal processing allows easy and quick meal preparation, maintains the fresh quality and prevents products' nutritive losses. But all these emerging technologies are not very popular at commercial level because of lack of consistent information on their impact on food, high cost of installation, maintenance and safety concerns. These minimal processing technologies faces challenges as they require much continued research and development before regulatory approval at industrial-scale

application. Researches are still continuing in this field for improvisations and overcoming challenges.

References

1. *Ana Allende, Francisco A. Tomás-Barberán, María I. Gil, Minimal Processing for Healthy Traditional Foods, Trends in Food Science & Technology 17, 2006, pg no. 513-519.*
2. *C.J.K Henry and C. Chapman ,The nutrition handbook for food processors, woodhead publishing in food science and technology, chapter 19, pg no. 407-409.*
3. *Ebenézer de Oliveira Silva, Maria do Socorro Rocha Bastos, NédioJair Wurlitzer, Zoraia de Jesus Barros, and Frank Mangan, Advances in Fruit Processing Technologies : Minimal Processing Fruits and Vegetables, Chapter 8, pg no. 217 and 218.*
4. *George B. Awuah, Hosahalli S. Ramaswamy, Juming Tang, Radio-Frequency Heating in Food Processing: Principles and Applications, CRC Press, Chapter 2, pg. no. 23-26.*
5. *Ghazala S. (ed.), Sous Vide and Cook Chill Processing for the Food Industry, Published in 1998, Manuscript version, Aspen Publishers Inc., Chapter 2, Pg no. 16-18.*
6. *Hosahalli S. Ramaswamy, Michele Marcotte, Food Processing: Principles and Applications, Pg no. 166.*
7. *http://www.foodtech-portal.eu/index.php?title =Special:Pdf Print & page= Thawing of food products by radio frequency*
8. *HudaaNeetoo and Haiqiang Chen, Alternative Food Processing Technologies.*
9. *Jasim Ahmed and Hosahalli S. Ramaswamy, Microwave Pasteurization and Sterilization of Foods, CRC press, second edition, Chapter 28.*
10. *J Prem Kumar, M. Ramanathan, T. V. Ranganathan, A Review.*
11. *K. Shiby Varghese, M. C. Pandey, K. Radhakrishna, and A. S. Bawa, Technology, applications and modelling of ohmic heating: a review, J Food Sci Technol. 2014 Oct.*
12. *Mohamed S. Shaheen, Khaled F. El-Massry, Ahmed H. El-Ghorab and Faqir M. Anjum, microwave application in thermal food processing, The Development and Application of Microwave Heating.*
13. *Mohammed Wasim Siddiqui, Mohammad Shafiur Rahman, Minimally Processed Foods: Technologies for Safety, Quality and Convenience , springer, food engineering series, pg no.2.*
14. *Philip Richardson, Thermal Technologies in Food Processing, woodhead publishing in food science and techology, pg no. 166 .*
15. *Punidadas Piyasena, Chantal Dussault, Tatiana Koutchma, H. S. Ramaswamy, and G. B. Awuah, Radio Frequency Heating of Foods: Principles, Applications and Related Properties — A Review, Food Research Program.*
16. *Sastry S. K., Ohmic Heating, Food Engineering, volume 3.*
17. *S. Chandrasekaran, S. Ramanathan and T. Basak, Microwave Food Processing –A Review, food research international 52(2013), pg no. 243-261.*
18. *Sona Jojo and R. Mahendran, Radio frequency heating and its application in food processing: a review, International Journal of Current Agricultural Research Vol. 1, No.9, PP. 042-046, September, 2013.*
19. *Thomas Ohlsson Nils Bengtsson, Minimal Processing Technologies in the Food Industry, woodhead publishing.*
20. *Vicente, A.A , Novel technologies for the thermal processing of foods.*

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Accuracy of Body Adiposity Index in estimating Adiposity among Adult Indian Women

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Abstract

There are various methods to assess body adiposity and determine obesity. These include either anthropometric indices or laboratory techniques. Body Mass Index (BMI) is widely used method to determine obesity. But BMI has one limitation that it does not measure the adiposity in the body accurately. To overcome this limitation, a new index has been developed namely, Body Adiposity Index (BAI). It is calculated as [((Hip Circumference) / (Height) 1.5) – 18]. However, the validity of this index under different conditions needs to be examined. The aim of the study was to examine the correlation between the BAI and Body Fat Percentage (BF%) in assessing obesity among adult Indian women aged between 25-45 years. The study also aimed to give approximate cut-off for this index. The data was collected on anthropometric measurements like height, weight, waist circumference, hip circumference, skinfold at triceps and body composition using Bioelectrical Impedance Analysis (BIA) method. The data was analyzed on 261 adult Indian women (25-45 years). Pearson's correlation coefficients were calculated between BAI, BMI and BF%. Receiver Operating Characteristic (ROC) curves were analyzed to determine optimal cut-offs for BAI. There was a significant correlation between BAI and BF% ($r = 0.765$, $p < 0.001$). The ROC curve analysis showed that at BMI ≥ 23 kg/m^2, the Area Under ROC curve (AUC) is more as compared to other criteria. BAI can be used as an anthropometric method to assess body adiposity and thereby determining obesity among adult Indian women (25-45 years). BAI is simple and non-invasive anthropometric technique that can be used to assess obesity. The compliance of the index under field setting is more as compared to other laboratory techniques used to determine BF%.

Keywords — Body Adiposity Index (BAI), Body Fat Percentage (BF%), adiposity, obesity

Introduction

The prevalence and incidence of obesity is rapidly blooming in the developing countries like India. Obesity is becoming one of the public health problems in India leading to dual burden of malnutrition (having both undernutrition and overnutrition). It is therefore, important to assess adiposity in order to accurately measure obesity. Obesity is defined as excess accumulation of fat which is a major risk factors for various diseases like cardiovascular diseases (CVD), type 2 diabetes mellitus (T2DM), hypertension and some cancers (WHO, 2000a; Kim et al., 2011).

There are various methods to assess body adiposity and determine obesity. These include either anthropometric indices or laboratory techniques. The anthropometric indices have benefit over laboratory techniques to estimate body fat percentage (BF%) as laboratory techniques are costly, require skilled professionals, include sophisticated equipments and impractical to use in field settings.

On the other hand, anthropometric indices require measurement of weight, height and body circumferences which are practically possible, inexpensive and easy to carry out in field setting (Cerquira et al., 2013).

The laboratory techniques used to estimate body composition includes Dual Energy X-ray Absorptiometry (DXA), Bioelectrical Impedance Analysis (BIA) method, hydrostatic weighing, water-replacement plethysmography etc. The different anthropometric indices used to assess obesity are – Body Mass Index (BMI), Fat Mass Index (FMI), Fat Free Mass Index (FFMI), Waist to Hip Ratio (WHR), Waist Circumference to Height Ratio (WC-HR) and Waist Circumference (WC). Among these the most widely used index is BMI. It is the ratio of weight (kg) to squared height (in m^2).

But BMI has one limitation that it does not accurately measure the body adiposity and it is influenced by age, sex, and ethnicity (Nevill et al., 2006). Therefore, a new index has been introduced by Bergman et al., 2011 to overcome the limitation of BMI, namely Body Adiposity Index (BAI). BAI is an index that can be used to determine BF% in adult men and women. They have validated this index against DXA which was taken as 'gold standard'. It is calculated as [((Hip Circumference) / (Height) 1.5) – 18]. However,

BAI has been validated in western population i.e. Mexican American and African American. Therefore, it is necessary to validate BAI in other ethnic groups.

In this study, the relationship between BAI and BF% in estimating body adiposity and thereby obesity among adult Indian women (25-45 years) was examined. Approximate cut-off values for BAI were also determined.

Methodology

Subjects

A cross sectional study design was followed to conduct the study on adult Indian women aged between 25-45 years. Purposive sampling was done to select the area i.e. south Delhi area and subjects. The data was collected on 320 subjects. Out of these, the data on 59 women were not included in the analysis as they met one of the following exclusion criteria – pregnant and lactating women, habitual smokers, morbidly obese women (BMI >40 kg/m^2), having irregular menstrual cycle and suffering from health problems like heart disease, diabetes, thyroid disease and some cancers.

Therefore, the final sample size for the study was 261 women in the age group of 25-45 years belonging to middle income group living in an urban setting.The study was approved by Institutional Ethics Committee (IEC) of Lady Irwin College, University of Delhi and informed consent was obtained from all the subjects enrolled in the study.

Measurements

The data was collected on weight, height, waist circumference (WC), hip circumference (HC), skinfold at triceps and body composition using BIA method. Weight was measured using digital weighing balance (TANITA weighing machine HD-358) with a sensitivity of 0.1kg. Height was measured using anthropometric rod (Galaxy Informatics, India) with a sensitivity of 0.1cm. Standard technique was followed while measuring height as described in NHANES, 2011manual and Cameron 1984.

For measuring WC and HC, a non-stretchable flexible tape was used with a sensitivity of 0.1cm. The standard procedure given in NHANES anthropometry manual, 2011 and WHO, 2000b was followed. The skinfold at triceps was measured using John Bull Harpender Callipers, British Indicator Ltd. with a sensitivity of 0.2 mm.

The procedure followed was described by Cameron, 1984. The body composition was measured using Bioelectrical Impedance Analysis (BIA) method. The equipment used was TANITA body composition analyzer, BC-420 MA.

Statistical Analysis

The data were entered on MS-Excel, 2007 and imported to SPSS version 23.0 and MedCalc version 15.11.4 for the analysis.

The Technical Error of Measurement (TEM) and coefficient of reliability (r) was calculated for anthropometric measurements to assess the precision and reliability.

The descriptive data was calculated that include mean and standard deviation for various anthropometric measurements, body compositions and anthropometric indices. Pearson's correlation coefficient was calculated between BAI and BF%.

To determine approximate cut-offs, Receiver Operating Characteristic (ROC) curves were analyzed using MedCalc version 15.11.4.

Results

The coefficient of reliability of all anthro-pometric measurements was above 0.98. The mean and standard deviations of the different variables under the study is summarized in Table 1. It also summarizes descriptive statistics according to different age group. In brief, the mean BF% was 35.9% (SD ± 6.7), BMI was 25.3 kg/m2 (SD ± 4.5) and BAI was 34.7% (SD ± 5.5).

The calculated Pearson's correlation coefficient between BAI and BF% was ($r = 0.765$, $p < 0.001$) (Fig. 1). The BAI was also significantly correlated with BMI ($r = 0.806$, $p < 0.001$). When correlation coefficients of BAI with BF% is compared with BMI with BF%, it can be seen that BMI has higher correlation coefficient ($r = 0.951$, $p < 0.001$) than BAI with BF%. Table 2 summarizes the inter-correlation coefficients between BF%, BMI and BAI.

Table 1 : Mean and standard deviations of different variables under study

Variable	*Age (y)*					
	25-45 y (n = 261)	25-30 y (n = 63)	30-35 y (n = 39)	35-40 y (n = 31)	40-45 y (n = 78)	45-50 y (n = 50)
Height (cm)	154.9 ± 6.1*	155.6 ± 5.5	156.4 ± 7.1	154.5 ± 5.8	154.1 ± 6.3	154.6 ± 5.4
Weight (kg)	60.9 ± 11.8	54.4 ± 10.8	63.3 ± 11.7	59.4 ± 12.3	63.5 ± 10.5	64.2 ± 11.6
WC (cm)	87.2 ± 11.9	77.9 ± 11.1	88.3 ± 10.9	85.6 ± 12.8	91.2 ± 9.6	92.9 ± 9.4
HC (cm)	101.5 ± 9.8	95.5 ± 9.2	102.6 ± 9.8	100.3 ± 10.1	103.5 ± 8.1	105.9 ± 9.7
Skinfold at triceps (mm)	22.6 ± 6.0	20.4 ± 5.6	24.2 ± 6.9	20.9 ± 5.4	23.0 ± 5.8	24.6 ± 5.3
BF%	35.9 ± 6.7	30.9 ± 7.2	36.4 ± 5.7	34.9 ± 7.0	38.3 ± 4.9	38.5 ± 5.4
BMI (kg/m²)	25.3 ± 4.5	22.5 ± 4.1	25.8 ± 4.4	24.8 ± 4.6	26.7 ± 3.8	26.8 ± 4.5
BAI (%)	34.7 ± 5.5	31.3 ± 4.8	34.6 ± 5.9	34.3 ± 5.4	36.2 ± 4.7	37.2 ± 5.3

* *Mean ± SD; WC – Waist Circumference; HC – Hip Circumference; BF% - Body Fat Percentage; BMI – Body Mass Index; BAI – Body Adiposity Index*

Table 2 : Inter-correlation coefficients between BF%, BMI and BAI (n = 261)

Index	*BF%*	*BAI*	*BMI*
BF%	1.00	0.765 (<0.001*)	0.951 (<0.001*)
BAI	0.765 (<0.001*)	1.00	0.806 (<0.001*)
BMI	0.951 (<0.001*)	0.806 (<0.001*)	1.00

* *p-value; Correlation is significant at p <0.01; BF% - Body Fat Percentage; BMI – Body Mass Index; BAI – Body Adiposity Index*

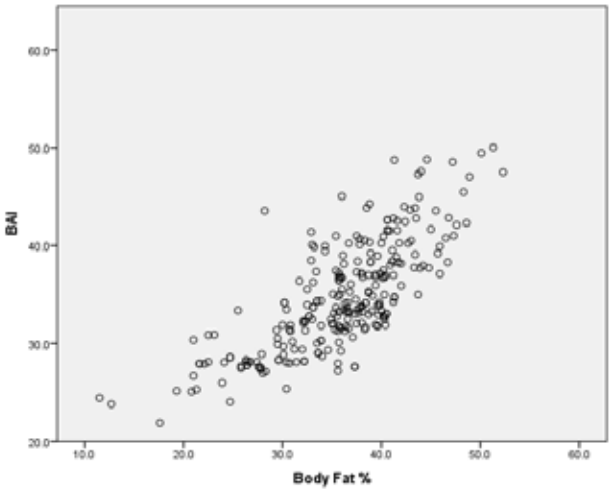

Fig 1 : Graphical representation of correlation between Body Adiposity Index (BAI) and Body Fat Percentage (BF%) (r = 0.765, p < 0.001)

Receiver Operating Characteristic (ROC) curve were also analyzed to determine the approximate cut-off for BAI. The Table 3 summarizes the cut-off values, its sensitivity, specificity and Area Under ROC curve (AUC) for BAI (see Fig. 2). The criteria used to define overweight and obesity was at BF% ≥ 35% **(Gallagher et al., 2000)** and BMI ≥ 23 kg/m2 and ≥ 25 kg/m^2 **(WHO, 2000a)**.

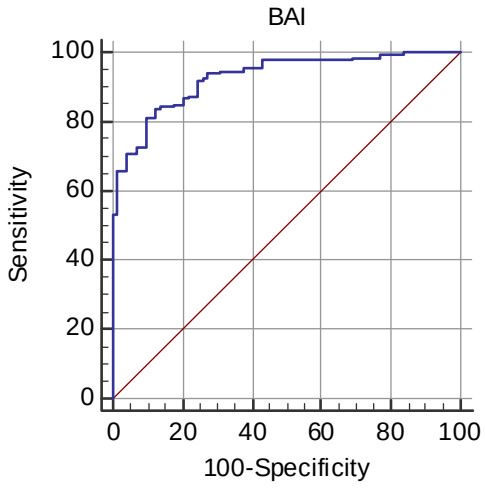

Fig. 2 (A)

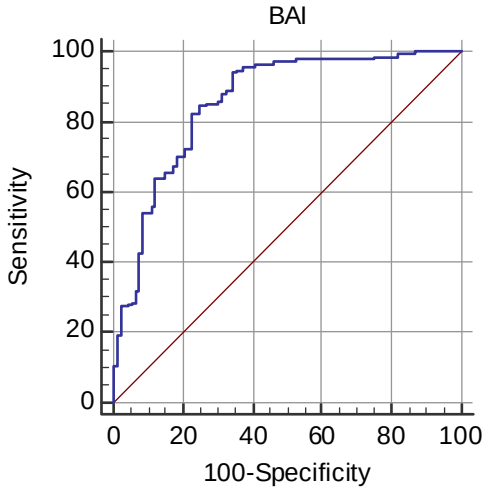

Fig. 2 (B)

Table 3: The optimal cut-off, AUC and sensitivity and specificity of BAI

Criteria	*Body Adiposity Index (BAI)*			
	AUC (95%CI)*	Cut-off	Sens (%)	Spec (%)
BF % ≥ 35%	0.857 (0.808 to 0.897)	31.3	95.8	62.4
BMI ≥ 23 kg/m^2	0.929 (0.890 to 0.957)	31.3	94.1	73.0
BMI ≥ 25 kg/m^2	0.861 (0.813 to 0.901)	32.5	86.2	68.8

* *All values were significant at p <0.0001; AUC – Area Under ROC Curve; CI – Confidence Interval; Sens – Sensitivity; Spec – Specificity; BF% - Body Fat Percentage; BMI – Body Mass Index; BAI – Body Adiposity Index*

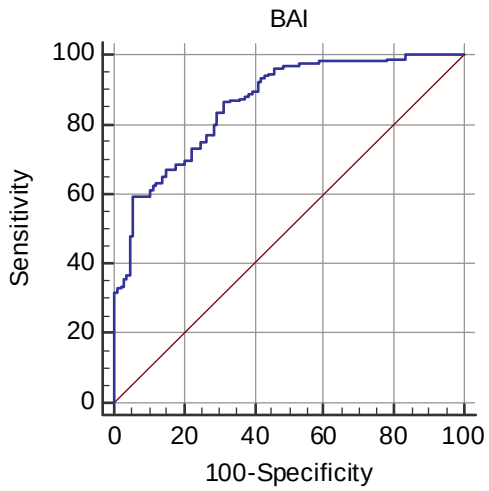

Fig. 2 (C)

Fig 2 : Area Under ROC Curve (AUC) has been shown in the figure. (A) AUC (0.857) at Body Fat Percentage (BF%) ≥ 35% as the criteria; (B) AUC (0.929) at Body Mass Index (BMI) ≥ 23 kg/m² as the criteria; (C) AUC (0.861) at Body Mass Index (BMI) ≥ 25 kg/m² as the criteria.

Table 4 : Correlation between BAI and BF% as projected by various studies

Study	Correlation	p-value*
Present study, 2016	0.765	< 0.001
Bergman et al., 2011	0.850	< 0.001
Freedman et al., 2012	0.750	< 0.001
Kuhn et al., 2013	0.710	< 0.001
Cerqueira et al., 2013	0.650	< 0.001
Sung et al., 2014	0.735	< 0.0001
Gupta and Kapoor, 2014	0.80	< 0.001
Lutoslawska et al., 2014	0.359	< 0.02

**Correlation is significant at the p < 0.01; BAI – Body Adiposity Index; BF% - Body Fat Percentage*

Discussion

The present study examined the effectiveness of BAI in assess adiposity among adult Indian women (25-45 years). Further, an approximate cut-offs were also determined for this index.

In the study, BAI was significantly correlated with BF%. This finding was also reported by various studies too. It is summarized in Table 4. A study done by Gupta and Kapoor, 2014 reported that BAI significantly correlated with BF% ($r = 0.80$, $p < 0.001$). Similarly, there are others studies also that reported significant correlation between BAI and BF%.

But a study done by Freedman et al., 2012, showed that BAI is not a good predictor of adiposity if it is compared with other indices like skinfold measurements, WC and BMI. Although, the correlation reported by them was ($r = 0.75$, $p < 0.001$). Another study done by Lutoslawska et al., 2014, projected a low correlation between BAI and BF% i.e. $r = 0.359$, $p < 0.02$, which is not significant.

Conclusion

The BAI is a simple and non-invasive technique to assess body adiposity and thereby determining obesity among adults. The results from different studies have showed varied results in correlation between BAI and BF%. The present study demonstrated that the effectiveness of the BAI in assessing adiposity is appropriate. Therefore, using BAI as a method to determine obesity among this population is being suggested by the authors of the present study.

Recommendations

Although, the BAI is better indicator to assess adiposity, the validation of the same under different ethnic groups and gender groups need to be carried out. The comparison of BAI with all other indices needs to be carried out. In addition, the analysis of ROC curves can be done by stratifying the groups based on their age as with increase in age there are changes in body composition.

References

1. *Bergman RN, Stefanovski D, Buchanan TA, Sumner AE, Reynolds JC, Sebring NG, Xiang AH and Watanabe RM. A better index of body adiposity. Obesity 2011; 19(5):1083-89. doi: 10.1038/oby.2011.38*
2. *Cameron N. The measurement of human growth. Croom Helm Ltd. 1984.*
3. *Cerqueira M, Amorim P, Magalhaes F, Castro E, Franco F, Franceschini S, Cerqueira L, Marins J and Doimo L. Validity of body adiposity index in predicting body fat in a sample of Brazilian women. Obesity 2013; 21(12): E696-9. doi: 10.1002/oby.20543*
4. *Freedman DS, Blanck HM, Dietz WH, DasMahapatra P, Srinivasan SR and Berenson GS. Is the body adiposity index (hip circumference/height1·5) more strongly related to skinfold thicknesses and risk factor levels than is BMI? The Bogalusa Heart Study. Br J Nutr 2013; 109: 338-45.*
5. *Gallagher D, Hemysfield SB, Heo M, Jebb SA, Murgatroyd PR and Sakamoto Y. Healthy percentage body fat ranges: an approach for developing guidelines based on body mass index. Am J Clin Nutr 2000; 72: 694-701.*
6. *Gupta S and Kapoor S. Body adiposity index: its relevance & validity in assessing body fatness of adults. ISRN Obesity 2014; 2014: 1-5.*
7. *Kim CH, Park SH, Park M, Kim H and Kim C. Optimal cutoffs of percentage body fat for predicting obesity-related cardio-vascular disease risk factors in Korean adults. Am J Clin Nutr 2011; 94: 34-39.*
8. *Kuhn PC, Filho JPBV, Franco L, Fabbro AD, Franco LJ and Moises RS. Evaluation of body adiposity index (BAI) to estimate percent body fat in an indigenous population. Clin Nutr 2013; 2013: 1-4. doi: 10.1016/j.clnu.2013.04.021*
9. *Lutoslawska G, Malara M, Tomaszewski P, Mazurek K, Czajkowska A, Keska A and Tkaczyk J. Relationship between percentage of body fat and surrogate indices of fatness in male and female Polish active and sedentary students. J Physio Anthro 2014; 33(10): 1-6.*
10. *National Health and Nutrition Examination Survey (NHANES). Anthropometry procedures manual. CDC, 2011.*
11. *Nevill AM, Stewart AD, Olds T, Holder R. Relationship between adiposity and body size reveals limitations of BMI. Am J Phys Anthropol 2006;129:151-6.*
12. *Sung Y, Oh JY and Lee H. Comparison of the body adiposity index to body mass index in Korean women. Yonsei Med J 2014; 55(4): 1028-35.*
13. *World Health Organization (WHO) / International Obesity Task Force (IOTF). The Asia-specific perspective: Redefining obesity and its treatment. International association for the Study of Obesity (IASO), 2000 a.*
14. *World Health Organization (WHO). Obesity: preventing and managing the global epidemic. Technical report series 894, 2000 b.*

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Analysis of Pesticide Residues in Grapes after Different Treatments using HPLC

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Abstract

Pesticides are manufactured compounds that are designed to kill specific pests, such as weeds and insects. If the organisms are exposed to high levels or for a long period of time,pesticides have the potential to cause harm. Due to the substantial developments in the Agriculture, toxic organic and inorganic compounds find their way to enter into the environmental streams. Therefore, it is critical to examine the levels of pesticide residues in fruits and vegetables as people are very frequently exposed to them. Keeping in view, the study is undertaken to determine the residue content of selected pesticides (Atrazine and Difenoconazole) in grapes. High Pressure Liquid chromatography (HPLC) technique was used to determine the level of pesticide residues left after post treatment of samples with hot water and sonicated water. Results show that which treatment is more suitable for a particular fruits or vegetable to make it free or to reduce the load from a particular pesticide. Data obtained can then be used for estimating the potential health risks associated with the exposures to these pesticides and the treatments that can be given to a fruits or vegetable to reduce the content of these pesticides in the food chain. The results show that despite a high occurrence of pesticide residues in fruits and vegetable post treatment, it could not be considered a serious public health concern. Nevertheless, astudy into continuous checking and tighter regulation of pesticide residues in fruits and vegetables is recommended.

Introduction

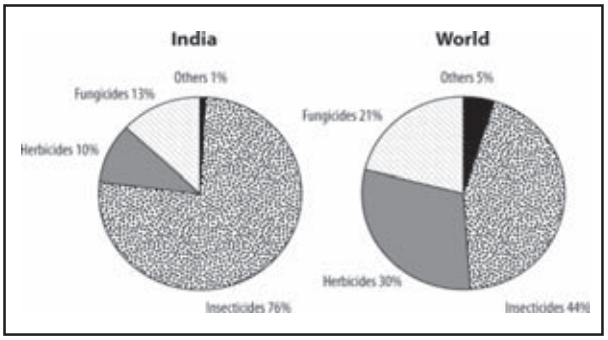
Pesticides are chemical substances used to kill insects and pests that damages crops. They are resistant against chemical/biological degradation, high environmental mobility, strong tendency for bioaccumulation in human and animal tissues, and significant impacts on human health and the environment, even at very low concentrations and consequently pollute food, ground and surface water resources. The majority of such substances are applied directly to the soil or sprayed over crop fields and hence released directly to the environment. The applied chemicals and/or their degradation products may remain as residues in the agricultural products, which becomes a concern for human exposure. Pesticides residue are examined through the use of MRLs.A maximum residue level or MRL is the maximum amount of residue legally permitted on food. Knowledge of MRLs is extremely importantin determining the safety of using certain pesticides.

People are mainly exposed to pesticide residues through the ingestion of contaminated foods (such as cereals, vegetables, and fruits), which are directly treated with pesticides or are grown in contaminated fields. Pesticides can affect adversely on the nervous system. Some harmful pesticides can cause several hazardous diseases like cancer, liver, kidney, and lung damage. Certain pesticides can also cause loss of weight and appetite, irritability, insomnia, behavioral disorder and dermatological problems.

India is now the second largest manufacturer of pesticides in Asia after China and ranks twelfth

globally *(Mathur, 1999)* is different from that for the world in general. As can be seen in Figure 1, in India 76% of the pesticide used is insecticide, as against 44% globally *(Mathur, 1999)*. The use of herbicides and fungicides is correspondingly less heavy.

Figure 1: The pattern of pesticide usage in India and the world



Fruits and vegetables are important part of the human diet since theycontain vitamins and minerals that can help to keep healthy. They can also help protect against some diseases. Like other crops, fruits and vegetables are also infested by pests and diseases during production and storage leading to damages that reducesboth the quality and the yield.

Grapes is a fruiting berry of the deciduous woody vines of the botanical genus Vitis. The combination of unique texture and sweet, tart flavor has made grapes an ever popular. The health benefits of grapes include its ability to treat constipation, indigestion, fatigue, kidney disorders, muscular degeneration and prevention of cataract.Grapes suffer from fungal diseases which affect leaves and fruit. To name a few are downy mildew, powdery mildew, grey mold, black rot and bunch rot. If left untreated they can damage entire crops and consequently reduce yield and quality. Use of pesticides provides the solution and serves the purpose.

This research is undertaken to study the residues of two selected pesticides i.e. Atrazine and difenoconazole on grapes .Atrazine is a herbicide of the triazine class and is used to prevent pre and post-emergence broadleaf weeds in crops. It is stable in neutral, weakly acidic and weakly alkaline media.Difenoconazole is a broad spectrum fungicide that controls a wide variety of fungi. It acts as a seed treatment, foliar spray and systemic fungicide.

Materials and Methods

Materials

Samples of grapes were chosen due to their commercial importance and potential consumption was procured from the local market (Bangalore, India) and was guaranteed in good condition. Samples of grapes with and without pesticide spray were examined for the determination of pesticide residue. Two different classes of common pesticides were studied and used as follows :

- Atrazine
- Difenoconazole

The analytical grade chemicals are used for the experiment.

Methanol and Acetone were of HPLC grade and collected from RANKEM.

Methodology

The samples were isolated and then spiked atrazine and difenoconalzole of a nominal concentration of 1 ppm for each compound. Samples were left to absorb the pesticides under normal conditions, ensuring the whole surface was in contact with the pesticide solution. Control samples were taken as it is without spiking any pesticide.

Analytical Technique : Agilent HPLC-VWD HPLC system (Agilent 1260 infinity) was used. The pesticide analysis data were acquired and processed using Chemstation for LC software running under Windows XP on a Pentium PC.

Other Apparatus : Electronic balance, Sonicator.

Procedure of Residue Extraction of Sample

Samples were taken in two trays. 2ml of prepared solution of 1 ppm concentration of atrazine and difenoconazole was sprayed on the sample. It was kept for drying for 20-30 minutes under normal conditions.

Treatments Given

Hot Water : Samples sprayed with atrazine and difenoconazole were washed with hot water. Washed again with 50 ml Methanol. Methanol containing residue was taken in rotoflask.

Sonication : Samples were taken in a beaker and 150 ml water at room temperature was poured so that the samples are fully immersed. Kept for sonication in sonicator for 10 minutes. Washed with 50 ml methanol. Methanol containing residue was taken in a rotoflask. Evaporator was used to extract the residue from the methanol. 2 ml methanol was added to the leftover residue in the rotoflask. This solution was transferred into a vial.

Results and Discussions

The levels of pesticides residues are controlled by Maximum Residue Levels (MRLs), which are established by each country. An easy method using HPLC was used for determining two pesticide residuesin fruit samples. For HPLC analyses, peak areas are used for quantitative calculations.

The area under the peak is proportional to the amount of the pesticide which has passed the detector. The chromatograms were analyzed quantitatively and the result (in ppm) was calculated using the following formula :

Concentration (in ppm) = area standard concentration x standard x dilution (2 ml)

Figure 2 : Typical chromatogram of grapes spiked with atrazine and treated with Hot water

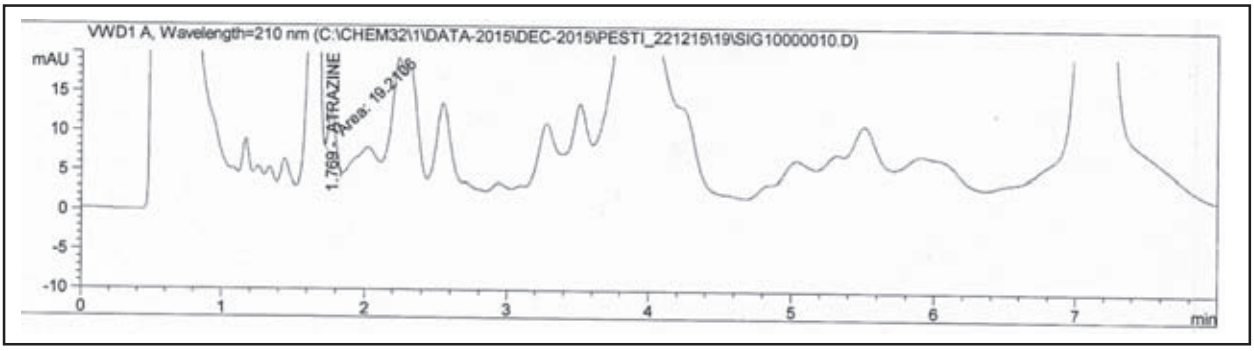


Figure 3 : Typical chromatogram of grapes spiked with atrazine given sonication treatment

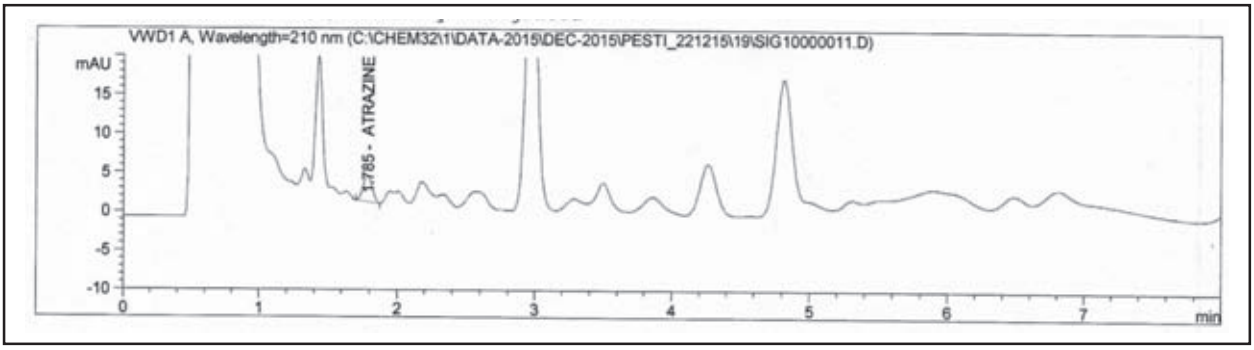


Table 1 : Calculated Atrazine concentration (post treatment)

Pesticide	*Sample*	*Treatment given*	*Area*	*Standard Concentration*	*Dilution*	*Result (ppm)*
Atrazine	Grapes	Hot water	19.21	1.0	2	0.56
		Sonication	14.63			0.42

In the chromatogram obtained from grapes which were spiked with atrazine and later treated with hot water, the peak area is seen to be 19.21 and the corresponding concentration was calculated to be 0.56 ppm whereas the ones given the sonication treatment show a peak area of 14.63 and concentration of 0.42 ppm. This shows that there is a considerable decrease (about 24%) in the pesticide residue level when the sample is given the sonication treatment.

In the chromatogram obtained from grapes which were spiked with difenoconazole and later treated withhot water, the peak area is seen to be 34.2 and the corresponding concentration was calculated to be 1.53 ppm whereas the ones given the sonication treatment show a peak area of 20.6 and concentration of 0.92 ppm. This shows that there is a considerable decrease (about 40%) in the pesticide residue level when the sample is treated with sonicated water.

Conclusion

Sonication treatment, being a physical method of food processing has proved to be a better method for extraction of pesticides and thus could efficiently play an important role in preventing several adverse effects in consumers. This may be because the interactions between the matrix and the analytes can be very strong for sediments; therefore, liberating the bound fraction often requires some type of intensive physical extraction method. Sonication provides

Figure 4 : Typical chromatogram of grapes spiked with difenoconazole and treated with Hot water

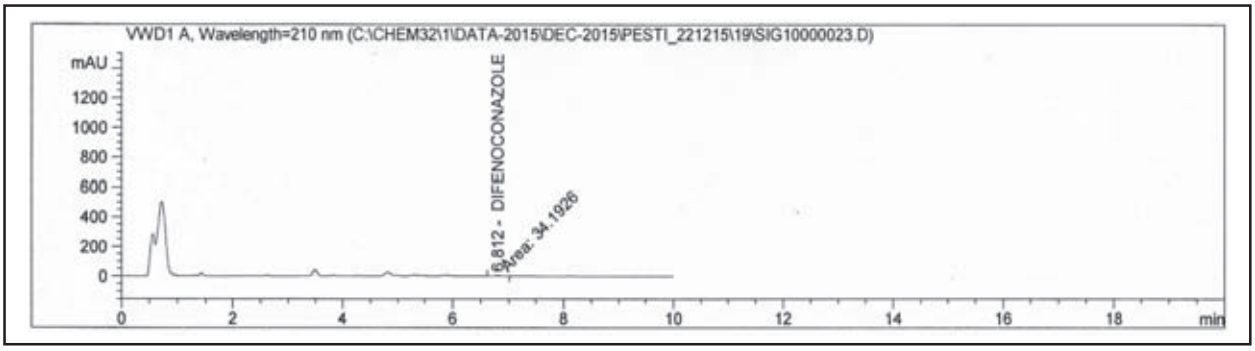


Figure 5 : Typical chromatogram of grapes spiked with difenoconazole & given sonication treatment

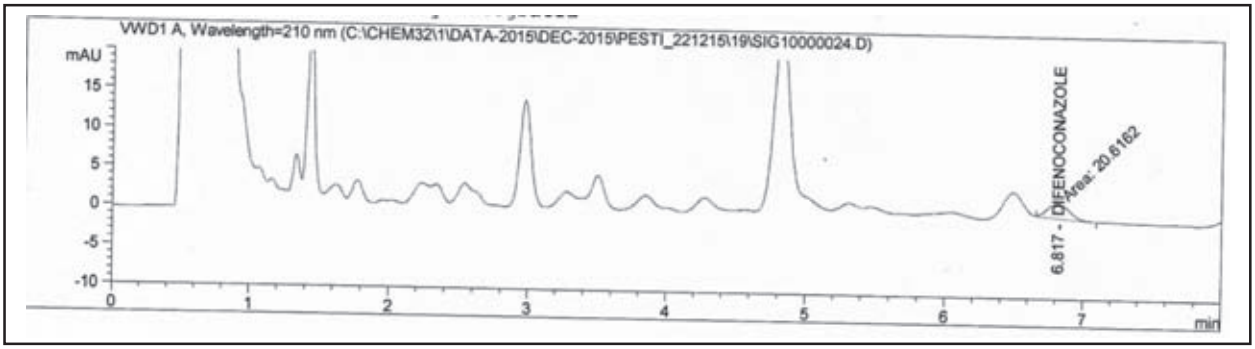


Figure 6 : Calculated Atrazine concentration (post treatment)

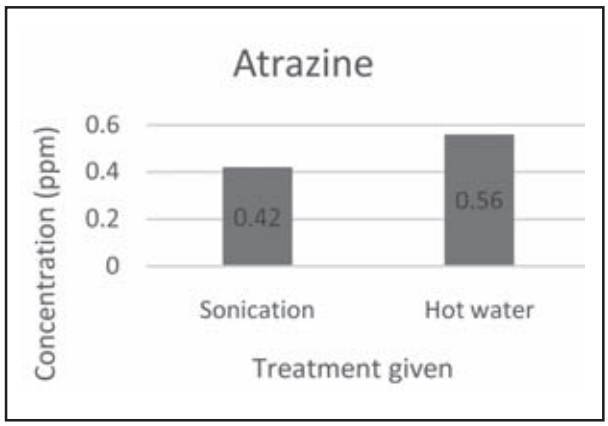


Figure 7 : Calculated Difenoconazole concentration (post treatment)

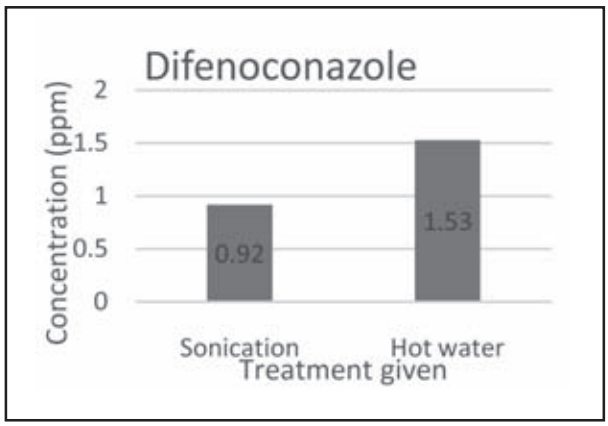


Table 2 : Calculated Difenoconazole concentration (post treatment)

Pesticide	*Sample*	*Treatment given*	*Area*	*Standard Concentration*	*Dilution*	*Result (ppm)*
Difenoconazole	Grapes	Hot water	34.2	1.0	2	1.53
		Sonication	20.6			0.92

an efficient method for extracting tightly bound chemicals from fruit tissues.

References

1. *H. DAHMEN and T. STAUB, Plant Protection Division, CIBA-GEIGY, CH- 4002 Basle, Switzerland : American pytopathological society — Plants disease/1992.*
2. *Sajjad Ahmad Baig, Niaz Ahmad Akhtera, Muhammad Ashfaq and Muhammad Rafique Asi : Determination of the Organo-phosphorus Pesticide in Vegetables by High-Performance Liquid Chromatography - American-Eurasian J. Agric. & Environ. Science, IDOSI Publications, 2009.*
3. *Guan Huat Tan[1] and Mee-Kin Chai: Sample Preparation in the Analysis of Pesticides Residue in Food by Chromatographic Techniques - Pesticides: Strategies for Pesticides Analysis, January 2011.*
4. *Agromany 317: Introduction to Weeds*
5. *H.V Annegowda, Rajeev Bhat, Liong Min-Tze, and A.A. Karim&S.M Mansor: Influence of sonication treatments and extraction solvents on the phenolic and antioxidants in star fruit - Journal of Food Science Technol. 2012 August.*
6. *J. You, D. P. Weston, M. J. Lydy Fisheries and Illinois Aquaculture Center: A Sonication Extraction Method for the Analysis of Pyrethroid, Organophosphate, and Organochlorine Pesticides from Sediment by Gas Chromatography with Electron-Capture Detection - Arch Environ Contam Toxicol. 2004 August.*
7. *Imma Ferrer, Juan F. Garcia-Reyes, Milagros Mezcua, E. Michael Thurman, Amadeo R. Fernandez-Alba : Multi-residue pesticide analysis in fruits and vegetables by liquid chromatography–time-of-flight mass spectrometry - Journal of Chromatography A, xxx (2005) xxx–xxx © 2005 Published by Elsevier B.V.*
8. *Kit Granby, Hinge Andersen, Hanne Bjerre Christensen: Analysis of pesticides in fruit, vegetables and cereals using methanolic extraction and detection by liquid*

chromatography – tandem mass spectrometry. Analytica Chimica Acta, 2004.

9. *SHARMA S. S., KAPADNIS K. H. Chemistry Research Laboratory and PG department of chemistry, M.G. Vidyamandir's L.V.H. College, Nashik-422003, Maharashtra : International Journal of Chemical and Physical Sciences, ISSN: 2319-6602 IJCPS Vol. 4 Special Issue – NCSC Jan-2015.*
10. *Paranthaman, R., Food Testing Laboratory Indian Institute of Crop Processing Technology, Ministry of Food Processing Industries, Govt. of India : Determination of Pesticide Residues in Banana by Using High Performance Liquid Chromatography and Gas Chromatography - Mass Spectrometry : American Journal of Biochemistry and Biotechnology 8 (1): 1-6, 2012 ISSN 1553-3468 © 2012 Thanjavur-613 005 (TamilNadu), India*
11. *Wissem Mnif,1,2 Aziza IbnHadj Hassine,1 Aicha Bouaziz, 1 Aghleb Bartegi, 3 Olivier Thomas,4 and Benoit Roig 4, : Effect of Endocrine Disruptor Pesticides: A Review : nt J Environ Res Public Health. 2011 Jun; 8(6): 2265–2303.*
12. *Dr. Soudamini Mohapatra: Dynamics of difenoconazole and propiconazole residues on pomegranate over a period of two years under field conditions: Pesticide Residue Laboratory, (ISO/IEC17025:2005), Indian Institute of Horticultural Research, Hessaraghatta Lake, PO, Bangalore.*
13. *Jack A. Freeman, A. J. Renney, H. Driediger: Influence of Atrazine and Influence of Atrazine and Simazine on Leaf Chlorophylls and Fruit Yield of Raspberries : Canadian Journal of Plant Science, 1966, 46(4)*
14. *Management of land use systems for enhanced food security: conflicts, controversies and resolutions — Effect of Food Processing on Residue of Difenoconazole in Strawberry Fruits: Reda Morsi Food Technology Research Institute, Agri Research Center, Special Food and Nutrition, Egypt, September 16-18, 2015.*

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Osmotic Dehydration of Papaya — Optimization and Comparison

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Abstract

Papaya is a highly nutritious fruit but as it lacks a sharp taste it is not preferred to be consumed in raw state by majority population. To increase its affinity, procedures like osmotic dehydration followed by drying are practiced. Osmotic dehydration is an upcoming technique which includes the partial removal of water from plant tissues by immersion in a hypertonic solution like sugar, salt, glycerol etc. It is used to preserve and enhance the flavor of products like Amla, Apples etc. The aim of the present study is to carry out the process of osmotic dehydration of papaya, study process variables, and to optimize and standardize the product. Osmotic dehydration was carried out using two techniques — Cooking in sugar syrup and sprinkling dry sugar in three different sugar syrup concentrations, namely 50°brix, 60°brix and 70°brix. The final products were analyzed for percentage moisture content on wet basis, shelf life, and sensory characteristics like taste, flavor and aroma. This is only a preliminary basic study and further studies are yet to be done for detailed analysis of shelf life studies and standardization of the product.

Keywords : Papaya, Osmotic dehydration, concentration, techniques, analysis

Introduction

Papaya (*Carica papaya*) is a fruit crop native to the tropical regions. It has 22 species varieties such as *Carica candamarcensis, Carica kapoh.*[1] India is the largest producer of papaya producing 4.2 million tones annually accounting for 35% of the world's total production. It is a highly nutritive fruit, rich in vitamin A and vitamin C followed by some percentages of fiber and carbohydrates. It has 91% of water content per 100 gram of sample.[2]

Because of high moisture content, Papaya is highly perishable. With time, techniques like dehydration, freezing etc have been devised to enhance its shelf life by decreasing physio-chemical and biological changes. As these methods are expensive and energy consuming, osmosis is gaining popularity and acceptance as a novel treatment followed by dehydration to reduce the cost of the final product.

The nutrient composition of Papaya is as follows :[3]

Nutrient	***Amount/100g***
Energy	39 Cal
Fat	1.29g
Total ash	14.12g
Sugar	15.15g
Fiber	1.88g
Carbohydrate	6.2 g
Vitamin C	51.2 mg

Osmotic Dehydration[4][12]

Osmotic dehydration is the partial removal of water from plant tissues by immersion in a hypertonic solution like sugar, salt, glycerol etc. It involves molecular movement of components

through a semi-permeable membrane to another solution with lower concentration.

Advantages of Osmotic Dehydration[5][12]

- It is a low temperature process with minimum loss of color and flavour.
- Flavour retention is more when dry sugar and sugar syrup are used as osmotic agent.
- Enzymatic and oxidative browning is prevented as the fruit pieces are immersed in sugar.
- Removal of acid and uptake of sugar by the fruit pieces give a sweet product.
- Cost reduction.[14]
- The textural quality of product is better after reconstitution.[14]
- The storage life of product is greatly enhanced.
- Simple equipments are required for the process.

The degree of Maturity / Ripeness of papaya plays an important role in its processing. It should be firm enough to get cut uniform shapes and sizes without being mushy. The quality also depends upon other factors like processing time and temperature, type of osmotic agent used, concentration of the sugar syrup and the product dimensions.[5][10]

Materials and Methodology

Procurement of the fruit — Papaya fruits were procured from the local fruit markets of East Delhi. Papayas were selected at an early stage of maturity. About 5 kg of the fruit was procured for processing. They were further divided into 6 parts of 334g each for processing and testing.

Pretreatment — Under-ripe papaya was selected, washed in running water, peeled and cut into uniform pieces of thickness of approximately 2-3 cm each. They were weighed and were immediately immersed in cold water to prevent browning.[6][9]

Initial moisture content determination — 10g of sample was finely cut and was evenly spread in the moisture dish and the moisture content on wet basis was calculated by oven drying at 105°Celsius for 4 hours.[7][11]

Pre Treatment (Blanching) — To enhance shelf life and to improve sensory attributes, the papaya cubes were blanched by dipping in boiling water for 3 minutes and then immediately immersed in cold water for 2 minutes. This is done to stop further cooking and prevent thermal losses on further processing.

Process — The process of osmotic dehydration was carried out in two ways, i.e cooking in syrup method and dry sugar method.

Cooking in sugar syrup method — Sugar syrups were prepared by mixing the calculated amounts of sugar in water and heating over a flame in a pan. Three variable concentrations were studied i.e. 50°brix, 60°brix, 70°brix. The syrup was stirred continuously and gently at a temperature below 100°Celsius. The pretreated Papaya cubes were added to the syrup while it was being prepared. The product was cooked till the desired degree brix was achieved. The cooking took around 30-45 minutes. After completion of osmosis, the product was cooled and excess sugar solution was strained off by immersing pieces in warm water for 20 seconds. [5][6][7][9][15]

Dry sugar method — It is a traditional method carried out at ambient room temperatures. In this method, papaya cubes were sprinkled with about 100g sugar (dry) initially and left overnight. Sugar syrup was formed due to osmosis the next day. The concentration of sugar was gradually

increased until the sugar solution of desired concentration was achieved. Sugar solution was stirred after certain intervals of time and its concentration was measured using a hand refractometer. Three variables concentrations were studied that are 50°brix, 60°brix and 70°brix. The process took about 48-72 hours for achieving the required degree brix. More time was required for higher sugar concentration solutions like 70°Brix.[6]

Drying in cabinet dryer — The final drying of the prepared product was carried out in a cabinet tray drier (make:NSW-148) at 60°C for 3-4 hours. After drying; the products were cooled and left overnight. They were then weighed accurately and then packaged in airtight polythene pouches for further usage and testing. [8][11][13]

Results

The Initial raw material and final products were analyzed for the following :

1) Moisture Content

S. No.	*Sample*	*Moisture Content on wet basis*
1.	Control sample Raw Papaya	86.76%
2.	50°Brix Dry Sugar(A)	14.11%
3	50°Brix cooking in syrup(B)	11.8%
4.	60°Brix Dry Sugar (C)	13.86%
5.	60°Brix cooking in syrup (D)	15.38%
6.	70°Brix Dry Sugar (E)	12.87%
7.	70°Brix cooking in syrup (F)	16.01%

The Average product moisture content lies in the range : 11% - 16%.

2) Sensory characteristics

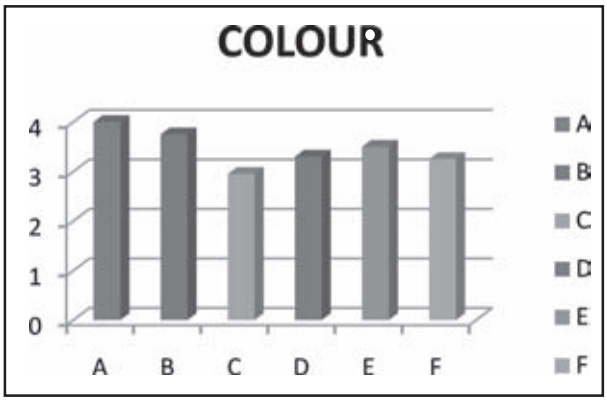
Sensory evaluation was carried out for all the samples. Most of the samples had a pleasing taste, appearance, texture and aroma and were highly appreciated and liked by our panel of judges.

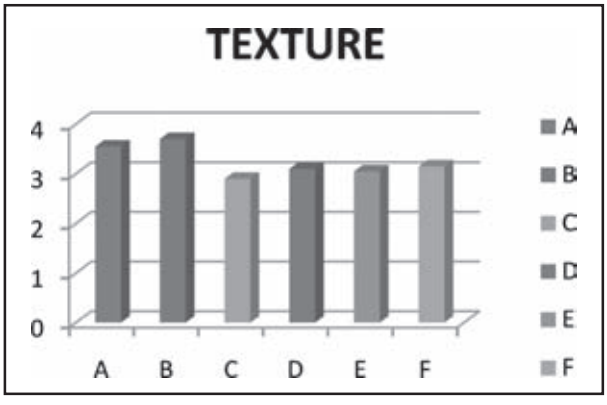
The final products were presented to a panel of 20 judges including the teachers and students of the college, who judged the sample on the basis of color, texture, aroma, taste and flavor and the overall acceptability was thus calculated.

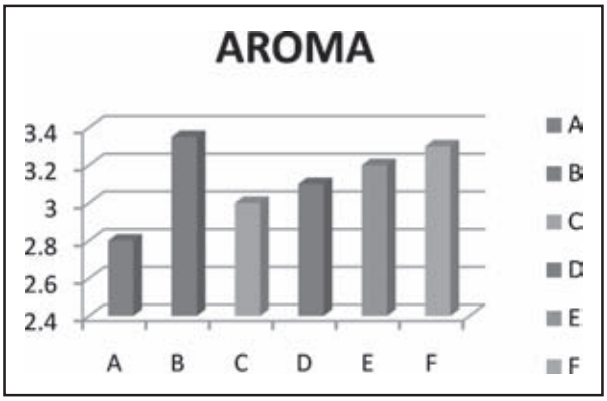
The average sensory scores were analyzed and represented graphically to get a comparative assessment of the samples prepared using different processing methods and sugar syrup concentrations. These results have been interpreted to find out the most acceptable product. The graphs are as follows :

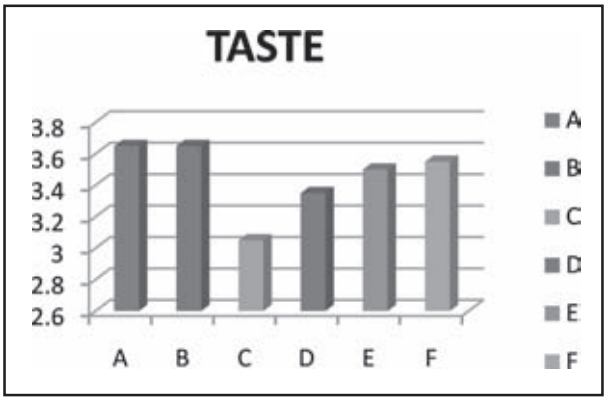
In the graphs :

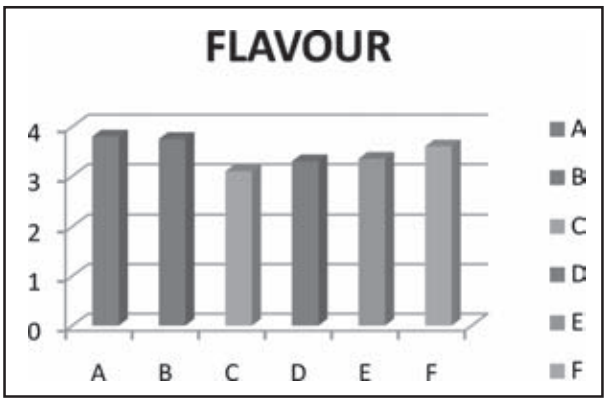
A : 50° brix constant cooking
B : 60° brix constant cooking
C : 70° brix constant cooking
D : 50° brix dry sugar
E : 60° brix dry sugar
F : 70° brix dry sugar
X-axis : products
Y-axis : average sensory scores

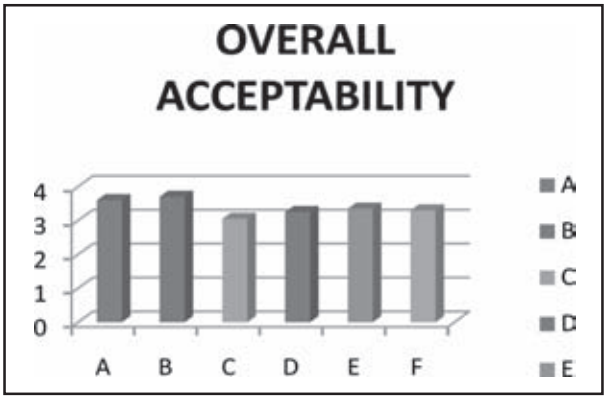












Conclusion and Discussion

On the basis of the observed results it may be inferred that :

- The color of product A was most preferred. This pleasant color could be a result of proper caramelization of sugar at the given concentration.
- The texture was most superior in product B. This was a result of proper cooking and osmosis at the given concentration.
- The aroma was most superior in product B as the method used enhanced the aroma of Papaya and even added a certain cooked aroma which enhanced the overall aroma.
- The taste was most superior for product B as osmosis took place completely in this product and cooking was also done for appropriate time.
- The flavor of product A was found to be most preferred as a cooked flavor was sensed and also there was optimum penetration of sugar in the product making it desirable.
- Overall acceptability was highest for product B.

Thus, it may be concluded from the results, that the most suitable method of processing that gave the best product was the cooking in syrup method because it took lesser time for osmosis to complete than dry sugar method, caramelization took place imparting a much more pleasant color and flavor and there was no scope left for oxidation of pigments as in dry sugar method. And the ideal concentration of syrup that was found to give the best product quality for the osmotic dehydration was 50°brix and 60° brix as osmosis took place completely at these concentrations.

Also, the moisture content for these two dried products was optimum and most stable because

of the optimum degree of osmosis and dehydration.

This study has been successful in comparing, standardizing and optimizing certain process methods and parameters for manufacture of Papaya candy. Further research is intended to modify and improve the product by including certain pretreatments, like addition of Calcium Chloride, salt, spices etc. and also to carry out detailed nutritional analysis, packaging and shelf life studies.

Also, the excess sugar syrup obtained after the process was stored in clean, sterilized bottles for experiments like Viscosity measurement etc carried out in college.

References

1. *Viewing all plants of: (n.d.). Retrieved March 04, 2016.*
2. *The Earth of India: All about Papaya in India. (n.d.). Retrieved March 04, 201.*
3. *Gopalan, C., V., R. S., & Balasubramanian, S. C. (1971). Nutritive value of Indian foods. Hyderabad, India: National Institute of Nutrition, Indian Council of Medical Research.*
4. *Yadav, A. K., & Singh, S. V. (2014). Osmotic dehydration of fruits and vegetables: a review. Journal of Food Science and Technology, 51(9), 1654–1673.*
5. *Jain, S. K., Verma, R. C., Murdia, L. K., Jain, H. K., & Sharma, G. P. (2011). Optimization of process parameters for osmotic dehydration of papaya cubes. Journal of Food Science and Technology, 48(2), 211–217.*
6. *Lal, G., Siddapa, G. S., & Tandon, G. L. (1960). Preservation of fruits and vegetables (2nd ed.). New Delhi: Indian Council of Agricultural Research.*
7. *Fernandes, F. A., Rodrigues, S., Gaspareto, O. C., & Oliveira, E. L. (2006). Optimization of osmotic dehydration of papaya followed by air-drying. Food Research International, 39(4), 492-498.*
8. *Chavan, U. D., & Amarowicz, R. (2012). Osmotic Dehydration Process for Preservation of Fruits and Vegetables. JFR Journal of Food Research, 1(2).*
9. *Singh, E., Kalyani, B., Reddy, B. S., Ravi, L., Shanti, M., Devi, V. H., & Kalyani, P. U. (2015). Study On dehydration of Papaya Slices Using Osmotic Dehydration Mediated Hot Air Oven Drying. Study On Dehydration of Papaya Slices Using Osmotic Dehydration Mediated Hot Air Oven Drying, 9(11).*
10. *A'noar Abbas El-Aouar a, Patricia Moreira Azoubel, Jose´ Lucena Barbosa Jr., Fernanda Elizabeth Xidieh Murr a (2005). Influence of the osmotic agent on the osmotic dehydration of papaya (Carica papaya L.). State University of Campinas, Brazil.*
11. *Alireza Yousefi, Mehrdad Niakousari and Mehdi Moradi (2013) . Microwave assisted hot air drying of papaya (Carica papaya L.) pretreated in osmotic solution . Shiraz University, Shiraz, Iran.*
12. *RANGANA, S. Handbook of Analyser and Quality Control for Fruit and Vegetable Products. (2nd Edition).*
13. *Misha, S., Mat, S., Ruslan, M. H., Sopian, K., & Salleh, E. (2013). Review on the Application of a Tray Dryer System for Agricultural Products. Review on the Application of a Tray Dryer System for Agricultural Products.*
14. *Pant, P., & Saini, S. (n.d.). Osmotic Dehydration of Fruits & Vegetables, 5(1).*
15. *Sunjka, P. S., & Raghavan, G. (n.d.). Assessment of Pre treatment Methods and Osmotic Dehydration for Cranberries.*

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Stability of Vitamin-C content in Sprouted Mung Beans (*Vigna radiata*) stored at different temperatures

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Abstract

The present study was conducted with an objective to assess the stability of Vitamin-C in sprouted mung beans stored at different temperatures. Mung beans sprouts were processed at laboratory in controlled conditions, packed in LDPE pouches and were stored at summer room temperature (SRT) (30-32°C), winter room temperature (WRT) (15-18°C) and refrigeration temperature (RT) (7°C). Shelf life studies were conducted periodically for physical, chemical and microbiological parameters for the time period of 0-96 hours at their respective storage temperatures. During shelf life studies, several changes were observed in mung beans sprouted samples. There was a significant increase in shoot length of sprouts samples stored at SRT followed by WRT and RT. Moisture content decreased significantly at RT followed by WRT and SRT. Vitamin-C increased significantly at RT followed by WRT while at SRT there was a significant decrease. Acidity increased significantly at all three storage temperatures followed by decrease thereafter. Microbial count in terms of total plate count, yeast and mold count was comparatively higher at SRT followed by WRT and RT whereas Coliform count was not detected in any sprouted sample. Thus it can be concluded that at RT (7°C) optimal retention of physicochemical and microbiological qualities are achieved.

Keywords : Mung beans, Sprouts, Vitamin-C, Stability, Temperatures.

Introduction

Mung bean (*Vigna radiata*) belongs to leguminous species & family Leguminosae (Fabaceae) grown for its protein rich edible seeds (pulse). In India, mung bean ranks third among the pulse crop, after chick pea and pigeon pea (Singh and Yadav, 1978). Mung bean is a rich source of nutrients. The process of sprouting has been identified as an economical and valuable technology for improving the nutritional quality of cereal and grain legumes (Khattak et al, 2008) particularly its palatability, digestibility and availability of certain nutrients. Mung bean sprouts are normally prepared after 2-3 days when shoot length increases in between 1.3 to 7.6 cm. Fresh Mung bean sprouts should have crisp white hypocotyls and yellow or green cotyledons in appearance and fresh characteristic odour of mung bean sprout. Due to high moisture content and high metabolic activity, mung sprouts like other high moisture fruits and vegetables are highly perishable and therefore, last only 1 day at room temperature (30-35°C) and 5 to 10 days at 0°C (Goyal et al, 2011). Sprouts are important in several protein supplements and nutraceutical formulations, several enzymes become active, vitamins (Vitamin-A, B1, B4, B12, and C) are increased, whereas there is reduction in phytates and tannins (Mehta and Bedi, 1993).

Vitamin-C / Ascorbic Acid is an antioxidant and also an important nutrient. Vitamin C attracts attention of the research community and consumers as a nutrient with a broad biologicalactivity and importance for human health. More than 90% of the vitamin C in human diets is supplied by fruits and vegetables. Recommended dietary allowance for adult men and women are 40 mg/d (Narasinga and Sivakumar, 2010). Deficiency of Vitamin-C causes scurvy. However, Young, in 1782, first observed that germinating seeds acquired

antiscorbutic properties. Several studies have shown that dry seeds have measurable amounts of ascorbic acid but the amount is increased by germination. Vitamin C content of legumes is less than10mg/100g while in sprouted legumes it ranges between 25-50 mg/100g (Rajalakshmi et al, 2013). Research states that, storing sprouts for a long period of time can reduce their vitamin C content since; vitamin C is water-soluble, unstable, heat labile and oxidizes readily on exposure to environmental conditions. Lipton et al, (1981) studied the changes during storage of mung bean sprouts. He reported that there is darkening of the roots, cotyledons; development of dark streaks on the hypocotyls; development of sliminess, decay, and musty odour takes place. Further reported by DeEll et al, (2000) that cotyledon colour in mung bean sprouts may blacken at low temperatures, which may be a symptom of chilling injury. In a study conducted by Varoquaux et al, (1996), he reported that the mung bean sprout sample held for 4 to 5 days at 8°C (46°F) in packages containing 5% O_2 and 15% CO_2 showed reduction in darkening of sprouts and development of sliminess was delayed. There are no established USDA quality standards for sprouts. Perforated film packaging helps to maintain the quality of fresh sprouts by reducing water loss (DeEll and Vigneault, 2000). In the United States, the FDA recommends soaking seeds in 20,000-ppm hypochlorite prior to sprouting in order to reduce the bacterial burden. However, there is no decontamination method available till date to ensure elimination of pathogens in seeds without reducing seed germination or sprout yields (EFSA Panel on Biological Hazards, 2011).

Since, very few studies have been carried out on Vitamin-C retention of mung bean sprouts at ambient temperatures. Therefore, in this study an effort has been made to investigate optimal storage conditions for good quality, nutritionally adequate and microbiologically safe sprouts.

Methodology

Green, even size, good quality mung beans, free from any infestation were procured from the local market in Sikandra road, New Delhi. For washing & soaking process of mung beans potable R.O. water was used which was analysed as per BIS method [IS: 5401(Part 1) 2002]. Mung beans were cleaned, washed and soaked in 4-5 volumes of water for 24 hours at 15-18°C. Towards the end of the soaking period, the water was drained and the seed samples were allowed to germinate in sprout maker for 48-72 hours at 15-18°C.

Packaging & Storage : Approx. 100g sprouts were packed in LDPE pouches (4x5 inches pack) and were stored at summer room temperatures (30- 32°C, maintained in incubator), winter room temperatures (15-18°C) & refrigerator temperature (7°C). Stored samples of mung bean sprouts were analysed in triplicate for their physicochemical and microbiological parameters for 5 days at period of 0, 24, 48, 72 and 96 hours.

Chemicals : The chemicals used for investigation were of analytical grade reagents (A.R.)

Analysis

Physicochemical Analysis : Appearance and odour perception was ranked 1, 2 and 3 i.e. fresh, objectionable and spoiled respectively. Shoot length was measured by taking the mean of hypocotyls length of 10 sprouts and expressed in cm. Moisture determination done by AOAC (1995) method. Vitamin-C determination was carried out by AOAC (1995) procedure, in mg/100g. Titrable acidity was analysed according to AOAC (1995) method, in terms of citric acid.

Microbial analysis was done according to procedures given in IS: 5401-2002 for Coliforms count, IS: 5402-2002 for Total plate count (TPC), IS: 5403-1999 for Yeast & mold count.

Statistical analysis: All the data were analysed and expressed as mean ± standard deviation in tabulated form. The data was subjected to analysis of variance (ANOVA) technique and post hoc test, using SPSS version 22. The significant difference value at 5% level was used for making comparison among different temperatures during storage.

Results and Discussion

Appearance and odour of stored mung beans sprouts deteriorated after 24 hours at summerroom temperature (30- 32°C), 48 hours at winter room temperature (15-18°C), 96 hours atrefrigeration temperature (7°C).

Shoot length showed the significant difference in mung beans sprouts stored at all three temperatures with the increase in storage period. Though, this increase was not significant between winter room temperature and refrigerated temperature after 24 hours. This indicates that with the increase in time, shoot length also increases, maximum at summer room temperature followed by winter room temperature and refrigeration temperature. This observation is supported by Alvarado & Bradford, (2002) who reported that germination rate usually increases linearly with temperature.

Moisture : The significant loss in moisture content of mung beans sprouts was more at refrigeration temperature (28%) followed by winter room temperature (22%) and summer room temperature (9%) with the increase in storage period. The possible reason for less moisture loss at summer room temperatures could be the presence of favourable temperature for sprouting which leads to optimum rate of respiration, causing insufficient exchange of gases and vapours through the LDPE pouches, which got accumulated in the pouches and retained in mung bean sprouts as moisture.

Acidity : Increase in % acidity was significant till 24 hours from 0 hour at summer and winter room temperatures. While at refrigeration temperature significant increase was observed till48 hours from 0 hour followed by decrease thereafter. Though this decrease was not significant ($p<0.05$) at refrigerated temperature as in the case of storage temperatures of winter and summer. Similar results were discussed by Goyal & Siddiqui, (2011). They reported that the decrease could be due to utilization of acids for respiratory activity or other metabolic processes.

Vitamin-C : As shown in Table-1 there was a significant increase till 24 hours from 0 hour of storage, followed by significant decrease with increase in storage period from 48 to 96 hours at summer room temperature (30-32°C), winter room temperature (15-18°C) and refrigeration temperature (7°C). This decrease in Vitamin-C after 24 hours may be due to unstable nature of Vitamin-C. Since, it has been reported by researchers that Vitamin-C is found in both reduced form (ascorbic acid) & oxidized form (dehydroascorbic acid), which indicates that during storage of sprouts Vitamin-C is present but in oxidised form i.e., dehydroascorbic acid. Though this decrease was significant among all storage three temperature, but with increase in storage time period maximum retention of vitamin- C content was observed at refrigerated temperature (7°C) followed by winter room temperatures (15-18°C) and summer room temperature (30-32°C). Similar results were reported by Guo et al, (2012). He observed that germination of mung beans dramatically increases vitamin C content in mung bean sprouts in a time-dependent manner. Increase in vitamin- C content during storage period from 0 hour to 96 hours was 16.6% at refrigeration temperature and 6.3% at winter room temperature. Whereas at summer room temperature Vitamin-C content decreased by 6.9% from 0 hour. This comparative increase in Vitamin-C retention of sprouts at refrigerated temperature may be due to the occurrence of metabolic processes at slower rate at low temperature.

Table 1 : Vitamin C content of laboratory processed mung beans sprout sample during storage at different storagetemperatures

Storage Period	*Vitamin Ccontent (mg/100g)*		
	Summersroom temperature (30-32°C)	*Wintersroom temperature (15-18°C)*	*Refrigeration temperature (7°C)*
	M±SD	*M±SD*	*M±SD*
0 hr (NS)	30.1±0.11	30.1±0.11	30.1±0.11
24 hrs*	40.0±0.13	37.2±0.11	36.1±0.09
48 hrs*	38.1±0.09	35.0±0.09	37.3±0.07
72 hrs*	35.3±0.09	34.1±0.09	36.1±0.08
96 hrs*	28.0±0.09	32.0 ±0.07	35.1±0.10

* *indicates significant differenceat p<0.05,(NS)indicates not significant differenceM±SD indicates mean± standard deviationfor threedeterminations*

Microbial Count : There was a considerable increase in total plate count of laboratory processed mung beans sprout sample from 7.0 × 102 to 6.9 × 104cfu/g when stored at summer room temperature (30-32°C), 7.0 × 102 to 4.8 × 103 cfu/g at winter room temperature (15-18°C) and 7.0 × 102 to 2.1 × 103 cfu/g at refrigeration temperature (7°C) over storage period from 24 to 96 hours. Similar results have been reported by Fett et al, (2006). There was a progressive increase in yeast & mold count in mung beans sprout sample from8.0 × 101 to 7.6 × 102 cfu/g when stored at summer room temperature (30-32°C), 8.0 × 101 to 5.4 × 102 cfu/g at winter room temperature (15-18°C) and 8.0 × 101 to 2.9 × 102 cfu/g at refrigeration temperature (7°C) over storage period from 24 to 96 hours. Inspite of these microbial increases was within the acceptable range of raw vegetables according to Standards of Association of European airlines and falls under grade A category which represents excellent microbiological quality for raw plant foods. Coliform count was not detected in mung beans sprout sample at all storage temperatures.

Conclusion

Based on the study it can be concluded that increase in Vitamin-C content in mung beans sprouts sample was 16.6% at refrigeration temperature and 6.3% at winter room temperature during storage period from 0 hour to 96 hours. Whereas at summer room temperature Vitamin-C content decreased by 6.9% from 0 hour. Hence, Vitamin-C retention was observed maximum at refrigerated temperature (7°C) followed by winter room temperatures (15-18°C) and summer room temperature (30-32°C) with the increase in storage period.

Thus, to have optimum keeping quality of mung beans sprouts, product should be processed under hygienic conditions i.e., by using potable water and sanitizing treatments. To retain freshness, crispness and optimal nutrients sprouts should be stored at refrigeration temperature (7°C). To maintain overall quality after processing it should be packed in LDPE pouches and stored under hygienic condition.

References

1. *Alvarado V, Bradford KJ (2002) A hydrothermal time model explains the cardinal temperatures for seed germination. Plant Cell Environment 25:1061-1069*
2. *AOAC (1995) Official methods of analysis Association of Official Analytical Chemists, Washington, DC*
3. *DeEll JR, Vigneault C (2000) vacuum cooling and storage temperature influence the quality of stored mung bean sprouts. Hortic Sci 35(5):891–893*
4. *DeEll JR, Vigneault C, Favre F (2000) vacuum cooling and storage temperature influence the quality of stored mung bean sprouts. Horticulture Science 35:5:891-893*
5. *EFSA Panel on Biological Hazards (BIOHAZ) (2011) Scientific opinion on the risk posed byShiga toxin-producing Escherichia coli (STEC) and other pathogenic bacteria in seeds andsprouted seeds EFSA J. 9:1–101*
6. *Fett WF, Sapers GM, Gorny JR, Yousef AE (2006) Interventions to ensure the microbial safety of sprouts. Microbiology of fruits and vegetables. CRC Press, Boca Raton, FL.187–209*
7. *Goyal A, Siddiqui S, Upadhyay N, Soni J (2011) Effects of ultraviolet irradiation, pulsed electric field, hot water and ethanol vapours treatment on functional properties of mung bean sprouts. Journal of Food Science Technology 51:708–714*
8. *Guo X, Li T, Tang K, Lui RH (2012) Effect of Germination on Phytochemical Profiles and Antioxidant Activity of Mung Bean Sprouts (Vigna radiata) Journal of Agriculture and Food Chemistry 60:44:11050–11055. Internet: http://pubs.acs.org/doi/pdf/10.1021/jf304443u (accessed on 22 march 2015)*
9. *Indian standard. General guidance for the enumeration of Coliforms. Bureau of Indian standards. N. Delhi. IS: 5401(Part 1) 2002*
10. *Indian standard. General guidance for the enumeration of microorganism-colony counttechnique at 30°C. Bureau of Indian Standard. N. Delhi. IS: 5402-2002.*
11. *Indian standard. Method for yeast and mold count of foodstuffs and animal feeds. Bureau ofIndian standards. N. Delhi. IS: 5403-1999*
12. *Jung WY, Choi YM, Rhee MS (2009) Potential use of supercritical carbon dioxide to decontaminate Escherichia coli O157:H7, Listeria monocytogenes, and Salmonella typhimurium in alfalfa sprouted seeds. International Journal of Food Microbiological 136:66–70*
13. *Khattak AB, Zeb A, Bibi N, Khattak MS (2008) Effect of germination time and type of illumination on proximate composition ofchickpea seed (Cicer arietinum L.). American Journal Food Technology 3:1:24–32*
14. *Lipton WJ, Asai WK, Fouse DC (1981) Deterioration and CO2 and ethylene production of stored mung bean sprouts. J. Amer. Soc. Hort. Sci. 106:6:817-820*
15. *Mehta P, Bedi B (1993) In vitro protein and starch digestibility in selected germinated legume flours. Indian J Nutr Diet 30:149–153*
16. *Narasinga Rao BS, Sivakumar B (2010) Nutrient requirements and recommended dietary allowances for Indians (ICMR), 2nd edition*
17. *Rajalakshmi R, Sakariah KK Applied Nutrition, Oxford & IBH Publishing Co. Pvt. Ltd. NewDelhi, 4th edition 2013*
18. *Rajkowski KT, Thayer DW (2000) Reduction of Salmonella spp. and strains of Escherichia coli O157:H7 by gamma radiation of inoculated sprouts. J. Food Prot. 63:871–875*
19. *Singh C, Yadav BS (1978) Production potential of mung bean and gaps limiting its productivity in India. Asian Vegetable Research and Development Center, Shanhua, Taiwan*
20. *Varoquaux P, Albagnac G, Nguyen-The C, Varoquaux F (1996) Modified atmosphere packaging of fresh bean sprouts. J. Sci. Food. Agr. 70:224-230*

Synthesis of Novel Thermoplastic Terpolyester Film by Lactic Acid, Phthalic Anhydride and Ethylene Glycol

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Abstract

In India, biodegradable polymeric films which are economical as well as eco-friendly are in great demand. Therefore, development of a flexible packaging material with good moisture and oxygen barrier properties which is also biodegradable was undertaken. The terpolymer were synthesised by condensation reaction of lactic acid, ethylene glycol and pthalic anhydride.The chemical and physical properties of obtained resin were determined using acid value which is obtained 0.0195 and 0.0200, hydroxyl value is obtained 0.0260 and 0.023 and number average molecular weight obtained is 10,256 δ and 10,000 δ of the terpolymer A and terpolymer B. The FTIR characterization also shows different peaks.

Keywords : Biodegradation,Terpolymer, Lactic acid, Ethylene glycol, Pthalic anhydride.

Introduction

Matter is created and destroyed all the time. Anything against it can create havoc to entire universe". In the coming anthropogenic plastic age, during which the human activity has been dominant influence on environment mainly plastic, there is high need of industrial application of biodegradable polymer. Plastic is synthetic polymer which is used in entire world due to its mechanical properties, long durability and its cost effectiveness but its properties like biodegradation resistant, its inertness and hard to degrade and obvious human behaviour of littering plastic are the major consequences for the need of biodegradable plastic. According to news report published in Hindustan Times, The Age of Plastic is upon us.[1] In next 40 years, Plastic waste will bury the land and choke the oceans of Planet Earth. Different degradable plastics, such as polylactides, poly (3 hydroxy-butyrate-3-hydroxyl valerate), ethylene-carbon monoxide polymers, vinyl ketone copolymers (Guillet process), and starch-filled polyethylene (Griffin process), have been developed. These plastics differ in degradation rate, application, and price. In one development, plastics' inertness and resistance to microbial attack was reduced by incorporating starch and later prooxidants (transition metals and oil).[2] Most of the plastics in the market, claimed to be biodegradable, are based on synthetic and microbial Polyesters.

Polyesters are potentially biodegradable due to the hydrolysable ester bonds. There are two types of polyesters: aliphatic and aromatic. Compared with most aliphatic polyesters, aromatic polyesters, such as poly (ethylene terephthalate) and poly (butylene terephthalate), have excellent material properties. However, it is now considered that their susceptibility to microbial attack is negligible. Therefore, to increase the biodegradability of aromatic polyesters, some studied focused on the synthesis of aliphatic-aromatic copolyesters or incorporation of aliphatic dicarboxylic acids or polyethylene glycol in polyester chains which greatly enhance the degradation rate.[3]

Among these polymers much progress has been made in polylactic acid (PLA),P olyglycolic acid (PGA) and their copolymers can be synthesized in wide range of molecular weights by following two methods : 1) Direct condensation reaction of lactic acid/ or glycolic acid which leads to low molecular weight; 2) ring opening polymerization of cyclic dimer i.e. lactide and glycolide, in the presence of metal catalyst to synthesize high molecular weight polymer.[4]

In this present work, polycondensation approach was attempted to produce terpolymer of Lactic acid, phthalic anhydride and ethylene glycol. Terpolymer so obtained were characterized for its acid value, hydroxyl value, number average molecular weight and FTIR.

Objectives

The aim of the study was :

- To develop biodegradable packaging film using lactic acid based novel thermoplastic polymers.
- The synthesized copolymers were characterized by following techniques — Acid value, hydroxyl value, number average molecular weight determination and FTIR.

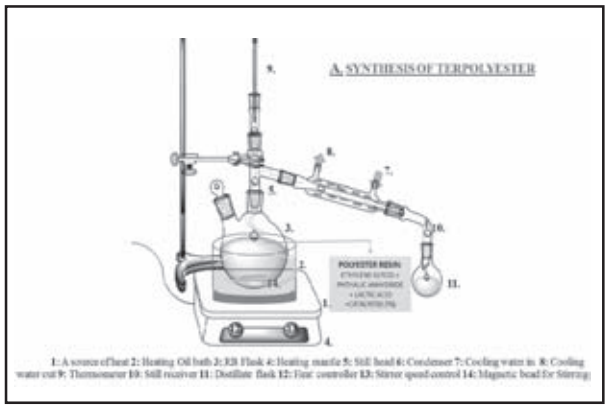
Materials and Methods

All the reagents Lactic acid (AR), phthalicanhydride, ethylene glycol and stannous chloridewere obtained either from E. Merck or Thomas Baker. All the glassware which were used for the laboratory purpose were kept overnight in a 10% (v/v) nitric acid solution and distilled water was used to wash the glassware. An IR spectrum was recorded on a PerkinElmer Model Spectrum RX-1. The FTIR spectra of synthesized terpolyester were recorded using KBr pallets. The samples are at the resolution of 4 cm^{-1} Scans were obtained over mid-IR region of 4000-400 cm^{-1}.

Synthesis of Terpolyester

Condensation reaction occur in two steps. First is polyesterification and second is polycondensation. Lactic acid, phthalic anhydride and ethylene glycol is taken in proportion of 0.3:1:1 in a three necked round bottom flask. A thermometer was fitted to the neck, a stirrer to the other and Dean Stark was fitted to third neck as shown in Fig. 1.

Figure 1 : Scheme of Terpolyester synthesis



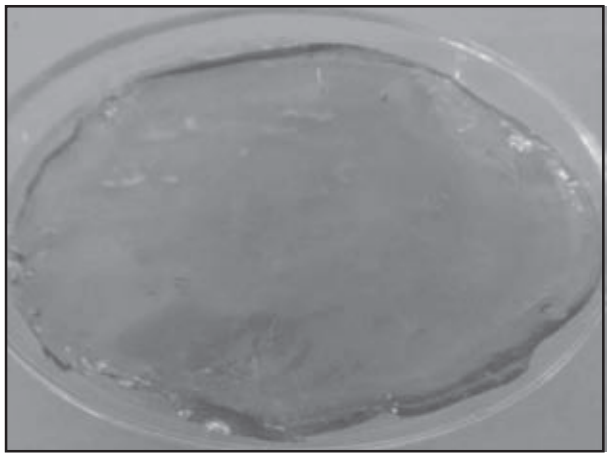
In first step temperature was kept at 140°C for 7 h in second step the reaction was carried out at 200°C for 10 h and added 0.5% catalyst stannous chloride with constant stirring. The reaction mixture was poured in a petri dish, having silica gel coating. After cooling terpolymers were removed from petri dish.Film formation is done by melting the formed polymer and pouring it onto Petri dish as shown in Fig. 2.

Lactic acid (0.4 mol) with phthalic anhydride (1.0 mol) and ethylene glycol (1.0 mol) was taken in three-necked round bottom flask. The procedure is same as described above. Film formation is done by melting the formed polymer and pouring it onto Petri dish as shown in Fig. 2.

Results and Discussions

Synthesized terpolyester film from three monomers Lactic acid, pthalic anhydride and ethylene glycol obtained from condensation reaction. The presence of yellow color indicates the lactic acid which helps in biodegradation.

Figure 2 : Polyester Film



The amount of lactic acid decides the color of film. Terpolymer "A" having ratio 0.3:1:1 on characterization, acid value and hydroxyl value comes to be 0.195 and 0.026 respectively which is comparatively higher than produced by R.K. Soni et al.[5] and Terpolymer "B" having ratio of 0.4:1:1 acid value and hydroxyl value comes out to be 0.020 and 0.023 respectively. Acid value and Hydroxyl value is determined by using end group analysis in which reactive functional end groups are analyzed to determine the average molecular weight of polymer chains formed. The no. average molecular weight obtained by substituting this value in formula is around 10,256 δ and 10,000 δ which will decide the film formation will occur or not and its strength, as the results depicted in Table 1. Comparatively with R.K. Soni et al.[5] Terpolymer "A" having molecular weight higher leads to good strength.

Infrared spectroscopy indicates the presence of ester bond and aromatic hydrocarbons. The sharp peak obtained at 1716 cm-1 indicated C=O in aryl ester. The broad peak at 3447 cm^{-1} indicates presence of O-H str. of alcohol and presence of two bands at 1134 and 1281 cm^{-1} indicates the presence of C-O in ester as shown in Fig. 3.

Table 1 : Results of the Synthesized Terpolymers

Name of Terpolymers	*Ratio*	*Acid Number*	*Hydroxyl Value Molecular Weight*	*Number Average*
(A)LA:EG:PA	0.3:1:1	0.0195	0.026	10,256
(B)LA:EG:PA	0.4:1:1	0.0200	0.023	10,000

Conclusions

Synthesized biodegradable film made from three different monomer such as lactic acid, pthalic anhydride and ethylene glycol in different ratios is a novel work. The Lactic acid which comes in the long polymer chain and which is biodegradable also.It is terpolymer based on PET. Hence, the film formed have low gas and water permeability, medium shelf life, high stain resistance, better mechanical strength and prevent microbial spoilage for food packaging.The proposed method is a simple and low cost procedure.

Acknowledgement

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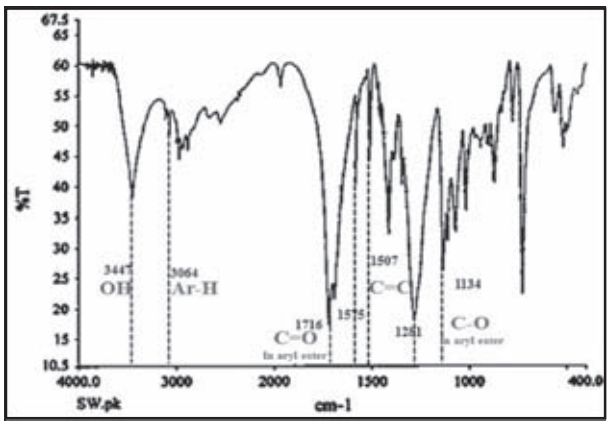
References

1. *Gnanavel G, Mohana Jeya Valli V.P, Thirumarimurugan M, Kannadasan T. Degradation of Plastics Using Micro-organisms. Inter. J of pharma. and Chem. Sci. 2012, V. 1 (3),1040-1043.*

Figure 3 : FTIR spectra of terpolyester



2. *Muller RJ, Keeberg I, Deckwer WD. Biodegradation of polyesters containing aromatic constituents. Journal of Biotech. 2000.*
3. *Mona Azza E.S and Sanaa H. Omar. Biodegradation of Synthetic Polyesters (BTA and PCL) with Natural Flora in Soil Burial and Pure Cultures under Ambient Temperature. Research Journal of Environmental and Earth Sciences. 2012, V. 4(3), 325-333.*
4. *Levefre, C. et al Comparative degradation by microrganisms of terephthalic acid, 2,6-naphthaence dicarboxylic acid, their esters and polyesters. Polymer Degradation and Stability.1999, 64, 9-16.*
5. *Soni R. K, Soam Shweta, Dutt Krishna Studies on biodegradability of copolymers of lactic acid, terephthalic acid and ethylene glycol, PolymDegrad and Stab.2009, 94, Issue 3, 432-437.*

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Development of Dehydrated Protein and Fibre rich Vegetable Chunks

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Abstract

Traditionally, wadi is well known to Indian society. A product solely made up of pulses is thought to be a good source of protein. Proteins consist of amino acids. But, the number and type of amino acids are variable in each source of protein. Therefore, there is a need to supplement missing amino acids by incorporating cereals in the same meal. It is well researched that cereals are deficient in lysine whereas pulses are deficient in methionine. Protein quality is calculated using NDpCal%. Hence, consumption of the ratio of cereal and pulse together will provide the appropriate protein quality. This will also enhance the protein bioavailabity in the body. According to ICMR 2010, 0.8-1g/kg body weight of protein is recommended for an adult intake. Fibre is very important in day today lifestyle. Fibre is the key constituent of a nutritious diet. Due to rapid globalisation and westernisation, lifestyle and eating habits have changed drastically. These have resulted in consumption of refined cereals and pulses more than whole cereals and pulses. Many common problems such as uneasiness, headaches, stomache, constipation etc. can be due to insufficient intake of fibre. The product is formulated in order to achieve good quality protein as well as fibre content. Various parameters such as moisture, temperature, particle size, soaking time, dehydration time etc are standardised. The present study attempts to develop a ready to use product and its technology from an existing product. The product will be rich in good protein quality and fibre content. The product is developed keeping in mind the essence of Indian taste and present needs of the consumer's health. It is easy to use and quick to incorporate in diet. The results so far achieved are very promising and organoleptic evaluations have shown great potential for the use of the product by consumers.

Keywords : protein quality, NDpCal%, bioavailability

Objective

- To develop ready to use dehydrated protein- and fibre rich vegetable chunks.
- To develop a wholesome cereal-pulse combined product.
- To develop technology to cook/eat high protein and fibre wadi.
- To conduct physico-chemical and micro-biological analysis.
- To develop suitable packaging for the product.
- To conduct consumer preference trials.

Methodology

The research was conducted using cereals and pulses rich in protein and fibre. Many experiments were conducted standardizing parameters such as water content, temperature, time etc.

The process used in standardizing the formulation is as follows :

- Standardizing Pulse : Cereal ratio to be used
- Standardizing amount of water for washing (300ml), temperature for soaking (15°C),

amount of water for soaking, time of soaking (overnight) for green gram dal

- Standardising roasting of oats (20 seconds), grinding of oats (20 seconds)

- Standardising dehydration temperature (70°C) and time (6 hours 25 mins)

The product was evaluated on 5 point hedonic scale. The evaluation was based of product in preparation in potato curry, raita and salad.

Materials

Whole moong dal of moisture content 9.22%, Split dal of moisture content 10.6%, washed moong dal of moisture content 11.65% were procured from local supplier. Whole oats of moisture content 7.82% and instant oats of moisture content 8.12% were procured from Bagrrys Oat's industry. Six combinations were prepared and analysed.

Sample Preparation

The spices were added on the basis of weight to each of the preparation. The salt was added at 1.5% of total weight, Kasuri methi 3% and Kashmiri Lal Mirch 2% of the total weight and mixed properly.

Findings

Physico-chemical analyses were performed on the three selected product on the basis of 5point hedonic scale. The moisture content, AOAC, 2000 for product 1, product 2 and product 3 were 2.97%, 2.89% and 3.59% respectively. The Ash content, AOAC, 2000 were product 1, product 2 and product 3 were 2.97%, 3.96% and 4.95% respectively. The fat content, AOAC, 2000, for product 1, product 2 and product 3 was same for all i.e., 0.14%. The total plate count and yeast and mould count were not detectable when performed aseptically.

Analysis	Reference	Product 1 (Whole Moong Dal + Instant Oats)	Product 2 (Split Dal + Whole Oats)	Product 3 (Washed Moong Dal + Whole Oats)
Moisture Content	AOAC, 2000	2.79%	2.89%	3.59%
Ash Content	AOAC, 2000	2.97%	3.96%	4.95%
Fat Content	AOAC, 2000	0.67%	0.64%	0.62%
Protein Content	IS:7219-1973	21.93%	21.55%	20.32%
Crude Fibre Content	IS:10226 (Part 1-1982)	2.99%	2.89%	2.57%

Discussion

Indian vegetarian diet holds many advantages for supporting good health. But, some disadvantages include poor protein quality and fibre content. The product developed in the present research attempts to develop a good quality protein product with good fibre content. It was found that the product has a great potential to come in market and replace many other exiting products.

Conclusion

Indian diets are commonly known to be poor in protein quality and fibre content due to recent changes in lifestyles. This product developed is sound and sufficient in protein content in both

quantity and quality and is also rich in fibre. Many alternatives apart from the ones it is evaluated in, it can be used in kadi pakora where it can replace fried pakora, gattee ki sabzi etc. The product requires a little more fine tuning and this will be done shortly as the research is still in process.

References

1. *Archana Singh, Som Nath Singh. 2015. Dietary Fiber Content Of Indian Diets. Asian journal of pharmaceuticals and clinical research 8 (3)*
2. *C. Gopalan, B.V. Rama Sastri & S.C. Balasubtramanian, 2011. Nutritive value of Indian foods.*
3. *D Joe Millward, Donald K Layman, Daniel Tomé, and Gertjan Schaafsma. Protein quality assessment: impact of expanding understanding of protein and amino acid needs for optimal health 1-4*
4. *FAO. Dietary protein quality evaluation in human nutrition. 2011*

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Eating Habits of Teenagers and Comparison of their Dietary Intake with the Food Pyramid

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Abstract

Objective — To assess the eating habits of teenagers and compare their dietary intake with the recommended food pyramid. A survey of 100 teenagers was carried out to know their food intakes by giving them a food frequency questionnaire. The questionnaire consisted of questions related to the different types of foods and how many servings is consumed by them. It was observed that only 40% teenagers do daily exercise and their diet is lacking in fruits and vegetables and pulses should be increased in their diets with the major focus on daily exercise also as well as in legumes and pulses.It was concluded that the intake of fruits, vegetables was found very less in their in diet.

Introduction

Food Pyramid — The food pyramid is an outline of what to eat each day. According to this food pyramid one should take variety of foods in right amounts to maintain the balance of health[18]. This pyramid illustrates the research based food guidance system developed by USDA and supported by the Department of Health and Human Services. Nutrition education is based upon RDAs of different nutrients and is usually depicted through food pyramids, circles or plates. [5]

USDA Food Pyramid

Source *: www.intp.usda.gov*

Related Terms

Adolescence — The period of life beginning with the appearance of secondary sex characteristics and ending with the cessation of somatic growth. [16]

Food frequency — A term describing how often foods are consumed over a specific time period. [17]

The eating habits as well as the perceptions of healthy eating among teenagers are dramatically changing [1]. Today, teenagers are moving away from the home cooked food and going towards junk food. Mostly school children and college goers come under teenagers (13-19 years).Their diet usually consist of foods high in sugar, salt and saturated fat and lacks in fruits and vegetables [4, 20]. The level of food intake of teenagers should be in a proportion matching with the food guide pyramid to a significant level. Good eating habits among teenagers is a must, as this is the age for the proper mental and emotional development of a person. Nutrition is fundamentally significant to all aspects of health

[6]. Good eating habits benefit in a long run as habits are inculcated for lifetime [2]. If they have a habit of nutritious eating, they will cherish it for whole life. Eating habits also influence lifestyle related disorders such as obesity, hypertension, diabetes etc. [1, 3, 9]. According to a study, teenagers with poor eating habits may suffer from weight problems [4, 1]. Also for young generation, it is important to practice healthy eating habits for the development of strength and cognitive ability. [7]

Strategy — For this study, a population of teenagers of Delhi-NCR are chosen. Since Delhi is a metropolitan eating habits here, are influenced by lifestyle factors also. Thus, this study would give a fair idea of eating habits among today's teenagers.

Previous studies about eating habits of teenagers have shown low health concerns in their food choices [23, 24]. They generally tend to prefer non healthy foods which tastes good to them. Some studies have also shown that nutrition label reading and food education does not lead to good eating habits in teenagers [15, 21]. Outside eating of food is the major choice of teenagers nowadays [11, 14] which is an issue of major concern to their health. Eatables taken from outside are usually less nutritious and contain high amount of salt, sugar and spices [18]. The teenagers are fond of having junk foods. There is a growing concern among policymakers and educators that junk food availability in schools is a significant contributor to the childhood obesity epidemic [8]. Even products made from refined carbohydrates are harmful to them and may lead to obesity and other lifestyle related disorders among teenagers. There is a research to suggest that refined carbohydrates should be avoided since they provide inadequate levels of fibre and some studies have linked them to heart disease [16, 17, 10].

For comparison of their eating habits with the recommended amounts of various food groups, USDA food guide pyramid is used and analysis is done on the basis of the level of food intake of teenagers from each shelf of food pyramid.

Methodology

The survey is conducted among 100 teenagers of different schools and colleges. Students from 9th grade to 12th grade from both private and government schools of north east Delhi and Noida were selected for this and 1st year students of DU colleges were also chosen. Each subject was given a food frequency questionnaire. It consisted of questions related to the variety in the food intake for different food groups and also about the physical activity or daily exercise they are doing. The survey was easy to fill and the language was proper to be understood by the target group that is, the teenagers. Thus, it was not difficult for the selected teenagers to fill the questionnaire. In the given a sample questionnaire; some of the points in were related to :

1. Gender of the person.
2. Age group
3. Level of cereal intake such as how many servings of rice wheat etc.
4. Level of fruits and vegetables intake.
5. Level of pulses and legumes intake.
6. Level of intake of milk products.
7. Level of intake of meat and related products.
8. Level of intake of fat rich and sugary food.
9. Their awareness about nutrition.
10. If they are doing any physical activity or not.

The data from all the sources was collected and analysed. A comparative study of the collected data was conducted. The data was recorded in a MS-Excel sheet and the level of dietary intake of each food group among teenagers was compared with the recommended level of that particular food group in the USDA food guide

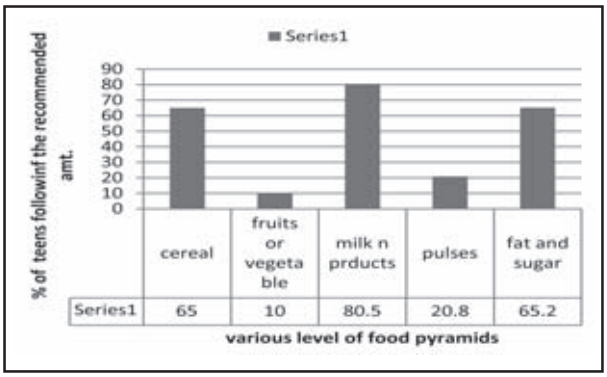
pyramid. This comparative study is shown using a bar graph and pie chart. Also, it is also analysed that how many times a week they are doing exercise or physical activity.

In this way, data is analysed and conclusion about the eating habits of teenagers from Delhi-NCR can be drawn.

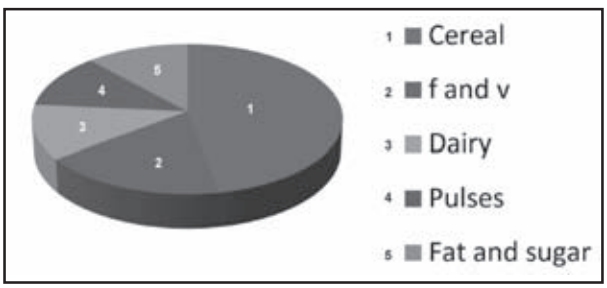
Result

A graph between various food levels in a food pyramid and the percentage of people following the recommended amounts from that particular shelf of the food pyramid is plotted. Also, the percentage share of each food group in a person's diet is shown using a pie chart.

Bar graph showing various levels of food pyramids and the percentage of people following the recommended amount from it



Pie Chart showing the percentage of each food group in a teenager's diet

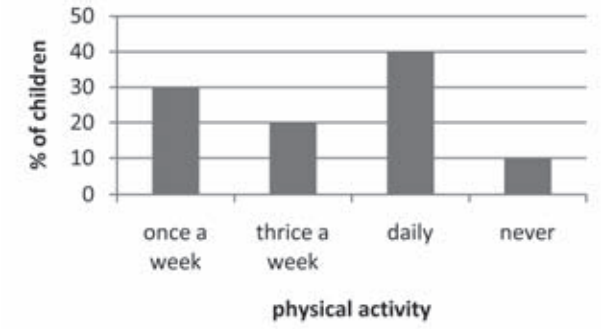


The percentage of teenagers following the recommended amounts of cereal intake is 65%, of fruits and vegetables is 10%, of dairy products is 80.5, of pulses is 20.8% and for fats and sugar is 65.2%.

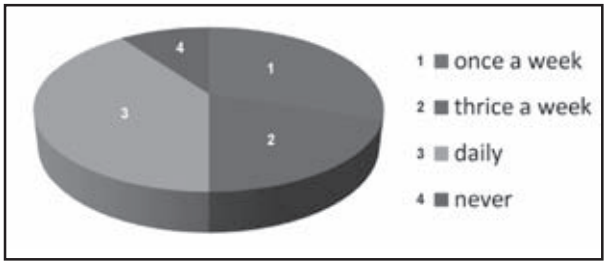
From the pie chart, it can be seen that cereals has the major share in a teenager's diet, followed by fruits and vegetables. But fruits and vegetables are not consumed according to the recommended amounts as shown by the bar graph, and thus, its intake should be increased.

Another graph is showing the percentage of people indulging in physical activity at how many times a week. The same data is also shown by a pie chart.

Bar Graph showing the percentage of people indulging in physical activity



Pie Chart showing the percentage of people indulding in physical activity



As seen from the graph and pie chart, Only 40% teenagers do exercise daily, followed by 30% doing once a week and 20% thrice a week and the least, 10% do it never.

Conclusion

As shown from the bar graphs, it can be concluded that the diet of teenagers is lacking in fruits and vegetables and also in consumption

of legumes and pulses. The share of cereals is the largest in a teenager's plate, followed by fruits and vegetables, dairy products, legumes and fats is quite similar. Although teenagers from Delhi-NCR consume fruits and vegetables regularly, but not as per the recommended amounts of USDA food pyramid.

The level of physical activity of teenagers is also not good as only 40% do daily exercise, followed by 30% who do it once in a week. 10% of the teenagers never do exercise. The causes of these results are the high intake of junk food among the teenagers and also a sedentary lifestyle as explained earlier also. Teenagers should be indulged in good amount of daily physical activity for their proper growth and development. This should be a priority in schools and colleges to make the students fit and healthy by providing them good nutritional education and educating them about the importance of daily physical activity.

References

1. *Bargiota, A., Delizona, M., Tsitouras, A., Koukulis, G., Hormones 2013, 12(2) : 246-253*
2. *Barry, K., What's food got to do with it, Nasc, The Irish Immigrant Support Centre, 2014*
3. *Befort, C., Kaur, H., Nollen, N., Nazir, N., Choi, W. S., Hornberger, L., & Ahluwalia, J. J. (2006, March). Fruit, vegetable, and fat intake among non-Hispanic black and non-Hispanic white adolescents : Associations with home availability and food consumption settings. Journal of the American Dietetic Association, 106(3), 367-373*
4. *Brunner, Mary Jo. A comparison of food habits of middle school students. American Psychological Association, 5th edition, May 2006*
5. *Burchett, H., Seeley, A., Good enough to eat, The Food Commission, April 2003*
6. *Chan, K., Prendergast, G., Gronhoj, A. and Bech-Larsen, T. (2009) Adolescents' perceptions of healthy eating and communication about healthy eating, Health Education,109(6), 474-490.*
7. *Darmon, I., Warde, A., Change in eating Habits: The contribution of new local food infrastructures, Sustainable Practices Research Group, January 2013*
8. *Datar, A., Nancy, N., Junk Food in schools and childhood obesity: Much ado about nothing, WR-672 ,March 2009, RAND Health And Labor And Population*
9. *Dietz, W. H. (1998b, March). Health consequences of obesity in youth: Childhoodpredictors of adult disease. Pediatrics, 101(3), 51 8-525.*
10. *DiNicolantonio JJ. (2014) The cardio-metabolic consequences of replacing saturated fats with carbohydrates or ?-6polyunsaturated fats: Do the dietary guidelines have it wrong?. Open Heart;1*
11. *Fitzgerald A, Heary C, Kelly C, Nixon E, Shevlin M, 2012 Self-efficacy for healthy eating and peer support for unhealthy eating are associated with adolescents'food intake patterns. Appetite 63:48-45.*
12. *Food habits. (2005). Retrieved October 17, 2005, from: http:l/www.biologyonline. orgldictionary1food~habits*
13. *Gidding, S. S., Dennison, B. A., Birch, L. L., Daniels, S. R., Gilman, M. W., Lichtenstein, A. H., Rattay, K. T., Steinberger, J., Stettler, N., Van Horn, L., & American Heart Association. (2006, February). Dietary recommendations for children and adolescents: a guide for practitioners. Pediatrics, 1 1 7(2), 544-559.*
14. *Guthrie, J. F., Lin, B-H., & Frazao, E. (2002, MayIJune). Role of food prepared away from home in the American diet, 1977-78 versus 1994-96: Changes and consequences. Journal of Nutrition Education &Behavior, 34(3), 140-150.*
15. *Huang TT, Kaur H, McCarter KS, Nazir N, Choi WS, Ahluwalia JS, 2004 Reading nutrition labels and fat consumption in adolescents. J Adolesc Health 35: 399-401.*

16. *Hu F (2010). Are refined carbohydrates worse than saturated fat? Am J Clin Nutr.; 91(6): 1541–1542.*
17. *Jakobsen MU, Dethlefsen C, Joensen A M, Stegger J, Tjønneland A, Schmidt EB and Overvad K (2010). Intake of carbohydrates compared with intake of saturated fatty acids and risk of myocardial infarction: importance of the glycemic index. AJCN, 91 (6), 1764-8*
18. *Kerr MA, Rennie KL, McCaffrey TA, Wallace JM, Hannon-Fletcher MP, Livingstone MB, 2009 Snacking patterns among adolescents: a comparison of type, frequency and portion size between Britain in 1997 and Northern Ireland in 2005. Br J Nutr 101: 122-131*
19. *Mahan, L. K., & Escott-Stump, S. (2000). Krause's food, nutrition, &diet therapy (loth ed.). Philadelphia, PA: W. 6. Saunders Co.*
20. *Manandhar, M., Share, M., Friel, S., Walsh, O., Hardy, F., Combat Poverty Agency Working Paper Series 06/01ISBN: 1-90548-512-3,May 2006*
21. *McCullum C, Achterberg CL, 1997 Food shopping and label use behaviour among high school-aged adolescents. Adolescence 32: 181-197.*
22. *Munoz, K. A., Krebs-Smith, S. M., Ballard-Barbash, R., & Cleveland, L. E. (1997,September). Food intakes of US children and adolescents compared withrecommendation.Pediatrics, 700(3), 323-329.*
23. *Ree M, Riediger N, Moghadasian MH, 2008 Factors affecting food selection in Canadian population. Eur J Clin Nutr 62: 1255-1262.*
24. *Striegel-Moore RH, Thompson D, Affenito SG et al, 2006 Correlates of beverage intake in adolescent girls: The national heart, lung, and blood institute growth and health study. J Pediatr 148: 183-187.*

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Food Wastage — A Global Concern

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Abstract

Despite high production and an existing distribution network, India finds it difficult to feed its own people. This is due to considerable wastage. Food wastage is ironically behind the billions of people who are malnourished or hungry. The actual worth i.e. Rs. 50,000 crore of food produced is wasted in India, according to the agriculture ministry. According to a Food and Agriculture Organization report about one-third (around 1.3 billion tonnes) of food is wasted every year. Some of the reasons for food wastage are inadequate and improper storage , inefficient transport system and insufficient cold storage facilities etc. and this problem of food wastage can be overcome by using IT and mobile services, computerization and online tracking, adopting latest technology,increase in processing rate & value addition of agricultural produce. Corrective plans should be proposed to encourage fast food chains to donate excess food, utilize biodegradable supplies, and recycle the waste.

Introduction

The definition of food wastage as per FAO 1981 is *the wholesome edible material intended for human consumption, arising at any point in the FSC (Food supply chain) that is instead discarded, lost, degraded or consumed by pests.* India, the world's largest producer of milk and the second-largest producer of fruits and vegetables, is also one of the biggest food wasters in the world — wasting INR 440 billion worth of fruits, vegetables and grains every year.[19]

The actual worth i.e. Rs. 50,000 crore of food produced is wasted in India, according to agriculture ministry.[20] The challenge of feeding India's billion plus people is not really about agriculture and food production but getting the food to the people. According to the *2015 Global Hunger Index* (GHI), India topped the world hunger list and having 194 million hungry people.[1] The number of hungry people in India has increased by 65 million more than the population of France. According to a new report on global food wastage, a quantity of wheat equivalent to the entire production of Australia goes to waste each year in India.[10] By 2050, the world would need about 60% more calories per year in order to feed 9 billion people. By cutting the current food loss levels half, the size of this food gap would shrink by 22%.[4]

Levels of Food Wastage

Figure 1 : Annual cumulative wastage percentage in various percentage in various commodities (2011)

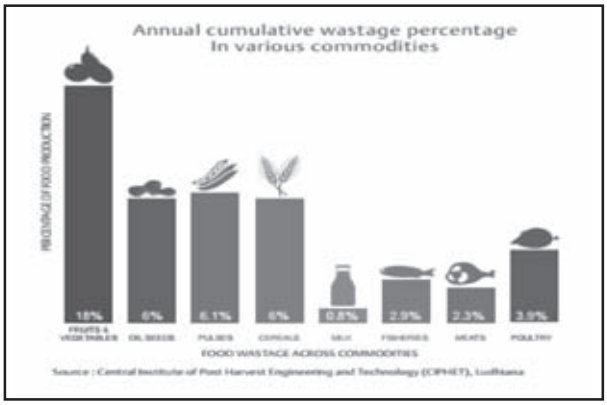
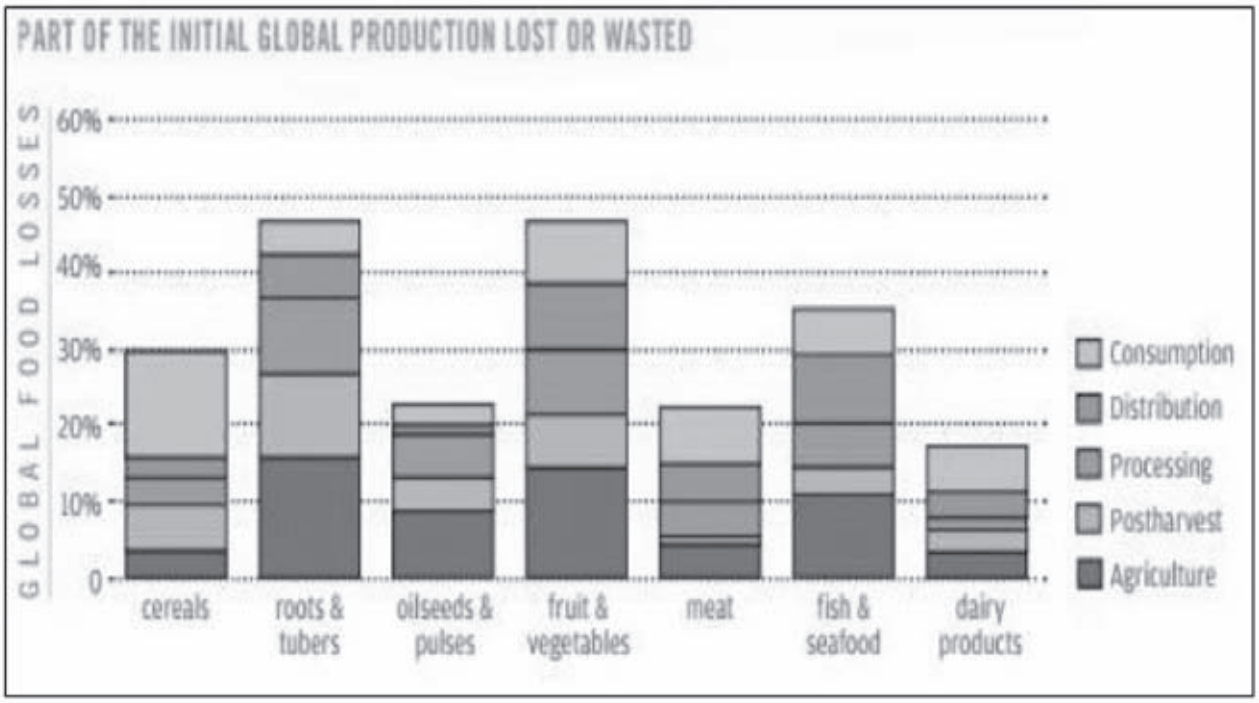


Figure 2 : Global Food Waste by Product (2012)



Source: FAO: Food Wastage Footprints, 2012

Reasons of Food Wastage

- ***Inadequate and improper warehouses*** — due to which the agriculture produce are stored in open or under tarps and hence get rotten or eaten by insects because of little protection from humidity, dust and pests and absence of erratic power supply.

- ***Insufficient cold storage facilities and refrigerated transport system*** — due to which the perishable products like fruits and vegetables rot even before reaching the market.

- ***Inefficient transport systems and poor roads*** — because of this the farmers have limited reach to mandi and hence a massive delay occurs in reaching the produce to the market. This causes decay of temperature sensitive produce.

- ***Lack of education, training and awareness*** — lack of information on new technologies and absence of modern food distribution techniques lead to significant losses. According to WRAP, lack of clarity of best before, last date etc and shoppers buying more than they need and large portion size are also the reasons for food wastage.

- ***Delayed processing*** — of agricultural produce after harvesting leads to wastage of food because of the increase in the loss rate due of normal physiological changes caused by temperature, atmospheric humidity and physical injury.

- ***Careless Handling*** — The internal bruising is caused by the careless handling of fresh produce which results in abnormal physiological damage or splitting and skin breaks, leading to increase in water loss rate and normal physiological breakdown.

Facts About Food Wastage

National Scenario

- According to the latest DIPP paper on Foreign Direct Investment (FDI), it has been

estimated that against an annual production of 180 million metric tons of fruits, vegetables and perishables, India has a capacity of storing only 23.6 million metric tonnes in 5,386 cold storages across the country, out of which, 80 per cent is used only for potatoes.[6]

- Approximately 40% of all fruit and vegetables is lost in India between the grower and consumer. Out of which 30% perishes due to the lack of cold storage facilities. Meat contributes to about 4% of food wastage but 20% of the costs, while about 70% of fruit and vegetable output is wasted, accounting for 40% of the total cost.[2]

- In 2012, the Saumitra Chaudhuri Committee indicated that the requirement of cold storage in the country is 61.3 MT against the present capacity of around 29 MT.[6]

- In 2013, it was found out that in the past 5 years, the country lost INR 45 crore ($7.2 million) worth of food grain (Data by Hindustan Times).[6]

- A report by the Institution of Mechanical Engineers reveals that about 21 million tonnes of wheat annually perishes in India and is equivalent to the entire annual production of Australia.[6]

- A report by Food Corporation of India (FCI) shows that the food grain worth INR 120.29 crore ($19.2million) was lost in storage while INR 106.18 crore ($17 million) worth in transit and the remaining INR 9.85 crore ($ 1.5 million) worth of food grains were not fit for human consumption (Data from Business Line).[6]

- The FCI was established in 1964 primarily to implement price-support systems, facilitate nationwide distribution, and maintain buffer stocks of staples like wheat and rice. But mismanagement, poor oversight, and rampant corruption means that the FCI, which gobbles up 1% of GDP, is now part of the problem. Former Food Minister K. V. Thomas *called it* a "white elephant" that needs to be revamped "from top to bottom." But the government has instead tried to end shortages by increasing production, without considering that up to half of the food will be lost.[3]

International Scenario

- It has been estimated by the Food and Agriculture Organization of the United Nations (FAO) that about one-third of all the food produced in the world for human consumption (around 1.3 billion tons) is lost or wasted each year. This includes about 45% of all fruit and vegetables, 20% of dairy products and 20% of meat, 35% of fish and seafood, 30% of cereals.[5]

- According to the report (2012) by the Waste and Resources Action Programme (WRAP) that the UK households threw about 4.2 million tonnes of avoidable food and drink waste last year i.e., equivalent to 24 meals a month.[20]

- WRAP informed that by 2030 global GHGs could be lowered by 0.2% from 7 % (2015) through food waste reductions. When food waste is decreased, this makes it more likely that an increasing population can potentially be fed from the same amount of land. It also stated that the 20-50% reduction in consumer food waste could save between US$120 and 300 billion per year by 2030.[7]

Corrective Action Plans

- ***Increase in processing rate and value addition*** — by doing this a great percentage of agricultural produce can be prevented from spoilage. A vision 2015 Action Plan has been formulated by the Ministry of food processing industry, to raise processing

levels of perishables from 6% to 20 % and increasing value addition from 20% to 35% and enhancing India's share in global food trade from 1.5% to 3%.

- ***Integrated post-harvest management solutions*** — it helps in eliminating the middlemen and connect the farmers directly to markets. It also eases the flow of produce from farms to buyers and processors due to which the wastage that occur because of long post harvest period reduces. For example, Sohan Lal Commodity Management and Star Agri provide solutions.

- ***Improved storage areas*** — the storage areas should be free from moisture, dust, dirt and also should have ample space for the storage of the grains.

- ***Integrated cold chain solution*** — According to Indian Institute of Management Kolkata, cold storage facilities are available for only 10% of the perishable food products, leaving around 370 million tonnes at risk.[10] Some companies have come up with the solution for this such as Coldstar Logistics and LEAF. These provide customized end to end solutions for cold storage and refrigerated transportation for temperature sensitive products. In India about 10 million tonnes of storage capacity of cold storage is required to reduce the 30% wastage of perishable produce.

- ***Better transportation facilities*** — the transportation in India is basically done by trucks etc. where lot of wastage occurs at the time of loading and unloading of food. If vehicles with automatic loading and unloading facility and better packaging are used, then this may help in reducing the wastage to some extent.

- ***Computerization and online tracking*** — the computerization and online tracking of the entire system from procurement time to distribution should be done to maintain the smooth running of the system. The efficiency of transportation can also be increased by using technologies like satellite monitoring, GPS which is successfully used for online shopping firms to keep track of the items to be delivered.

- ***Utilize IT and mobile service*** — these services are necessary to provide the real time market information, price transparency and personalized advisory services. A company called Ekagon provides these tools allowing about 11,000 farmers in rural India to access the weather alerts, market price information and best agricultural practices.

- ***Use latest technology for processing*** — for example, proper dryers should be available for grain drying as sun drying may lead to other type of losses and it is one of the key links in terms of minimizing postharvest losses, since it directly affects safe storage, transportation, and processing quality, as well as distribution. The New York based Anuj Jhunjhunwala[9] and his colleagues Margaret Tung and Jason Chen have developed a new app that will help to curb food wastage and hunger simultaneously by connecting the consumers with restoraunts and grocery stores having excess food at discounted prices.

- ***Implementation of government policy of creating Mega food parks*** — the government has taken the initiative of building 42 'mega food parks' across the country for pushing the processing industry. Out of these 4 are in operation including one at Bengaluru run by the retail powerhouse Future group. These mega food parks are built to provide adequate and appropriate storage facilities, better processing, better preserving of food to elongate its shelf life.[8]

- ***Support the global collaborative initiatives*** — International initiatives such

as *Save Food* and *Think, Eat, Save* bring a range of actors like government, inter-governmental organizations, private businesses to tackle the issue of food wastage. These provide a effective collaboration and sharing of best practices.

Conclusion

Food waste is a serious issue that contributes to social, environmental, and economic problems. It leads to higher rates of food insecurity, especially among needy families, causes atmospheric pollution, and results in millions of dollars wasted on inputs. To combat this issue, a corrective plan has been proposed to encourage fast food chains to donate excess food, utilize biodegradable supplies, and recycle. We found that the only way to get this initiative going is to lobby the government to pass legislation that encourages the aforementioned behaviors. In doing so, it will provide economic incentive for business owners, and social cause for community members. Of course, such plan is expensive, but with proper funding, it can be done. When it is complete, we hope to assess the progress of the plan by referring back to our recycle committee, the USRAC, and determining which companies have actually recycled. Therefore, by shifting accountability on businesses, we hope to end the issue of fast food waste and save lives.

References

1. *India tops World Hunger List with 194 million people (2015) UN Report.*
2. *Chauhan, Chetan. 2013. India wastes more farm food than China: UN , Hindustan Times, New Delhi.*
3. *Reducing food waste could save the global economy $300 billion a year (2015). Press release.*
4. *Lipinski, Brian. 2013. 10 ways to cut global food loss and waste.*
5. *Chainey, Ross. 2015. Which countries waste the most food?*
6. *Reducing Agri Food Waste – Opportunity for startups (2013).*
7. *Arsenault, Chris. 2015. Reducing consumer food waste could save $300 billion years by 2030.*
8. *Sharma, Reetu. 2014. Modi unveils Mega Food Parks to empower farmers, boost ailing food sector.*
9. *This new app can help avoid Food Wastage (2014).*
10. *Biswas, Asit K; Tortajada, Cecilia. 2014. India must tackle food waste .*
11. *Lipinski, Brian. 2013.2015. 10 ways to cut global food loss and waste.*
12. *Ali, Javed; Sharma, Aaushi; Rani, Poonam. 2015. Overview of Grain Drying and Storage Problems in India. International Journal of Engineering Research and General Science Volume 3, Issue 5, ISSN 2091-2730*
13. *Badal, Harsimrat Kaur. 2015.42 Mega Food Parks to start operations by 2019, Press Trust of India.*
14. *Whitehead, RJ. 2013. India damned by food wastage report.*
15. *Joshi, Yogesh. 2015. World Food Day: Indians waste as much food as UK consumes.*
16. *Ladva, Harshit; Manoharan, Naveena. 2015. How can India minimize the Agro-waste from farms to markets?*
17. *India waste Rs 44,000 crore worth food every day, DHNS New Delhi (2013).*
18. *Kazmin, Amy. 2014. India tackles supply chain to cut food waste.*
19. *The Food Wastage and Cold Storage Infrastructural relationship in India (2013).*
20. *Household food and drink waste in UK 2012.*
21. *Parry, Andew; James, Keith; LeRoux, Stephen. 2015. Strategies to achieve economic and environment gains by reducing food wastage. ISBN: 978-1-84405-473-2*
22. *Agarwal, Akash. 2015. "Make in India" A golden chance to unleash the new potential of Indian Food Processing Industry.*

Microbial Analysis of Tap Water from Different Zones of Delhi (North, West, East, South and Central)

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Abstract

Water quality is essential for the social, health, economic well-being of people. Testing of water quality on a regular basis is an important part of maintaining a safe and reliable source. This will help ensure that the water source is protected from contamination and that proper treatment is selected and operating properly. Water samples were collected into clean containers from different regions of Delhi which includes north, south, east, west and central. The water samples were subjected to microbiological testing of water in order to evaluate the quality of tap water of different regions of Delhi. Coliform group of bacteria can be detected by the presumptive test, confirmatory test and complete test. Acid and gas production indicating Coliform contamination (which exceeds the standard set up by the government) was observed. This explains the reason for the high incidence of water borne diseases such as diarrhea, dysentery, and typhoid etc. Thus consumption of tap water directly or using it for cooking purposes is not advisable. If it has to be used for consumption then boiling treatment should be given before using.

Introduction

Water is the most important resource for living organisms. It is used for variety of purposes like drinking, cleaning, washing, cooking etc. The safety of water is a major issue. Water quality testing is important to ensure the suitability of water for a particular use, identify any existing problem and to determine the effectiveness of a water treatment plant. The bacterial examination of water has been standardized into three tests. The first presumptive test is done for the presence of Coliform organisms. If the presumptive test is negative, it shows that the water is microbiologically safe, but if presumptive test is positive then confirmed test is performed on the tubes showing positive test and the third test is the completed test which is done to determine the morphology of the isolate. Tap water should be Coliform free . Many food borne diseases such as diarrhea, typhoid, jaundice, dysentery, cholera, and other illness is associated with impure water. E. Coli, lives longer in water as compared to most pathogens. Thus if no E. Coli are present, there should be no pathogens present in the water sample. Therefore Coliform testing is done as an Index of water pollution. The rural population of India drinks tap water having no knowledge of safety of it. In many developing countries, availability of drinking water or even water has become a major issue. Many of us depend on the tap water available from the government agencies and thus it needs to be free from fecal contamination or other sources of contamination. The aim of the study is to evaluate the quality of tap water circulating in different zones of Delhi.

Most Probable Number (MPN) Test

Multiple-tube fermentation test or most probable number (MPN) test is the most oftenly

used technique for the sanitary analysis of water.The test is used to detect coliforms (coliforms are defined as facultatively anaerobic, gram negative, non-sporing, rod shaped bacteria that ferment lactose with the production of acid and gas within 24 hrs of incubation at 35 degree celcius that make up approximately 10% of the intestinal microorganisms of humans and other animals and have found widespread use as indicator organism faecal contamination.

The test is performed sequentially in three stages presumptive, confirmed and completed test.

The Presumptive Test

In the presumptive test, a series of lactose broth tubes are inoculated with measured amounts of the water sample to be tested. The series of tubes may consist of three or four groups of three, five or more tubes. The more tubes utilized, the more sensitive the test. Gas production in any one of the tubes is **presumptive** evidence of the presence of coliforms. The **Most Probable Number** (MPN) of coliforms in 100 ml of the water sample can be estimated by the number of positive tubes.

The Confirmed Test

If any of the tubes inoculated with the water sample produce gas, the water is presumed to be unsafe. However, it is possible that the formation of gas may not be due to the presence of coliforms. In order the **confirm** the presence of coliforms it is necessary to inoculate BGLB (BRILLIANT GREEN LACTOSE BILE) broth from a positive presumptive tube. Brilliant green is a pH indicator showing color change from lush green to olive green when acid is produced. Use of ox bile in the media makes it selective for coliforms as they are resistant to bile but other organisms are not. Lactose is readily fermented by coliforms. Therefore presence of acid and gas in these tube from positive presumptive test is the confirmatory test for coliforms.

The Completed Test

The completed test is made using the organisms which grew on the **confirmed** test broth media. These organisms are used to inoculate a nutrient agar slant and a tube of lactose broth. After 24 hours at 37°C, the lactose broth is checked for the production of gas, and a Gram stain is made from organisms on the nutrient agar slant. If the organism is a Gram-negative, non-spore forming rod and produces gas in the lactose tube, then it is positive that coliforms are present in the water sample.

First Step

Material

1. **25 test tubes** of double-strength lactose broth and 50 tubes of single strength.
2. 10, 1.0 and 0.1 ml pipets
3. Water samples

Procedure

Presumptive Test

1. Take a water sample and inoculate five tubes of lactose broth with 10 ml, five tubes with 1.0 ml and five tubes with0.1 ml.
2. Apply this for the 5 water samples.
3. Incubate all tubes at 37°C for **24 hours**.

Second Step

Procedure

Presumptive Test

1. Observe the no. of tubes at each dilution that show gas production in 24 hrs. Record results.
2. Re-incubate for an additional **24 hours** at 37°C.

Confirmed Test

1. Inoculate 0.1ml of positive previous tubes samples into brilliant green lactose bile broth.
2. Incubate the tubes at 37°C for **24 hours.**

Table 1 : Result of Presumptive Test on Tap Water from Various Localities of Delhi

Area	*0.1 ml*		*1 ml*		*10 ml*	
	Colour	*Gas*	*Colour*	*Gas*	*Colour*	*Gas*
East Delhi	Positive	Negative	Positive	Negative	Negative	Negative
	Positive	Positive	Positive	Negative	Negative	Negative
	Negative	Negative	Negative	Negative	Negative	Negative
	Negative	Negative	Positive	Negative	Negative	Negative
	Positive	Negative	Positive	Positive	Negative	Negative
West Delhi	Positive	Positive	Positive	Positive	Positive	Positive
	Positive	Negative	Positive	Positive	Positive	Positive
	Negative	Negative	Positive	positive	Positive	Positive
	Negative	Negative	Positive	Positive	Positive	Positive
	Negative	Negative	Positive	positive	Positive	Positive
South Delhi	Negative	Negative	Positive	Negative	Negative	Negative
	Negative	Negative	Positive	Positive	Negative	Negative
	Negative	Negative	Positive	Negative	Positive	Positive
	Negative	Negative	Positive	Negative	Positive	Negative
	Negative	Negative	Positive	Negative	Negative	Negative
Central Delhi	Positive	Positive	Positive	Positive	Positive	Positive
	Positive	Positive	Positive	Positive	Positive	Positive
	Positive	Positive	Positive	Positive	Positive	Positive
	Positive	Positive	Positive	Positive	Positive	Positive
	Positive	Positive	Positive	Positive	Positive	Positive
North Delhi	Positive	Positive	Positive	Positive	Positive	Positive
	Positive	Positive	Positive	Positive	Positive	Positive
	Positive	Positive	Positive	Positive	Positive	Positive
	Positive	Positive	Positive	Positive	Positive	Positive
	Positive	Positive	Positive	Positive	Positive	Positive

Results

Presumptive Test : Test results are given at Table 1.

Confirmed Test : Test results are given at Table 2.

Table 2 : Result of Confirmed Test on Tap Water from Various Localities of Delhi

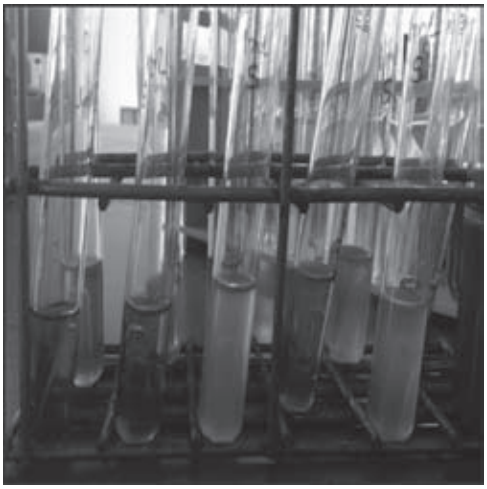
Area	*0.1 ml*		*1 ml*		*10 ml*	
	Colour	*Gas*	*Colour*	*Gas*	*Colour*	*Gas*
North Delhi	Positive	Positive	Positive	Positive	Positive	Positive
	Positive	Positive	Negative	Positive	Positive	Positive
	Positive	Positive	Negative	Positive	Positive	Negative
	Negative	Positive	Positive	Positive	Positive	Positive
	Negative	Positive	Positive	Positive	Positive	Positive
East Delhi	Negative	Negative	Positive	Positive	—	—
South Delhi	Negative	Negative	Positive	Negative	Negative	Negative
	Negative	Negative	Positive	Positive	Negative	Negative
	Negative	Negative	Positive	Negative	Positive	Positive
	Negative	Negative	Positive	Negative	Positive	Negative
	Negative	Negative	Positive	Negative	Negative	Negative
Central Delhi	Positive	Positive	Positive	Positive	Positive	Positive
	Positive	Positive	Positive	Positive	Positive	Positive
	Positive	Positive	Positive	Positive	Positive	Positive
	Positive	Positive	Positive	Positive	Positive	Positive
	Positive	Positive	Positive	Positive	Positive	Positive
West Delhi	Negative	Negative	Positive	Positive	Positive	Positive
	—	—	Positive	Positive	Positive	Positive
	—	—	Negative	Positive	Negative	Positive
	—	—	Negative	Positive	Negative	Negative
	—	—	Positive	Positive	Negative	Positive

Conclusion

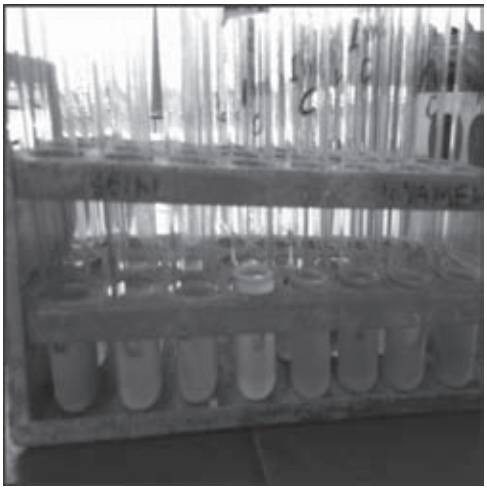
Zone	*No. of positive tubes*	*MPN / 100ml*
Central Delhi	5-4-5	430
South Delhi	0-0-1	2
East Delhi	0-1-0	2
North Delhi	5-5-4	1600
West Delhi	0-5-4	41

Acceptable levels of coliform bacteria in drinking water are less than 2.2MPN/100ml. Therefore, through this we can conclude that Central Delhi, North Delhi & West Delhi tap water is not fit for drinking purposes. However East and South Delhi water coliform count comes out in permissible limits so these can be used for drinking purposes.

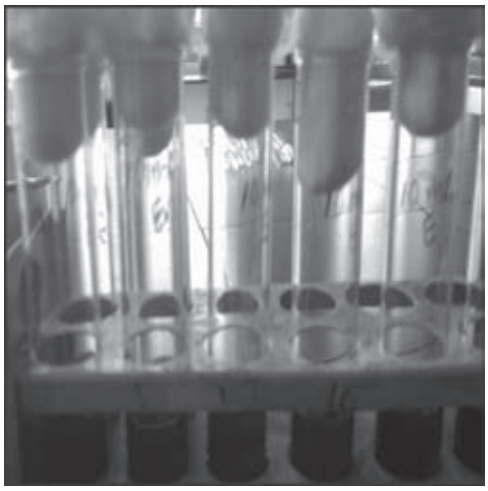
Figure 1 : Presumptive Tests



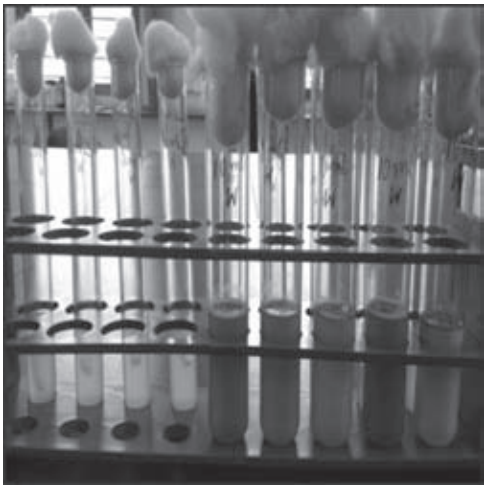
South Delhi



Central Delhi



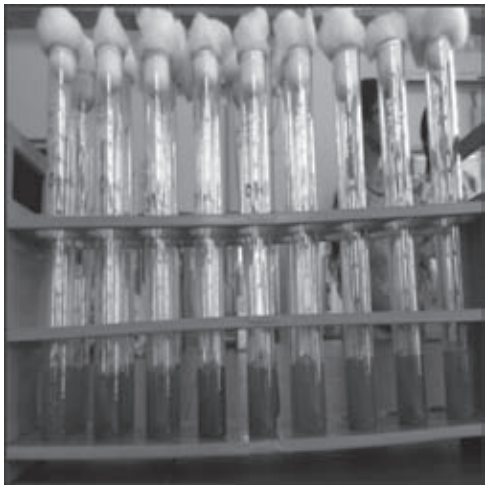
East Delhi



West Delhi

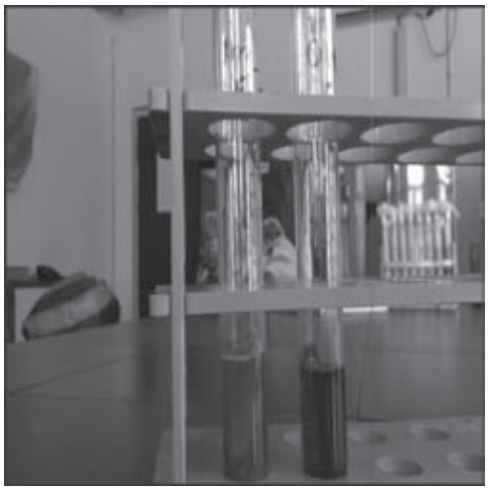
North Delhi

Figure 2 : Confirmed Tests

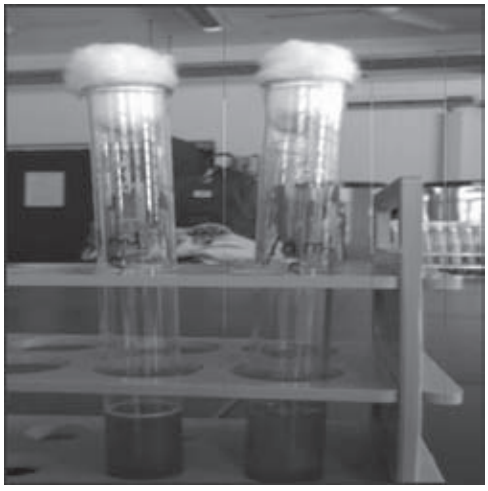


North Delhi

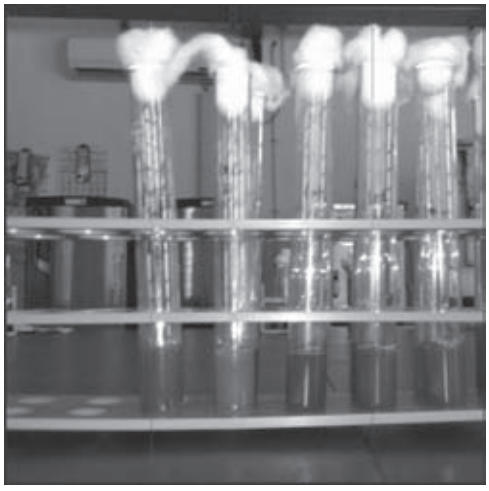
Central Delhi



East Delhi



South Delhi



West Delhi

References

1. *SohaniSmruti and IqbalSanjeeda, Microbiological analysis of surface water in Indore, India (research journal of recent sciences), Vol. 1 (ISC.2011, 323-325)*
2. *OA ojo, SB Bakare and AO Babatunde, Microbial and chemistry analysis of portable water in public-Water supply within Logos University.*
3. *Standard methods for the examination of Water and Wastewater, 13th Edition New York. American Public Health Association, 1971*
4. *Standard methods for the examination of Water and Wastewater, 12th Edition New York. American Public Health Association, 1967, p. 608.*

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Role of Folic Acid in the Development of Human Health

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Abstract

Folic acid plays a major role in the development of healthy life while it is required in minor amount. To understand the effect of folic acid is important because its vital effect cannot be avoided or it cannot be compensated with any other nutrient as it assures the appropriate development of fetus by cell division. It prevents many birth defects therefore many of the countries have started awareness and fortification of folic acid. Here the need and importance of folic acid (folate or polyglutamyfolacin or pteroylmonoglutamate) is discussed with the practices that are going on globally. While we need folic acid in micrograms but it has a huge effect on health it can alter lives by deforming normal growth of infants.

Keywords : Folic Acid, dose, health, disease and prevention.

Introduction

Folic acid is the synthetic form which is used in various types of vitamins supplements and fortified foods. While, folate is a B-9 vitamin and it is found in minor amounts in many foods. It occurs naturally in foods like dark green leafy vegetables, strawberries and citrus fruits, spinaches kale, brussels sprouts, cabbage, broccoli, legumes (peas and beans), yeast, beef extracts, orange, wheat bran and other wholegrain foods, Poultry, pork, shellfish and liver, Fortified foods. Human body needs it to make new cells. It converts in the body to the coenzyme tetrahydrofolic acid (THFA) by accepting and donating single carbon groups via '1-carbon metabolism' a vital step in the process of DNA formation. THFA is involved in the number of additional key metabolic reaction. It supports the metabolism of amino acid particularly the conversion homocysteine to methionine.

In order to be absorbed, folate polygluatamates must be broken down to monoglutamate in the digestive process. The excess glutamates are removed by action of conjugate enzymes, which are present in the cells lining the small intestine.

- About 70-85% of the monoglutamate form is absorbed. (Alcoholics detrimental to folate absorption because it interferes with the action of the conjugate enzymes as well as enterdepatic circulation of the vitamin. Thus, many people with alcoholism develop folate deficiency.)

- About half of the body's total supply of folate is stored in the liver, most in the form of polyglutamatefolate in excreted from the body through the bile and urine.

Doses of Folic Acid

Researches suggests that folic acid doses greater than 1 mg/day may increase the risk of developing colorectal cancer. Consumption of folate in excessive amounts can hide vitamin B-12 deficiency. Higher consumption of folic acid can cause nerve damage due to the lack of Vitamin B-12. So FDA limits the amount of

folate for infants, children and adults not more than 100, 300 and 400 mcg respectively as it is not good for health in excessive amounts. Although Intake of appropriate doses of the folic acid is required for a good health. So it is mandatory the consumption of the folic acid based on recommended daily allowance as mention in Table 1.

Table 1 : Doses of Folic Acid as per Age Group

Particulars	*Age group*	*Dose (mcg/day)*
Infants	0-6 months 7-12 months	65 80
Children	1-3 years 4-8 years 9-13 years	150 200 300
Adolescents and adults	Male age 14 and older Female age 14 and older Pregnant teens 14-18 years Pregnant females 19 year and older Breast-feeding females 14-18 years	400 400 600 500 600

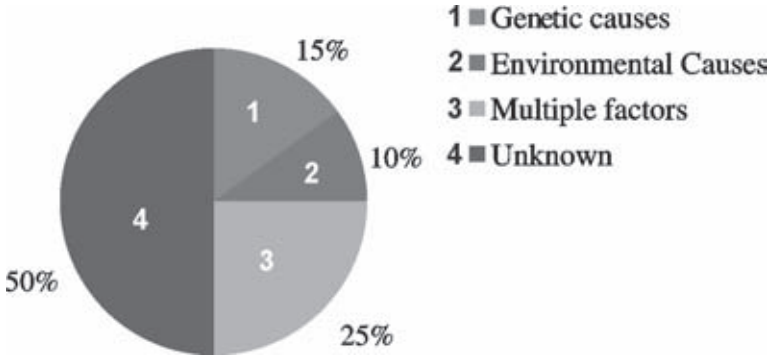
Importance of Folic acid

Folic acid is very important for the development of a healthy life. It also protect the human life by acting as a disease controller.

Daily folic acid supplementation is recommended as part of the antenatal care to reduce the risk of low birth weight, maternal anaemia and iron deficiency (WHO). It can also prevent the birth defects, heart diseases, behavioural disorders, pernicious anaemia, cancer, megaloblastic anaemia, stomach cancer and strokes etc.

Prevention of Birth Defects

There is strong evidence of a causal association between low maternal folate intake and increased risk of neural tube defects. 750 children born each year in Canada are born with a neural tube defect. In prevention of birth defects (spina bifidia, anencephaly, certain disorders of limb shortening disorders) 50%-70% relies on folic acid adequacy in the very early weeks of pregnancy. Some studies also shows that low blood folate levels are linked with increased risk of miscarriage.



Each year among 135 million new births in the world among them 3% are affected with major structural birth defects, called congenital abnormalities (CAS). We can estimate 4 million each year on 11,376 daily of children born with CA.

***Source** : Hindwani publishing corporation, Journal of pregnancy, VOL-2012, Article ID 295083, 9 pages, periconceptionalfolate deficiency and implication in neural tube defects.*

Prevention of Heart Disease

Folate along with riboflavin, B-6 and B-12 is required to help prevent a buildup of homocysteine in the blood and homocysteine is the amino acid that has emerged as a new risk factor for heart attacks and atherosclerosis.

Prevention of Behavioral Disorders

Deficiency of folic acid can also *cause* headaches, heart palpitation, a sore tongue and behavioral disorders.

Prevention of Pernicious anaemia

Folic acid supplements can prevent the anaemia particularly pernicious anaemia. Along with creating and regenerating new cells folic acid has also protective effects.

Prevention of Cancer

Studies show that folic acid reduces the risk of certain cancers, cardiovascular diseases and stroke, and cognitive diseases or mental condition such as Alzheimer's disease, age related dementia or cognitive decline and depression. It also contributes to spermato-genesis.

Prevention of Megaloblasticanemia

Its deficiency can cause megaloblastic anaemia that is why it is important in preventing this. It is important because it helps in synthesizing DNA, RNA and to repair them. It aids in rapid cell division and growth. It produces healthy RBC and prevents NTD (neural tube defects).

Prevention of Stomach Cancer and Strokes

Its deficiency can cause stomach cancer so it is important in preventing this**.** Its deficiency can also result in higher risk of strokes. A study reported that adding folic acid to foods significantly reduces stroke death by lowering homocysteine levels, which is an emerging risk factor for cardiovascular disease.

Based on the importance of folic acid, it is really needed to fulfil the requirement of folic acid to make the disease free healthy nation. For this purpose most of the practices can be followed and that are already established to fulfilling folic acid needs. According to Government of India programme guideline there is a provision for supply of iron and folic acid through tablets especially for pregnant women. Multi vitamins and folic acid pills can be taken from pharmacy stores. One must check the label to be sure that it contains 100% of the daily value of folic acid, i.e. 400 mcg. Eat a bowl of breakfast cereal that has 100% of the daily value of folic acid every day (not every cereal has same amount. So one should check the label. Folic acid is a water soluble vitamin and it is lost from vegetable during cooking.

This can be reduced by steaming and microwaving foods instead of boiling. 46% reduction in neural tube defects is reported, after the fortification of flour. In Canada folic acid must be added to white flour, enrichedcornmeal etc. Supplementation of diet with iron and folic acid (IFA) tablets is a part of the ministry of health and family welfare program for over 3 decades. Institute of research council approved that the study (iron-folic acid intake in pregnant women can really helps in good development of baby. It was done among the women of Tamil Nadu. IFA tablets must be taken for at least 90 days from the second trimester of pregnancy. Some of the answers given by the women of Tamil Nadu were as follows :

Mrs. R. said, *"I feel nausea, giddiness and vomiting as soon as I took the tablets, so I didn't take any IFA tablet."*

Mrs. P. said, *"My mother in law told, don't take IFA tablet if you take IFA tablets your baby will be black in colour."*

In many countries, cereal products are fortified with folic acid to reduce neural tube defects. Folic acid fortification may also reduce serum homocysteine levels. In 1998, the U. S. Food and Drug Administration started fortifying grain and cereal products to folic acid in order to reduce neural tube defects. The centers for disease control and prevention and the U.S public health service recommended that all women of child-bearing age take 400 mcg of folic acid every day. Fortification of wheat flour has been accepted and put into practice in a number of countries, including the USA, Canada and Chile. Following statutory fortification of all enriched cereal grain products since January 1998 in the U.S.A. The scientific advisory committee maintains its support for COMA's recommendation that bread flour in the UK be fortified at the rate of 240 mcg/100g.

Other Related Information

- The FDA ordered the mandatory fortification of folic acid of US cereal grain and flour products beginning in 1988.
- In IRAN more than half of study pregnant women were aware that folic acid was beneficial for the fetus, although only 15-4% knew it could prevent NTD's.
- Birth defect of the brain and spine happen in the very early stages of pregnancy, often before a woman knows she is pregnant, it might be too late to prevent those birth defects.
- Folic acid is easier for our body to absorb than folate.
- January 4 to 10 is folic acid awareness week.

Conclusion

We should be obtain the sufficient amount of folate in our diet by eating plenty of vegetables, fruit beans and wholegrain. These foods will be naturally rich in folate and may protect against bowel cancer, heart disease etc. Really folic acid plays a major role in the development of healthy life by keeping us disease free. So we should try to develop a healthy nation.

References

1. *Washington state WIC Nutrition Program (2012), Folic Acid and its health benefits nutrition-in-service for staff; September 2012, page 3-4.*
2. *WHO (2012). Daily iron and folic acid supplementation in pregnant women, World Health Organization, 2012, page-1.*
3. *Andrew E. C. (2004). The primary prevention of birth defects: multi vitamins or folic acid?, Int. J. Med sci 1: 50-61.*
4. *Kurian et. al (2013). Determinants of knowledge regarding folic acid in periconceptional use among pregnant mothers in southern India, IOSK. Journal of Dental and Medical Sciences. 4(3):25-29.*
5. *Douglas, R., Wilson, M.D. and Calgary, A.B. (2014). Preconception folic acid and*

Table 2 : Knowledge related information among the Study Population (n=131)

1	Subjects heard about folic acid	36.6%
2	Subjects correctly knew regarding benefit of folic acid	12.2%
3	Subjects correctly knew the food items containing folic acid.	30.5%
4	Subjects receive advice from the health care provider regarding preconception use of folic acid.	16%
5	Subjects took folic acid before conception.	3.8%

***Source** : Kurian et. al., 2013*

multi vitamin supplementation for the primary and secondary prevention of neural tube defects and other folic acid sensitive congenital anomalies, Pregnancy and Nutrition: Folate and neural tube defects, number 38c October 2014.

6. *Kumar, S. (2014). Iron-folic acid intake among pregnant women in anumanthai PHC of Villupuram, Tamil Nadu; Indian Journal of Clinical Practice. Vol. 24(9), February 2014.*
7. *Periconceptional folate deficiency and implication in neural tube defects., Journal of pregnancy, Hindwani publishing corporation Vol-2012, Article ID 295083, page-9.*

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Applications & Utilization of Waste Whey in different fields and for manufacturing valuable products : A Review

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Abstract

Whey is a liquid byproduct of cheese making process that contains most of the water soluble components and water present in milk. Initially it was thought to be as a pollutant but with increasing interest in preservation and restoration of the environment, researchers have proposed various ways of using whey in a better and useful manner. This review enlists almost all the uses of whey be it food and non- food applications. This article also gives therapeutic uses of whey and also its use in pharmaceutical industry. With this it also gives the nutritional composition of acidic and sweet whey and its uses in different industries.

Introduction

Milk is an essential food item of our diet. It helps in growth and development. Nutrients from milk can be taken in many forms. Those forms could be cheese, curd,etc. But while making of cheese a lot of waste commonly known as milk whey is generated. In ancient times this whey was drained into rivers and streams in order to get rid of it. But this led to water pollution. So in order to reduce pollution,companies started treating whey before disposal. This was the time when companies realized the importance of whey. Whey being high in proteins, carbohydrate, sugar and other nutrients led to eutrophication and high BOD levels. Then these companies started making products out of whey which could be consumed by human as well as animals. As the time passed by new ways of using the so called waste were discovered. This article enlists some of those food and non- food applications of milk whey. First we start with the composition of whey. [1]

Whey is a liquid byproduct of the cheese making process that contains most of the watersoluble components and water present in milk. Curd separates from the milk, following coagulation of the casein proteins through the action of chymosin ormineral/organic acid, the remaining watery and thin liquid is called whey. Depending on the quality and type of milk used, whey has yellow green or sometimes a bluish tinge.Thecomposition of whey depends on the quality of milk used.It also depends on other parameters such as temperature and processing techniques. Cows' milk is the most popular. This byproduct represents 85%–95% of the milk volume and retains about 55% of the

Table : Typical composition of sweet and acid whey

Components	*Sweet whey (g/L)*	*Acid whey (g/L)*
Total solids	63-70	63-70
Lactose	46-52	44-46
Proteins	6-10	6-8
Calcium	0.4-0.6	1.2-1.8
Phosphate	1-3	2-4.5
Lactate	2	6.4
Chloride	1.1	1

milknutrients. The most abundant of these nutrients are lactose (45–50 g/L), soluble proteins (6–8 g/L),lipids (4–5 g/L) and mineral salts (8%–10% of the dry extract). The mineral salts are mainly NaC1 andKC1 (more than 50%), calcium salts (mainly phosphate) and others. Whey also contains appreciablequantities of lactic and citric acid, non-protein nitrogen compounds (like urea and uric acid) and B group vitamin. Based on the production process used and the coagulation of casein, Whey is divided into two Categories: acidic whey, which has a pH less than 5 (pH < 5), and sweet whey with a pH valuebetween 6 and 7 (6 < pH < 7). The acidic whey contains fewer proteins. Because of itsacidic flavor and high salt content, it has limited use in nourishment food. Whey has an exceptional biological value that exceeds the egg protein by about 15%.

Whey can also be used to manufacture certain **beverages**. It is also suitable for the production of beer, wine and champagne. Beverage purely made of whey has also been manufactured. The production of beer from whey has been carried out since 1940s. Russians have developed a process for producing sparkling whey wine from acid whey. Example : Whevit, Fruit flavoured drinks with 75 -90% whey. Polish workers have developed a way to produce whey champagne. [8]

Demineralised Whey Powder

Demineralised Whey Powder is produced using similar equipment to that used to produce milk powder. Whey is first subjected to either electrodialysis and/or ion exchange to reduce the mineral content by up to 90%. The demineralised whey is then evaporated to about 58% total solids and then rapidly cooled to force as much of the lactose as possible into fine crystal form. The cooled slurry is spray dried. The spray-dried product is about 75% lactose. Spray drying is very fast and gives insufficient time for the lactose to crystallize, so that the lactose dries as a hygroscopic glass. This makes whey powders very sticky under humid conditions. The problem is minimized by first converting as much as possible of the lactose to the a-monohydrate crystal form, which is not hygroscopic. The resulting powder is sold mainly for use in infant formula preparations.

Whey Protein Concentrate (WPC)

Whey Protein Concentrate (WPC) is produced using ultrafiltration. This is also a membrane separation, but it selects on the basis of molecular size and is driven by pressure. Ultrafiltration retains any insoluble material or solutes larger than about 20 000 Da molecular weight. The rest of the whey stream passes through the membrane, driven by the applied pressure and is called permeate. The permeate contains most of the lactose, minerals and water from the whey. The retentate, the volume of which is about 1-4% that of the feed whey is spray dried to a powder containing 35-85% protein as desired. WPCs are made at low to moderate temperatures so that the proteins remain in their native form and the dried product is highly soluble. New Zealand is now the largest manufacturer of WPC in the world. WPCs are used as food product ingredients in hams, custards, confectionery, crab-sticks, cakes, infant formulae, sports drinks and formulated stock foods. Most WPCs contain 5-7% milk fat in the dry powdered product. This fat originated in the milk and is not removed by the cream separators through which the whey passes before ultrafiltration. The most modern WPCs use either microfiltration or ion exchange of the proteins themselves, prior to ultrafiltration, to make a protein product almost devoid of all fat. These very high value proteins find favor in clear acid sports beverages such as those for body-builders.

Lactalbumin

Lactalbuminin the traditional name for a product made from the same whey proteins as are in

WPCs, but in an insoluble form. Lactalbumin is prepared from whey by heat precipitation under acidic conditions. Here, the major whey proteins denature and aggregate into fine flocculent curd particles. These can be separated from the liquid serum by centrifugation, and then washed and dried. Lactalbumin is nutritionally very valuable and is used primarily for baking, for speciality foods and to fortify some pizza cheeses. However, as the protein is insoluble, it is not useful in helping a food to gel or foam or bind together.

Whey Protein Hydrolysates

Whey Protein Hydrolysates are manufactured by enzyme digesting, at controlled temperature and pH, either WPC or lactalbumin raw materials, and then filtering and spray drying the resulting solution. Whey protein hydrolysates find uses in high value specialist nutritional applications such as tube-feeding preparations or special dietary supplements. Appropriately hydrolysed proteins lose the ability to induce allergic reactions in susceptible people, and so can be used in hypoallergenic infant formulae. Proteins are chains of amino acids, in which the amine group of one amino acid is bound to the carboxylic acid group of the neighbouring amino acid by an amide bond.

Proteolytic enzymes catalyse the hydrolysis of these bonds Small chains of amino acids are called peptides. In a hydrolysate, we might seek to get all the protein into peptides of two to five amino acids, with few free amino acids and no larger peptides. Interestingly, some peptides released from milk proteins can be biologically active. Some can transport calcium from the gut into the blood during digestion, some can inhibit enzymes in the human body involved in excessive blood pressure and some can induce sleepy feelings. However, a problem is that some peptides can be very bitter on the tongue. Choice of the right enzymes and careful control of the hydrolysis process are required to make the desired hydrolysate product.

Milk Mineral Products

Milk mineral products rich in natural milk calcium and phosphate are valuable nutritional supplements in today's osteoporosis-sensitive world. These products are made by precipitation of the calcium phosphates in whey ultrafiltration permeate under suitable conditions of concentration, pH, time and temperature. The crystals that first precipitate quickly undergo solid state transitions depending on the conditions to which they are subjected. It is necessary to grow calcium phosphate particles to sufficient size to recover them in a good yield by centrifugation and filtration. Milk mineral is used as a natural calcium supplement in a growing range of food products including milks, yoghurts, canned milk powders, confectionary and health foods.

Demineralized Permeate Powders

Demineralized Permeate Powders are manufactured in a very similar manner to demineralized whey powders, but use ultrafiltration permeate of whey as a raw material. The spray-dried product contains about 95% lactose.

Alcohol

The lactose in whey can be converted by fermentation by a variety of organisms to products ranging from lactic acid to flavoringmaterials. Industrial Plants use yeast to ferment the whey ultrafiltration permeate or lactalbumin serum to ethanol. The ethanol is recovered by distillation to yield potable or industrial grade alcohol.

Exopolysaccharides

Exopolysaccharides (EPS) are biopolymers composed of repeated carbohydrate units. They are commonly divided in two groups: the homopolymers composed of a single type of sugar, and heteropolymers, made up of different types of sugars. Both types of polymers may

contain organic and inorganicsubstituents.They are produced extracellularly by lactic and halophilic bacteria. These compounds allow the microorganisms to adhere to the surfaces, facilitate the formation of biofilms and protect the organisms against environmental agents. EPS show functional properties that can be applied in the food and pharmaceutical industries. These include acting as emulsifiers, viscosifiers, stabilizers, texturizers, detoxifiers, and antineoplastic agents.

Whey enriched biscuits

Several studies have been carried out to make whey enriched biscuits. In this wheat flour is mixed with whey protein concentrate at different levels of substitution. This idea makes use of the high amount of nutrients in the whey. This can convert common snack into a healthy one. [9]

Artificial sausage casing

Many experiments have been carried out to produce artificial sausage casing using whey. This work is based on the whey protein film forming capabilities. This process involves heat denaturation in aqueous sloutions at around 75-100 °C. This results in intermolecular disulphide bonds which are responsible for film structure. A plasticizer is added to impart flexibility and extensibility. [10]

Other food applications

Sweet whey is also used in making confectionery products such as sweetened condensed whey, whey candies and dishes like dulce de leche.

Whey can also be used to make cheese like ricotta, mizithra, mysost and gjetost.

Sweet whey cream is used for making butter.

Whey is also used as flavor and nutrition enhancer in soups and stalks. It is also used in cooking of pasta.

Also used in making breads, muffins, pancakes,etc in place of water to get a good texture in the finished product.

It is used as animal feed for efficient production of meat and milk. Liquid whey is used to feed dairy cattle, beef cattle, swine and sheep. It is also used as feed for poultry.

Whey concentrate additions can improve the quality of grass and legume silages.

Non-food applications of whey

Bio-plastic (Coated films and Laminates)

Whey is a by-product of cheese production. It contains about 7% dry matter, rich in proteins. The dry matter contains 13% proteins, 75% lactose, 8%minerals, aprox.3% organic acid, and less than 1% fat. It is one of the most promising among all other proteins which could be used in packaging of food sensitive to water and gas permeation. Whey protein- coatings are biodegradable. As a result its multilayer films can be recycled easily. [13]

The whey is collected from cheese-making, is then filtered and spray-dried to extract the pure whey proteins. This is then used in several thin layers to create plastic film for food packaging, which is both air-tight and water-resistant.

This whey protein dissolves easily in water with the help of enzymes. The layers come apart easily and make recycling more simple. In contrast, plastics made from non-renewable materials take hundreds of years to breakdown.

It has potential to extend the shelf life of food because of its excellent oxygen barrier properties. WHEYLAYER project (http://www.wheylayer.eu) is a research project which is going on developing a sustainable packaging material by using whey proteins.

Therefore, this type of packaging reduces CO_2 emission and consumption of natural resources

in packaging production. Also, it is less expensive than other plastics or packaging material.

Water-resistant and eco-friendly adhesives for plywood

Generally, whey proteins contain compact globular proteins. The globular whey proteins mostly form compact layers or even rigid particles sometimes via adsorption without being unfolded which results in poor interfacial strength or bond strength during adhesion. The structure is unfolded which releases the hidden or bonded polar groups in whey proteins, it can also offer the additional cohesion strength of the adhesive due to the inherent intermolecular disulfide linkages, which results in more efficient and firm attachment to the wood surface by adsorption. Therefore, whey protein-based adhesive have good bond strength and water resistant which meets requirements for structural wood applications and environmental standards.

Single cell protein production

Due to its good nutritional value, the utilization of whey as protein substrate from bacteria is more efficient for the production of single cell production. Also, it is used as a carbon source for the production of yeast biomass, which is a simple treatment process for increasing the value of food industry co-products.

The single cell proteins are used in animal nutrition such as fattening calves, poultry, pigs and feed for laying hens and domestic animals etc., in foodstuffs area such as aroma and vitamin carriers, as emulsifying aids, in soups, diet recipes, ready-to-eat meals etc., in technical field as foam stabilizers, in paper and leather processing, etc.

Biogas production

Whey has high organic content, also rich in lactose content (approx.50g/l). It has good biogas potential which is a complicated substrate for the production of biomethane due to the process instability. Biogas is produced by anaerobic treatment given in one or two phases. The anaerobic treatment process includes degradation and stabilization of organic matters by microorganisms under anaerobic conditions which lead to biogas and biomass production. Biogas produced, basically is a mixture of carbon dioxide and methane.

Biomass

The idea of using a mixture of oil press water and milk whey as a substrate to produce biomass came out because of the favorable features of this fungus. The experiment was run for 5 days at 30°C under aerobic conditions using a mixture 20:80 of oil press water and milk whey respectively.

The results reported high growth of the fungus, a clearance of 54.4% of the media mixture and a 55.3% reduction in phenolization. It was concluded that oil press waste and milk whey are the cheapest and most effective substrates to obtain biomass from G. candidum.

As Manure or field fertilizer

Whey proteins improve soil aggregation as they are rich in nutritional values. It provides phosphorus and potassium, and contains simple organic compounds. The plant grows healthy and fields gave higher yield. Mostly sweet whey is used for sensitive and fragile plants by diluting them with water. Acid whey is good for too alkaline soils. It is best manure for tomato and lemon plants.

Organic acids

Whey is also used in production of organic acids like citric, lactic, succinic and propionic acid. This is achieved by fermenting whey using different microorganisms. Example : lacto-bacillus casei for lactic acid.

Biosurfactants

It was concluded that milk whey maybe a comparatively better medium to produce biosurfactants without the addition of specific nutrients to culture. [22]. Bacillus licheniformis M104 is able to grow in whey and produce a bio surfactant lipopeptide with antimicrobial activity against gram-positive and pathogenic enterobacteria. [23].

Therapeutic Applications of Whey

Anti-Cancer properties

Whey protein concentrates and glutathione modulation is used for the treatment of cancer. The primary immune-modulating mechanism is the stimulation of glutathione.

They can increase the concentration of glutathione in relevant tissues, detoxify potential carcinogens and stimulate the immunity. Whey also having good iron-binding capacity which contributes to anti-cancer potential as iron may cause oxidative damage to tissues by acting as a mutagenic agent.

Human Immunodeficiency Virus (HIV)

The person infected with HIV has deficiency of glutathione. Several researches and studies are being conducted on the uses of whey proteins on HIV-positive person. After six month research conducted on patients in which they are given a specific dose of whey protein powder. There is a significant increase in glutathione levels compared to baseline numbers.

Hepatitis

Whey protein supplementation does not show any significant changes in hepatitis C virus (HCV) patients. But, in the group of hepatitis B virus (HBV) patients , there is decrease in serum lipid peroxidase levels, serum alanine transferase levels were reduced in six of eight patients , while in five of same eight patients there is increase in plasma glutathione levels.

Cardiovascular Disease

There are many factors like a high fat-diet, increase in age , genetics, obesity, sedentary lifestyle and alcohol intake results in high risks of cardiovascular diseases (CVD). Milk is made up of more than 12 different types of fat, including free sterols, cholesterol, sphingolipids, and oleic acid. It is found that the intake of milk and milk products reduce the risk of hypertension and lowers down the blood pressure.

According to a study which was conducted on a group of healthy adult males to find out whether a fermented milk supplemented with added whey protein concentrates would affect the blood pressure and serum lipids or not. The fermented milk contains Streptococcus thermophilus and Lactobacillus casei. 200ml of fermented milk with whey protein concentrates is consumed daily in morning and evening for the period of eight weeks. After eight weeks, they have significantly higher HLDs, lower triglycerides, systolic blood pressure and lower LDL levels and total cholesterol.

Obesity

Whey contains bioactive components which act synergistically with calcium to attenuate lipogenesis, accelerate lipolysis and affects nutrient partitioning between adipose tissue and skeletal muscle. It may improve the body mass index by acting as substrate for protein synthesis. Therefore, it has made a significant impact in the weight loss.

Osteoporosis

Due to its bio available calcium content, milk aids in the prevention of osteoporosis. Milk basic protein (MBP), a component of whey has the ability to stimulate proliferation and

differentiation of osteoblastic cells as well as suppress bone resorption.

Whey protein has demonstrated a protective effect on the gastric mucosa. Whey provides protein necessary for wound healing.

Conclusion

Whey is a byproduct of cheese manufacturing industries , is highly polluting waste if they are directly dumped into rivers, lakes, seas or soil or any other water bodies. Utilization of whey protein is a much talked topic nowadays.A lot of research in this field has been done and is going on. This review has compiled all the uses of whey that has been discovered yet whether it is a food application or non-food or any other such as fuel , chemical and medicinal . Research in this field is going on which might result in discovery of more new products.

References

1. *Rajka Bonzanic, Irena Barukcic, Katrina Lisak, Jakopovic and Ljubica Tratnik, (2014), Possibilities of Whey Utilisation, Austin Journal of Nutrition and Food Sciences*
2. *Blessy B Mathew, TP Krishna Murthy,(2013), whey from Waste to Worth, International Global Research Analysis,volume-2 Issue 8, August 2013. ISSN:2277-8160*
3. *Eman.T.Yousef, (2015), Utilization of whey as one Dairy Industrial waste in the production of Alcohol, International Journal of Current Microbiology and Applied sciences (2015) 4(7):224-228, ISSN:2319-7706*
4. *Geoffrey W.Smithers (2008), whey and whey proteins from gutter to gold, International dairy journal 18 (2008) 695-704*
5. *Webb.B.H (1966),Whey – a low cost dairy product for use in candy, Journal of Dairy Science,49:1310-1313*
6. *Kosikowski, F.V and V.V Mistry, (1997) Cheese and Fermented Milk Products, 3rd, Edition, Volume 1*
7. *Kravchenko, E.F. (1988), Whey Beverages. Trends in Utilization of Whey and Whey derivative. IDF Bulletin No. 223, International Dairy Federation, Brussels, Belgium*
8. *Nelson, F.E., and W.C.Brown (1969)whey utilization in fruit juice drinks, Journal of Dairy Science,52:900*
9. *Beena Munaza, S.G.M.Prasad, Bazilla Gayas (2012), Whey Protein Concentrate Enriched Biscuits, International Journal of Science and research publications, volume 2, Issue 8,August 2012. ISSN:2250-3153*
10. *Bryne Mubururu,Dinga N.Moyo,Perkins Muredzi (2014),Production of artificial sausage casings from whey proteins, International Journal of Nutrition and Food sciences,2014; 3(6-1):30-38. ISSN: 2327-2694 (print); ISSN:2327-2716(online)*
11. *Sharratt, W.S, A.E.Peterson,ands H.E, Calbert, (1962), Effect of whey on soil and plant growth. Agron.J.54:359-361*
12. *Cortes-Sanchez Alejandro De Jesus,Valle-Gonzalez Elba Ruth, Salazar-Flores Rodolfo Daniel,Ashutosh sharma (2015) Advances in Bioscience and Biotechnology,2015,6,223-235*
13. *Markus Schmid, Kerstin Dallmann, Elodi Bugnicourt, Dario Cordoni, Florian Wild, Adrea Lazzeri and Klaus Noller,(2012). Properties of whey protein- Coated Films and Laminates as novel Recyclable Food Packaging Materials with Excellent Barrier properties, International Journal of Polymer Science, volume 2012, Article ID 562381., doi: 10.1155/2012/562381*
14. *Wenbowang, Zongyan Zong Zhao, Zhenhua Gao and Mingruo Guo; whey protein based water-resistant and environmentally safe adhesives for plywood, peer reviewed article*
15. *Jean-Luc AUDIC, Bermard CHAUFER, Georges DAUFIN, (2003) Non-Food applications of Milk components and dairy co-products: A review, Lait 83 (2003) 417-438, DOI: 10.1051/lait:2003027*

16. *Aspasia A.Chatzipaschali and Anastarsios G.Stomatis, (2012) Biological Utilization with a Focus on Anaerobic Treatment of Cheese Whey: Current Status and Prospects, Energies, 5, 34923525; doi: 10.3390/en 5093492*
17. *Janis Jasko, Eriks Skripsts, Vilis Dubrovskis, Vladimirs Kotelenecs, (2011). Biogas production from Cheese whey in two phase anaerobic digestion, Engineering for rural development, Jelgava, 26-27.05.2011*
18. *Keri Marshall, ND, MS, (2004) Therapeutic Applications of Whey protein, Alternative Medicine Review, Volume 9, Number 2*
19. *Sukumar De, Outlines of Dairy technology(2011).*
20. *Sienkiewicz, T.,and C.L.Riedel. (1990) Whey and whey utilization, 2nd ed., Verlag Th. Mann, Gelsenkirchen-Buer, Germany*
21. *Modler, H.W (1987) The use of whey as animal feed and fertilizer. Bulletin of the IDF No.- 212,pp.111-124, International Dairy Federation, Brussels, Belgium*
22. *Colak,A.K and Kahraman, H. (2013) The uses of raw cheese whey and olive oil milk waste water for Rhamnolipid production by recombinant Pseudomonas aeruginosa. Environmental and Experimental biology,11,125-130*
23. *Gomaa, E.Z (2013) Antimicrobial activity of a biosurfactant produced by Bacillus licherniformis strain M104 Grown on whey, Brazilian archives of biology and technology, 56,259-268*

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Effects of Temperature on Physical Properties of Some Fats and Oils

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Abstract

A study was carried out to determine the effect of shear rates on the viscosities of different vegetable oils at different temperatures (5 to 80°C) using Brookfield Viscometer (DV-I) and to study rheological behavior of fresh and used vegetable cooking oils & fats. Rotational Viscometry using different kinds of rotor (spindles) has been applied in order to determine relative shear stress of various samples. Also, Specific Gravity is estimated using Specific Gravity Bottle which is important in processing of a mixture of fluids as well as in the trading of oils where oils are sold on weight basis. This study aimed to study the temperature dependence of oils and fats on flow behavior and their characterization which determined the quality of oil and fat samples and thus safety for their consumption. Six different types of vegetable oil & fat samples were studied comprising three Fresh Samples purchased from a Food Store-in east Delhi and other three used samples collected from local restaurants in Mayur Vihar area of Delhi Market shops. The viscosities of the vegetable oils showed a decrease with increasing temperature .The Specific Gravity of all the samples was found to be less than 1 which showed that they were all less dense than water. It is recommended not to use same oil repeatedly as repeated use can deteriorate its quality.

Keywords : Shear Rate, Viscosity, Brookfield Viscometer, Specific Gravity

Introduction

The minor components of edible fats and oils are formed of mono and diethyl-glycerol, free fatty acids, phosphatides, sterols, fat-soluble vitamins, tocopherol, pigments, waxes and fatty alcohol. Oils are liquid at room temperature whereas fats are solid. They are insoluble in water but are soluble in such organic liquids as benzene, acetone, and ether. These ingredients were found to add flavor, lubricity, texture, and satiety to foods. Also, they have role in human nutrition being the highest energy source of the three basic foods (carbohydrates, proteins, and fats), carriers for oil soluble vitamins, and many contain essential fatty acids required by the human body.

The physical properties of edible oils depend primarily on composition and temperature. Pure fats and oils are generally white or yellow solids and liquids. Pure fats and oils are also odorless and tasteless. However, Rancid Flavor develops which produces off odor and taste.

With the increasing global demand of vegetable oil, it is intended to study the properties of oil samples through the specific gravity and viscosity.

Viscosity

Viscosity of the oils and fats is determined to study behavior at various temperatures of handling oil during processing. The knowledge of viscosity is necessary for modeling & optimization of technological operation in food industry. Viscosity is a measure of the resistance of a fluid which is being deformed by either shear

stress or tensile stress. The study of flowing matter is known as rheology, which includes viscosity. The greater the friction, the greater the amount of force required to cause this movement, which is called shear. Shearing occurs whenever the fluid is physically moved or distributed, as in pouring, spreading, spraying, mixing, etc. Highly viscous fluids, therefore, require more force to move than less viscous materials. The fundamental unit of viscosity measurement is the poise.

Newtonian Fluids

These Fluids are whose viscosity remains constant by varying shear stresses, they follow Newton's Law of Viscosity which says, shear stress and shear rate is directly proportional to each other, showing ideal flow, giving straight line graph,

$\sigma = -\eta\gamma$, where, σ = Shear Stress,
η = Viscosity and γ = Shear rate

This type of flow behavior is influenced by the variation in temperature.

Non-Newtonian Fluids

A non-Newtonian fluid is broadly defined as one for which the relationship Shear stress between shear rate is not constant. In other words, when the shear rate is varied, the shear stress doesn't vary in the same proportion (or even necessarily in the same direction). The viscosity of such fluids will therefore change as the shear rate is varied. Thus, the experimental parameters of Viscometer model, spindle and speed all have an effect on the measured viscosity of a non-Newtonian fluid. There are several types of non-Newtonian flow behavior, characterized by the way a fluid's viscosity changes in response to variations in shear rate. The most common types of non-Newtonian fluids you may encounter include: *Psuedoplastic*— This type of fluid will display a decreasing viscosity with an increasing shear rate. This type of flow behavior is sometimes called shear-thinning. Second type is *Dilatant*— Increasing viscosity with an increase in shear rate characterizes the dilatant fluid. Dilatancy is also referred to as shear-thickening flow behavior. Third type is Plastic- This type of fluid will behave as a solid under static conditions. A certain amount of force must be applied to the fluid before any flow is induced; this force is called the yield value. Tomato catsup is a good example of this type of fluid.

Specific Gravity

Specific Gravity is the ratio of the Density of the substance to the Density of the water or the ratio of the mass of the substance to the mass of an equal amount of water at specific temperature. It is very important in the trading of oils since shipments are sold on a weight basis but measured on a volume basis as well for the determination of quality and purity of oil. Also, it plays role in processing of mixture of fluids.

Aims and Objectives

The aim of this study is to determine the viscosities and the specific gravity of the different samples of edible vegetable oils (including both Fresh and Rancid oils) for the sake of scientific education to the public and then to compare their values with the PFA Standards to estimate whether the oils will meet the set specifications which will provide information on their quality issues and thus on its safety for consumption. This is because the stability or shelf-life of edible oil is essential, especially in developing countries where the storage condition for the edible oils is not ideal which can result into formation of off flavors and odors due to the formation of free fatty acids.

Justification for the Project Work

The study is to justify that physical properties like viscosity and specific gravity of different oils (Soya bean Oil, Mustard Oil, Hydrogenated Fat (Dalda) & Rancid Oils) have essential role in quality control check. Also, they have a major role in daily uses as cooking, salad, foods and

in various other industries (e.g. cosmetics, pharmaceuticals, lubricants, medicinal properties, etc.). They are key components of the diet and provide characteristic flavors and textures to foods and play many other roles as mentioned. This therefore motivated us to present project on this idea using the mentioned parameters so as to know whether it is in consonance with the PFA standard values and can be used for the edible purposes.

Experiment Work

1. ***Materials & Apparatus***

Materials

Six (06) different types of vegetable oils samples were studied comprising three Fresh Samples purchased from an east Delhi Food Store and three used rancid samples were collected — one from College Canteen, others from local restaurants and sweet shops.

Apparatus

About Brookfield Viscometer DV-I-Brookfield deals with liquids and semi-solids. Rheological relationships help us to understand the fluids we are working with so that we can either know how they are behaving or force them to behave according to our needs.

The Brookfield Dial Viscometer measures fluid viscosity at given shear rates. The Dial Viscometer rotates a sensing element in a fluid and measures the torque necessary to overcome the viscous resistance to the induced movement. This is accomplished by driving the immersed element, which is called a spindle, through a beryllium copper spring. The degree to which the spring is wound, indicated by the red pointer, is proportional to the viscosity of the fluid.

The Brookfield Viscometer is powered by a precision synchronous motor. Speed changes are affected by a gear train having either four or eight speeds. Maximum speed (RPM) will be set at full clockwise rotation and minimum speed at full counter-clockwise rotation. Four speed Viscometers have a square speed control knob with one number shown on each of four faces. The instrument's rotational speed is indicated by the number facing up. Eight speed models have a square speed control knob with two numbers on each face; by moving the knob through two complete turns, speeds may be changed in sequence.

2. ***Methods***

Determination of Viscosity

Viscometer Readings and Viscosity Calculations

1. Mount the guard leg, if used, (spindle protector) on the viscometer.

2. Attach the spindle (left-hand thread) to the viscometer lower shaft by lifting the coupling screw slightly. Hold it firmly with one hand while screwing the spindle on with the other (note left-hand thread). Avoid putting side thrust on the shaft.

3. Lower and center spindle in the test material (600 ml beaker) until the "meniscus" of the fluid is at the center of the immersion groove on the spindle's shaft.

4. To make a viscosity measurement, turn the motor switch "ON". This energizes the viscometer drive motor. Allow time for the indicated reading to stabilize. The time required for stabilization will depend on the speed at which the viscometer is running and the characteristics of the sample fluid.

5. When making a viscosity measurement, the reading should be noted and multiplied by the factor appropriate to the viscometer model/spindle/speed combination being used.

6. Refer to the table below or to the FACTOR FINDER for calculating viscosity.

7. Turn the viscometer motor switch "OFF" when changing a spindle, changing samples.

Determination of Specific Gravity

Specific gravity is important in determining the quality and purity of an oil. Water has a density of 1 gram/m^3. As Specific Gravity of all the samples is found to be less than 1, so it can be concluded that they all will have floating character on water.

Density bottle was used to determine the Specific density of oils. A clean and dry bottle of 50 ml capacity was weighed and empty weight is taken (W_0) and then filled with Oil, stopper inserted and again weight is taken (W_1). After that the bottle is cleaned again and kept for drying in the oven for about 10-15min, after which it is filled with water and then weighed again to give (W_2).

The Expression used for calculation is :

Specific Gravity = $(W_1-W_0)/(W_2-W_0)$, which is mass of the substance/mass of the equal amount of water.

Results and Discussions

It has been well established that temperature has a strong influence on the viscosity of fluids with viscosity generally decreasing with increase in temperature. This was due to the higher thermal movement among the oil molecules, reducing the intermolecular forces, making the flow among them easier, and reducing viscosity.

Sample wise results and analysis are presented below :

- **S1-USED PALMOLEIN OIL —** Since it is highly saturated vegetable fat, mainly constitutes of 43.5% palmitic and 36% oleic acids. It showed Newtonian behavior in the shear rate of 2-20 rpm at both 40°C and 80°C.Also, we clearly observed that with increase in temperature, viscosity decreases at 4, 10 & 20 rpm.

- **S2-USED KACHI GHANI MUSTARD OIL —** It showed Newtonian behavior at 60°C and 80°C as viscosity remained almost the same. But, acts as Non Newtonian fluid at refrigerator & room temperature for shear rate of rpm 2-20. At 5°C, a curdy layer of scum was observed due to cold temperature & deteriorated quality.

- **S3-USED HYDROGENATED COTTON SEED OIL** - (94% SFA) — It acts as Newtonian fluid at shear rates of 2-20 rpm at room temperature & 80°C.

- **S4-FRESH HYDROGENATED VEGE-TABLE FAT —** It showed Newtonian behavior at 40°C & 80°C for shear rates of 2-20 rpm.

- **S5-FRESH KACHI GHANI MUSTARD OIL —** It can be interpreted as Non Newtonian fluid as viscosity changes rapidly at various temperatures for shear rates from 2 to 20 rpm. This change in viscosity is due to the increase in the average speed of the molecules, thus increased collision and decreased holding ability resulting in decrease in viscosity (Forster & Ferrier, 1979).

- **S6-FRESH REFINED SOYABEAN OIL :** (PUFA 58%; MUFA 23%) — It has

less viscosity value as compared to other samples as it is thin in texture as compared to other samples. It behaves as Non Newtonian fluid at room temperature, 60°C & 80°C.

- **Also, comparison of Used v/s Fresh Kachi Ghani Mustard Oil Samples was done and following result was obtained —** While comparing at shear rate of 10 rpm, S2 is more viscous than S5 (more the no. of frying cycles, more is the viscosity of oil/fat).

  Highest viscosity is 185cp of S2, lowest viscosity recorded is 20cp in S2 only.

Conclusion

In the present study viscosity and specific gravity of oils have been studied and it may be used for quality control of the different edible oil samples. Of all the samples of oils and fats, highest viscosity is that of S2 at refrigerator temperature which is 300 cp& lowest viscosity is observed in S1 at 80°C which is 15 cp. Edible oils are mainly Newtonian fluids, but slight deviation from Newtonian behavior is observed in samples at various shear rates. This can be due to various reasons :

1. **Instrumental error** (inbuilt calibration faults; wear and tear of instrument due to long term usage; fluctuations in working of motor)

2. **Manual error** (parallax while seeing Dial reading; inaccurate spindle for particular oil sample-mainly of used samples) their viscosity has increased as compared to its fresh counterparts due to release of water, Food particles in oil/fat, breakdown of fatty acids & formation of other compounds by processes like Auto-oxidation leading to formation of compounds like volatile short chain aldehydes & ketones and free fatty acids. Auto-oxidation leads to formation of primary secondary tertiary products of Auto-oxidation.

Composition of oils and fats : Fresh samples contain additives and preservatives like antioxidants which in turn affects its behavior as a fluid under influence of temperature & shear stress/torque. Storage of samples for long time at incorrect conditions leads to formation of various oxidation products which in turn affects rheological properties like viscosity of these oils and fats. Viscosity increased with increasing degree of saturation & decreased with increasing temperature. Also viscosity slightly decreases with increasing the degree of unsaturation. Oils & fats containing a greater proportion of fatty acids of relatively low molecular weight are slightly less viscous than ones of an equivalent degree of unsaturation, but containing a higher proportion of high molecular weight acids.

This is the preliminary experimental study done which will be further extended by estimating various other parameters of oils and fats such as Free fatty acids, Acid value, Peroxide value. We will also study the change that can occur in viscosity of fresh samples after they are used for frying & also correlate individual change in viscosity of samples after particular duration of exposure of oils for frying consecutively ex. 5, 10, 20 minutes of frying time. This way we can set some standard for viscosity of fresh versus rancid samples. This in turn can help to check for adulteration or estimating quality of oils and fats.

Industrial Application : Viscosity of oils and fats is of great importance in food industry for flow characteristics in pipelines, be in for food preparation or transportation to different locations within food industry (checking for time duration versus speed). Rheological property like viscosity & also Specific Gravity of lipids helps to understand the insight into mixing of two food components with oil or within oil. All this may in turn affect sensory parameters of food prepared. Study of oils & fats at various temperatures is important to investigate its effects in processing & food preparation like frying or keeping at cold temperatures.

Table 1 : Viscosity data for different samples at different temperatures

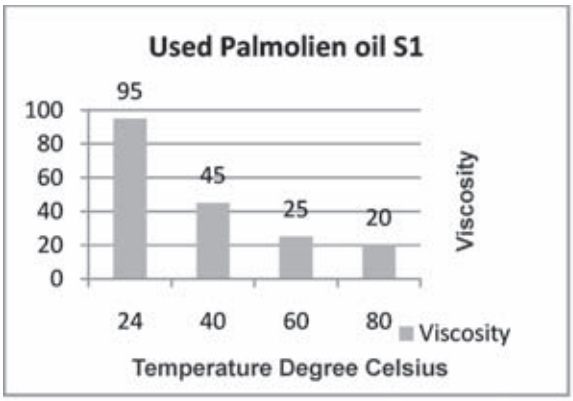
S.No.	Sample	Rpm	Viscosity(cp) at different temperatures:				
			Refrigerator Temp.	Room Temp.	40°C	60°C	80°C
1.	S1	2	-	100	50	50	25
		4	-	100	50	37.5	25
		10	-	95	45	25	20
		20	-	82.5	50	30	15
2.	S2	2	300	150	75	25	25
		4	250	100	62.5	25	25
		10	185	75	45	25	20
		20	130	72.5	45	27.5	20
3.	S3	2	-	50	50	50	50
		4	-	50	62.5	37.5	25
		10	-	50	50	25	20
		20	-	57.5	47.5	27.5	20
4.	S4	2	-	-	50	50	25
		4	-	-	50	37.5	25
		10	-	-	40	30	20
		20	-	-	42.5	22.5	20
5.	S5	2	200	100	75	50	50
		4	175	87.5	62.5	37.5	37.5
		10	165	80	45	30	25
		20	155	77.5	45	27.5	20
6.	S6	2	150	75	25	50	50
		4	125	50	37.5	37.5	37.5
		10	115	45	30	25	20
		20	100	42.5	30	20	17.5

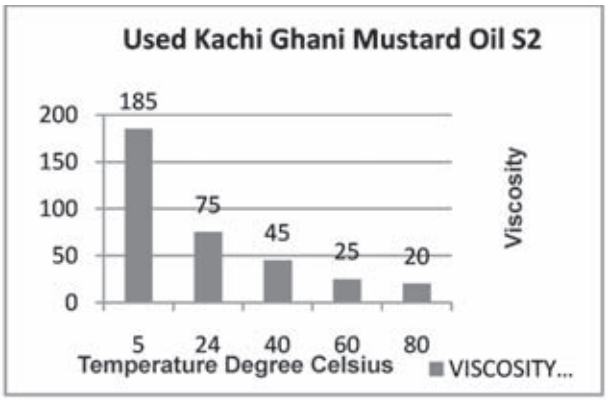
Limitation : The Brookfield viscometer that we used had limitation of working up to 80°C temperature only due to safety limits. It is also recommended not to consume food cooked in rancid or repeatedly used oils as the oil develops carcinogens after long term usage. Rancid oil forms harmful free radicals in the body, which are known to cause cellular damage and have been associated with diabetes, Alzheimer's disease. Chemicals such as peroxides and aldehydes can damage cells and contribute to atherosclerosis.

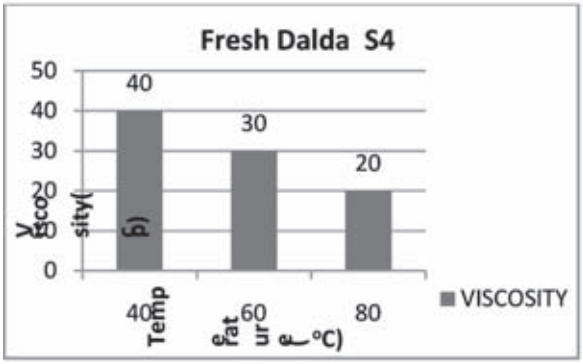
Table 2 : Specific Gravity values for different Oils at different temperatures

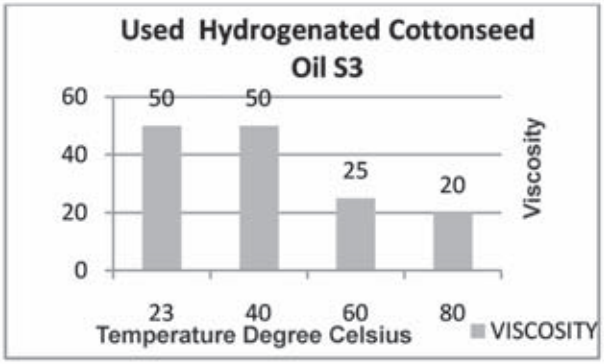
SAMPLE	SPECIFIC GRAVITY
S_1	0.9137
S_2	0.9250
S_3	0.9187
S_4	0.9132
S_5	0.9125
S_6	0.9498

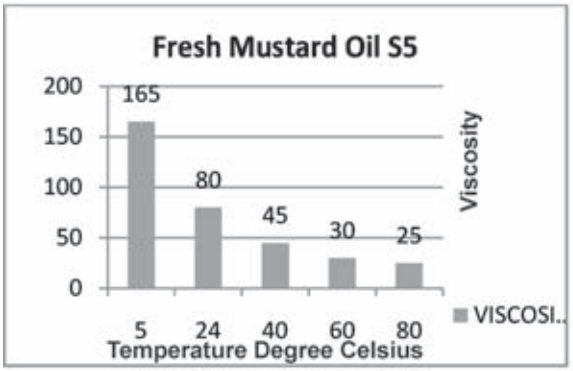
Figure 1 (a, b, c, d, e, f) Graphs showing Viscosity and Temperature relation of different oil samples at 10 rpm & Fig. 1 (g) shows the Comparison between Sample S2 & S5 showing Viscosity differences at same temperatures

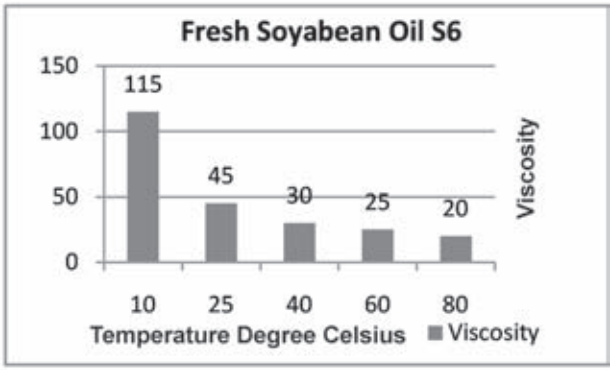


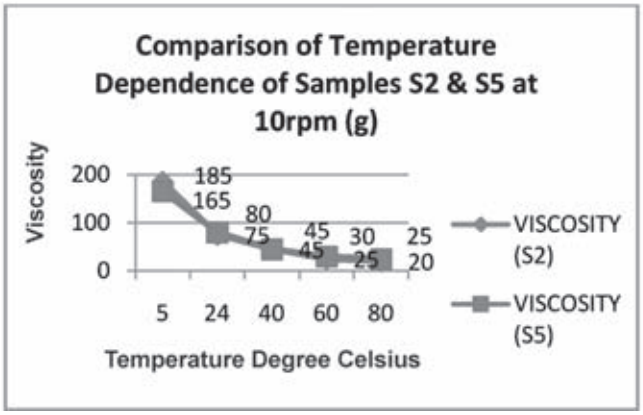












References

1. *Gary R. Takeoka, Gerhard H. Full &Lan T. Dao, August 1997, Effect of Heating on the Characteristics and Chemical Composition of Selected Frying Oils and Fats, agricultural and food chemistry, 2.91 · DOI: 10.1021/jf970111q.*
2. *Lemuel M. Diamante &TianyingLan, 3 August 2014, Absolute Viscosities of Vegetable Oils at Different Temperatures & Shear Rate Range of 64.5 to 4835 s1, Hindawi Publishing Corporation, Journal of Food Processing, Volume 2014, Article ID 234583, 6 pages, http://dx.doi.org/10.1155/2014/234583.*
3. *Abdel Moneim E. Sulieman, Mashear B. Mohammed & Ali O. Ali, Physicochemical and Sensory Properties of Traditionally and Laboratory Made Ghee (Samin) of the Sudan, Food Science and Nutrition Engineering 2013, 3(1): 7-11, 10.5923/j.food.20130301.02.*
4. *N.A. Fakhri & H.K. Qadir, July 20, 2011, Studies on Various Physico-Chemical Characteristics of Some Vegetable Oils, Environmental Science and Engineering, 5 (2011) 844-849.*
5. *Kola Odunaike, L. P. Akinyemi, J. A. Laoye, A. O Williams & O.T. Ogunmoroti, Estimation of the physical characteristics of some locally and imported edible vegetable oils samples in Nigeria, International Journal of Engineering and Applied Sciences, Dec 2013, Vol.4, No.6.*
6. *Naveed Akhtar, Qazi Adnan, Mehmood Ahmad, Ahmad Mehmood & Kalsoom Farzana, 3rd May, 2008, Rheological Studies & Characterization of Different Oils, J.Chem. Soc. Pak., Vol. 31, No.2, 2009.*
7. *E. Choe & D.B. Min, Chemistry of Deep-Fat Frying Oils, Concise Reviews in Food Science, Vol. 00, Nr.0, 2007, 10.1111/j.1750-3841.2007.00352.x.*
8. *http://ac.els-cdn.com/S0260877403004126/1-s2.0-S0260877403004126-main.pdf?_tid=7d445254-dfda-11e5-b085-00000aacb360&acdnat=1456856700_a6a59fb40c355ae4888c17130a258348*
9. *http://ac.els-cdn.com/S0260877404002201/1-s2.0-S0260877404002201main.pdf?_tid=ec1c0852-e057-11e5-81ac-00000aab0f6c&acdnat=1456910573_2160afadb 877119f6a6c687cb9730aa2*
10. *http://ac.elscdn.com/S0260877406005966/1-s2.0-S0260877406005966-main.pdf?_tid=7952ea50-e063-11e5-bf10-00000aacb360&acdnat=1456915534_d09066fa9747b88812bd256dc2f832aa*
11. *http://www.chempro.in/fattyacid.htm*
12. *https://en.wikipedia.org/wiki/Shortening*
13. *https://en.wikipedia.org/wiki/Soybean_oil*
14. *http://www.brookfieldengineering.com/education/what-is-viscosity.asp*
15. *http://www.brookfieldengineering.com/*
16. *http://www.dynamixinc.com/specific-gravity*
17. *http://joshealthcorner.blogspot.in/2011/07/physiochemical-testing-of-essential.html*
18. *http://www.foodtestingindia.com/health-effects-rancid-oils*

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Designer Foods – An Emerging Concept

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Abstract

"Let food be your medicine and medicine be your food" was a tenet espoused by Hippocrates, the most celebrated Greek physician almost 2500 years ago Food as medicine philosophy is receiving a greater attention in the name of health foods. Designer food is an evolving concept meant for reducing or delaying the risk of disease. Such foods must possess characteristics like modified composition; limit the presence of certain potentially harmful components and possibility of including certain desirable ingredients either naturally or by addition. The driving forces for development of these foods are increasing health costs, encouraging self health maintenance, consumer health awareness etc. Designer foods can be classified as designer meat foods, cereal flour, designer milk, designer eggs and designer fruits. At present, there is no comprehensive law, and regulations to regulate manufacturing, processing and marketing of designer foods in general. Legal definition and regulation of these categories of foods are yet to be developed. Major players in this fastest growing market include Nestle, Kellogg, Unilever, Glaxo Smith Kline. Lack of scientific substantiation, variation in definition and product category are the major challenges for designer food market. It is the responsibility of not only health care professionals, but also individuals to begin the conscientious effort to improve their diet. There comes the importance of designer foods where we are least concerned with harmful components.

Introduction

The concept that natural components in many foods could have a beneficial effect on human health is not new. In our country, it forms the basis of 'Ayurveda', while Hippocrates, the most celebrated Greek physician advised almost 2500 years ago 'Let food be your medicine and medicine be your food'. Over the last 25 years, the man-food relationship is particularly focussed on the ability of foods to modulate physiology and biochemistry and thereby conferring protection against a range of human diseases (Aiyar 2001).

Traditionally, food products have been developed for taste, appearance, value, and convenience of the consumer. The development of products to confer a health benefit is relatively new trend, and recognizes the growing acceptance of the role of diet in disease prevention and treatment. Interest in health benefits of foods is propelled by rising health care costs and legislative changes i.e. nutrition labelling that permits health claims for foods and associated components (Bawa *et al* 2003).

Nowadays, food as medicine philosophy is receiving a greater attention in the name health foods. Such foods are those, which are nutritious, prevent diseases and maintain health. Such foods must possess characteristics like modified composition; limit the presence of certain potentially harmful components and possibility of including certain desirable ingredients either naturally or by addition (Jimenez-Colmenero *et al* 2001). Designer foods are known by various names like medical foods, fortified foods,

nutritional foods, nutraceutical foods, pharma foods, health foods, functional foods (Joshua *et al*, 2006).

World market for functional foods has grown by about 60% over the period 1995-2000 and was valued at US $ 50,000 million in 2000. The aging population, advances in therapeutic knowledge of natural foods and changes in consumption habits are all believed to contribute to the growth of functional foods industry. As consumers become more aware of the links between diet and health, functional foods are also perceived by many as one answer — a quick fix solution — to unhealthy lifestyles (Varshney 2002).

The development of the functional foods market is based on several driving forces (Table 1) which are based on the positive contribution of functional foods to improve health in contrast to conventional foods to maintain health (Varshney 2002).

Designer Foods : The term designer food emerged some years ago to describe foods tailored to certain specific concentration and proportion of nutrients that are important to health. It was first coined in 1989 by Dr. Herbert Pierson. Designer foods are known by various names like medical foods, fortified foods, nutritional foods, nutraceutical foods, pharmaceutical foods, health foods, functional foods, fortified foods, indulgence foods. There is no internationally agreed definition for designer foods. The term 'designer foods' is subjected to change based on nutritional labelling regulations, new developments, consumer perceptions and expectations. Therefore, it can be said that designer food is an evolving concept meant for reducing or delaying the risk of diseases (Pszczola 1993).

Table 1 : Driving Forces

Demand for	**Due to**
Health and longevity;	Increasing health costs;
Quick and convenient solutions;	Greying population;
Natural products; maintenance;	Encouraging self health
Preventive measures.	Consumer health awareness and choice.

Types of Designer Foods : Designer Meat Foods, Designer Cereal Flour, Designer Milk, Designer Eggs, Designer Fruits.

Designer Meat Foods

To achieve designer meat foods, it is necessary to avoid harmful components present in meat and meat products or reduce them to appropriate limits. It is possible through eliminating a component which gives negative physiological effect by increasing the concentration of beneficial components such as antioxidants, vitamins, essential fatty acids, minerals, prebiotics, probiotics etc. It is also possible through partially replacing a food component (as excess of which is likely to have adverse effect) with an ingredient that provides additional physiological effect. This will require increased complexity and monitoring of processing. Because, our traditional aim of meat processing is to convert raw materials into edible safe, wholesome, nutritious products with extended shelf life and convenience of eating, whereas the development of designer meat foods requires additional aim, i.e., functional components either created or optimized (Anandh *et al* 2003).

Options for Designer Meat foods Development

Three options are suggested to achieve designer meat and meat products which includes production practices, post harvest techniques and reformulation techniques (Kinsella 1987). For reduction of fat, modification of fatty acid contents, and to enhance the vitamins and protein content of meat. A number of approaches are followed at production level. Such production

practices include feeding practices, hormonal treatments, genetics and breeding and biotechnological approaches (Keeton 1994).

Reformulation of existing products by blending and use of health promoting ingredients now days increasingly are used to design the meat products. Reformulation is most commonly used method to design for novel meat products because it will help to avoid undesirable composition with optimum palatability (Jimenez-Colmenero *et al,* 2001). By using reformulation techniques, it is possible to develop with range of designer meat foods with the help designer food ingredients (Anandh *et al* 2003).

Types of Designer Meat Foods

Based on the approaches involved, the designer meat foods have been categorised into the following groups :

a) Low Fat Meat Products

High proportion of saturated fat in meat fat leads to a negative health image for meat and meat products in general. Research has shown that saturated fat intake is one of the strongest predictor of high serum cholesterol level and major reason for certain disorders such a heart diseases, cancer and obesity (Giese 1996). Altering saturated fat with unsaturated fat or with non-meat ingredients may be more effective lowering the risk of chronic heart disease and obesity (Akoh 1998). With the increased interest in reducing the intake of fat, low-fat meat products are being developed as they have been perceived as more healthy by consumers (Anandh *et al* 2003).

As per standard nutrition labelling regulation, low-fat meat products should contain less than 10 per cent fat and such fat reduced meat products contribute 40 per cent reduction in calorific value as compared with traditional products (Wirth, 1988). Most successful method for altering the fat content in meat products is incorporation of non-meat ingredients as fat replacers Table 2 (Lyons *et al* 1999).

b) Low-Sodium Meat Products

Salt is an important additive in our diet. From processed meat products about 20-30% of salt intake is reported. High intake of sodium has been identified as one of the possible contributor to development of hypertension and cardiovascular diseases. According to standard nutrition labelling regulation, the low sodium foods are designated as sodium free (5mg or less), very low sodium (35-40 mg or less) and low sodium (120-140 mg) products (Reddy and Marth 1991).

There are two possible options suggested to reduce the sodium content in meat

Table 2 : Low Fat Meat Products

Meat products with % of fat	*Low fat ingredients with % added*	*Low fat meat products' % fat*
Beef Patties (20%) Pork Frankfurter (30%)	Carrageenan (0.5%)	8 12
Bologna (30%)	Oat fiber (3.5%)	10
Beef patties (20%)	Soy isolates (2%)	10
Frankfurter (30%)	Maltodextrin (2%)	12
Frankfurter (30%)	Olive oil (12%)	10
Smoked sausages (30%)	Whey protein (6%)	6

products : to reduce level of salt added during processing to the minimum level and replace all or part of the salt being used in processing with salt substitutes.

In order to reduce sodium in meat products, a number of salt substitutes have been tried and reported. These include chlorides, phosphates, lactates, potassium sorbates, hydrochloride, glutamate, glutamic acid, calcium ascorbate and, very recently, transglutaminase. The positive and negative effects of each salt substitute have been reported. Salt reduction leads to loss of functionality, increased cooking losses, poor textural properties and reduced flavour which, in turn, lower the product acceptability (Sofos 1983). Therefore, finding a suitable salt substitute is very difficult because of its unique pure salty taste and flavour enhancing properties.

c) Nitrite Reduced Meat Products

Nitrite is the critical agent in meat product processing because it stabilises colour, produces specific flavour and possibly improves textural properties and imparts preservative effect, especially against the growth of Clostridium botulinum. It also produces some harmful compounds which are carcinogenic in nature. There are three potential problems currently associated with use of nitrite in meat products, viz., the possible presence of preformed nitro samines, the presence of residual nitrite and concern for the unknown (Cassens et al 1979).

Due to health concern, nitrite reduced meat products are produced by elimination or reduction of nitrite in meat products and use of nitrosamine inhibitors. The possible alternatives for nitrite in meat products are erythrosine, betalines, n-nitrosocystine, p-hydroxy benzoic acid, EDTA salts, propyl gallate, ascorbyl palmitate, lactic cultures, nisin, acid phosphates, α-tocopherols, ascorbates, erythorbates, sorbic acid etc. (Cassens, 1997). However, the search for viable alternative to nitrite is still ongoing. It is impossible to find any single compound

Table 3 : Designer Food Ingredients

Ingredient	***Examples***	***Benefits***
Phytochemical	Allicin, Flavanol, Curcumin, Phenolic Acids	Anticarcinogenic, Antioxidant, Antihypertensive, Antibacterial
Prebiotics	Dietary Fibres; Oat Fibre, Oligosaccharide; Insulin	Retain Water, Natural Flavour, Improve Sensory Rating, Replace Fat, Replace Fat Absorption
Poly unsaturated fatty acids (PUFA)	Omega Fatty Acids, Peanut, Olive, Soybean, Fish, Sunflower Oil	Modified fatty acid profile, Reduce Cholesterol and Reduce risk Cardiovascular disease, Palatability Retained, Source of Antioxidant vitamin
Bioactive ingredients	Ascorbic Acid, Vitamin E, β-Carotene	Reduce Risk of Free Radical Related Oxidative disorders like Cataract, Cancer, Cardiac disease
Probiotics	Fermented Meat Foods; *Lactobacillus (L. caselii, L. acidophilus, L. delbrenekii) Bifidobacterium (B. longum, B. infantis)*	Anticarcinogenic Activity, Immunostimulation and Antagonistic action against Enteric pathogens

capable of replacing the functions of nitrite in meat products. The solution must therefore, be necessary to combine several compounds, which together have a cumulative effect on colour, flavour and antimicrobial activity (Anandh et al 2003).

d) Meat Foods With Designer Food Ingredients

Food components designed to modulate the human body and cure or prevent diseases are called designer food ingredients. The well known and developed designer food ingredients fall into five major categories, namely phytochemicals, prebiotics, polyunsaturated fatty acids, bioactive ingredients, and probiotics (Table 3) (Anandh et al 2003).

Designer Flour

Lab built wheat genes may improve dough quality. Wheat plants of the future might provide grain for designer flours that yield delicious, wholesome new breads, pastas, and other appetizing foods. And giving some of wheat's flour genes to other kinds of grains — barley, oats, corn, rye, or rice, for instance could lead the way to innovative, versatile flours (Joshua et al 2006).

The scientists are investigating proteins unique to wheat flour, called high molecular-weight glutenins. These glutenins are critical to making strong dough. For dough, strength is an asset because it leads to high quality yeast raised breads. Strong dough is able to trap tiny bubbles of carbon dioxide gas formed naturally by yeast during mixing and rising. Bubbles enable dough to rise, helping form high, light loaves.

Dough strength and the ability to contain gas bubbles are known as viscoelasticity. Wheat with large amount of certain high molecular weight glutenins yields flour that produces stronger dough, larger bread loaf sizes and light finer textured breads.

Scientists have anticipated that using genetic engineering to change a wheat flour protein could change the character of the resulting dough. The Albany team was the first to succeed in doing that –using biotechnology. Wheat glutenin genes inserted into other grains may lead to unique, healthful products impossible to make today. Moving one or two of wheat's high molecular weight glutenin genes into barley, for example, might open the door to popular new products from barley flour. Currently, American-grown barley is used mainly for malting and animal feed. Barley flour lacks the high molecular weight glutenins that wheat flour boasts. Although barley has flour proteins somewhat similar to those in wheat, barley flour does not make similar viscoelastic dough. They have succeeded in moving wheat glutenin genes into barley plants. Some of those plants produced kernels with good levels of wheat inside. In another venture, scientists using wheat glutenin genes furnished by the Albany researchers have produced oat plants with the borrowed wheat genes inside. Like the barley foray, oat experiments may leas to development of tasty new foods that rely on new oat flours. Today's oats are grown mostly for animal feed or processed into breakfast cereals and other foods for people. The glutenin experiments with wheat target the protein rich portion of wheat flour (US Patent).

Flour's other main component; starch might also be reworked through genetic engineering into a more marketable product. Wheat starch is composed of molecules known as amylose and amylopectin. Wheat flour low in amylose, for example, is desirable for noodle making. Reduced-amylose flours may also improve dough for frozen foods like pizza crusts or ready-to-bake breads by helping maintain flavour. Scientists suspect that boosting the amount of amylopectin in starch may concurrently reduce the amount of amylose, resulting in a value-added, low amylose flour. With the wheat genes now in hand, genetic engineers might soon be able to increase the ratio of amylopectin to

amylose. Modifying wheat starch could also make it more suitable any of hundreds of industrial uses ranging from pastes to papers to textiles (Joshua et al 2006).

Designer Milk

Nutritional and genetic interventions to alter the milk composition for specific health and/or processing opportunities are gaining importance in dairy biotechnology. Altered fatty acid and amino acid profiles, more protein, less lactose and absence of b-lactoglobulin are some challenges of 'designing' milk for human health benefits. Alteration of primary structure of casein and lipid profile, increased protein recovery, milk containing nutraceuticals and replacement for infant formula are some of the processing advantages envisaged. Final acceptability of the newly designed products will depend on animal welfare, safety and enhanced health properties of the products and increased profitability vis-à-vis conventional practices (Sabikhi 2004). Types of Modifications are as follows :

a) Milk with Modified Fat

The level of saturation of milk fat can be decreased. By feeding cow with highly unsaturated oils (e.g. soybean oil) caused depression in milk fat but increased the proportion of USFA to SFA in milk (www.extension.iastate.edu).

Conjugated linoleic acid (CLA) levels can be increased by feeding cows on a diet rich in linoleic acid and grass. CLAs reportedly suppress carcinogens, inhibiting proliferation of leukemia and cancers of colon, prostate, ovary and breast. They are antiatherogenic, antidiabetic, enhance immunity and improve bone mineralization (Eynard et al 2003 and Bauman et al 2001).

A "designer cow" called Daisy which can produce semi skimmed milk has been bred by Britain's Agricultural Development and Advisory Services (ADAS) in collaboration with Samsbury's, the retail grocer chain. Cows fed with fish oil, fishmeal or plankton can produce milk rich in omega-3 fatty acids (Murthy et al 2002).

b) Milk with Modified Protein

Modification of milk composition through transgenesis is a promising way for improving existing products and extending the uses of milk components.

A human like milk enriched with human lysozyme and lactoferrin might enhance defense against GI infections and promote iron transport in the digestive tract. It might also be possible to produce antibodies in the mammary gland that are capable of preventing mastitis infection or antibodies that aid in preventing of human diseases. Elimination of β-lacto globulin from cow's milk is unlikely to have any detrimental effects, either on cow or human formula and might actually overcome many of the major allergy problems associated with cow milk (Murthy et al 2002).

One of the major products of the mammary glands being protein, exciting research and technology opportunities extends the frontiers for better protein supplementation. Improved amino acid profile by the addition of L-leucine, L-taurine and L-phenylalanine offers additional nutritional benefits. High value, low volume therapeutic proteins can be produced in the milk of domestic animals transgenic animals can also secrete proteins such as blood clotting factors needed by human hemophilia-sufferers in their milk (Sabikhi 2004).

c) Milk with Modified Carbohydrates

Some infants and even adults are not able to tolerate milk but can assimilate dahi. This is primarily due to lactose intolerance. These

subjects suffer from an inherent deficiency in the intestinal enzyme called β–D-galactosidase which is responsible to cleave lactose to glucose and galactose. To combat this problem, low lactose milk can be produced via transgenesis. Hydrolyzed low lactose products are developed and use of fermented milk products is promoted for lactose intolerant people (Sabikhi 2004).

Table 4 : Potential Changes In Milk Through Genetic Engineering (Murthy et al 2002)

Potential Modification	***Change in Milk***
Increase Casein Content	Increased protein, better cheese manufacturing properties
Engineered Casein	Better cheese manufacturing properties, increase recovery
Remove β-lactalbumin	Decreased milk allergies
Remove fat	Easier to produce low fat milk products, decrease the butter surplus,
Produce β-galactosidase, antibodies of pathogens	Safer food, mastitis prevention

Designer Egg Foods

Designer eggs provide options for consumers who want eggs with different nutritional benefits or properties than generic eggs. A generic shell egg provides a nutrient dense, high quality, inexpensive source of protein as well as a variety of essential vitamins and mineral, with other functional components. By feeding hens special diets, eggs can offer functions above and beyond the excellent nutrition that they already provide.

The egg industry is in the process of developing new designer eggs. A small percentage of eggs (3-5%) sold are "Designer eggs" because they contain nutrients or added factors that set them apart from generic eggs. The possibilities for designer eggs are limitless. Types of Designer Egg Foods are as follows :

a) Nutritionally Enhanced

Hens fed with modified feed content produce nutritionally enhanced eggs. The designer eggs currently available include vegetarian eggs and eggs with modified fat content. Hens fed on all grain diet, free of animal fat and by-products, lay eggs which are marketed as vegetarian eggs. Vegetarian eggs may differ slightly in nutrient content from generic shell eggs depending on the nutrient content and quality of the vegetarian feed. This type of designer egg appeals to individuals who are lacto-ovo-vegetarians (Joshua *et al* 2006).

Eggs with modified fat content are very popular and in many parts of the country because these contains modified fat. These are marketed as containing less cholesterol, less saturated fat, higher amounts of omega-3 fatty acids, higher vitamin E content, and high amounts of iodine when compared to generic shell eggs. The reported cholesterol level of modified fat eggs is 190 mg per egg in comparison to 215 mg in generic eggs, and the saturated fat content is 1.0 grams compared with 1.5 grams in generic eggs (Table 5). Hens are typically fed all grain diets supplemented with canola oil, bran; kelp and vitamin E. Studies have shown that diets high in omega-3 fatty acids can reduce heart disease risk (Surai et al 2000).

b) Value Added

Organic and free range eggs are marketed as value added eggs and are available in many parts of world. Everything that effect the production of the egg must be certified organic for the egg to be considered organic,

from the hen's feed to the amount and type of space the hens live in, to the chemicals in the wash water. Organic eggs have the same nutrient content as generic eggs if the feed is of the same quality. Free range eggs are produced by hens that are not kept in cages. Hens have daily access to outdoors, depending on the climate. The nutrient content of free range eggs is identical to generic eggs if the quality of the feed is equivalent. Free range eggs are not nutritionally enhanced unless the feed is modified. Some eggs are marketed as "Hormone Free". This term is misleading as all eggs are produced from hens that are not given hormones (Joshua et al 2006).

c) Added Processing

Pasteurization has been used for years for liquid egg products; however, the technology to pasteurize a whole shell egg is relatively new. The process involves heating eggs to specific temperatures in water baths designed to heat the egg enough to destroy pathogenic bacteria but not enough to coagulate the proteins. The eggs are then cooled and packaged.

Table 5 : Comparison of fat and antioxidant levels in designer and generic eggs

Component	*Generic Egg*	*Reduced fat egg*	*Modified omega-3 egg*
Total fat (g)	4.5	4.0	4.5
Saturated fat (g)	1.5	1.0	1.5
Linolenic acid (mg)	17	>50	1000
DHA (mg)	18	>50	100-150
Total omega-3 (mg)	33	>100	100-150
Linoleic acid (mg)	500	>100	100
Cholesterol (mg)	213	190	213
Vitamin EU (IU)	1.1	7.5	6.0

(Shallo 2003)

Designer Fruits

For the past few years, growing interest has been devoted to the phytochemical content of fruits and specific attention has been given to the antioxidant capacity.

a) Breeding fruits with higher bioactive compounds

Studies showed that antioxidant activity of fruits was correlated with total phenolic content rather than with any individual phenolic compound and in some fruits like strawberries ellagic acid along with some flavonoids (anthocyanins, proanthocyanins, catechin and epicatechin) are the main compounds. These compounds are known to influence quality, acceptability and stability of foods by acting as flavorants, colorants or antioxidants. Antioxidant composition of fruits varies among cultivars and genetics play a major role. Furthermore, the phytochemical content of the fruits not only increases the quality of the fruit but also has a major impact on shelf life and susceptibility to diseases. In the last several years the objective of the AAFC fruit breeding program re-directed toward selection of genotypes rich in antioxidant phenolic compounds in order to select those individuals that not only have a good shelf life but also resistance to disease. During the past several years, new selected apple and strawberry lines were significantly different from the reference variety in antioxidant capacity and total phenolic compound. These lines not only show a resistance to disease with good shelf life but also stimulate greater interest in the nutraceutical aspects of these fruits, as well as in the processing (Khanijadeh *et al* 2004).

b) Breeding fruits with improved composition and texture

It is said that within a year you will find a fruit that you have never seen before and may

not be able to pronounce: the ***peacotum*** – with yellow flesh of peach, the texture & juiciness of plum and the velvety overcoat of an apricot. It tastes more like fruit punch that any of its parent breeds and is the first three-fruit hybrid headed for the mass market. Floyd Zaiger, a Modesto, Calif., inventor and the most prolific fruit breeder in the world, created the ***peacotum***. He has patented more than 200 new varieties of fruit, all through conventional pollination. Among his achievements, Zaiger has found a way to reduce the acid level in peaches, give unripe apricots an appealing red blush, and make white peaches –previously a mushy mess –firm enough to be shipped around the world. Another of Zaiger's successes is the ***plout*** –a plum-apricot hybrid that is available in purple, yellow or green with red polka dots (Carlye 2004).

Regulatory Aspect

Although functional (or designer) foods may indeed play such important roles, it is crucial that their manufacturers are not allowed to make claims based on hearsay. In an attempt to ensure this, the United Nation's FAO/WHO, Codex Alimentarius, the Council of Europe and National Regulators are drafting codes, allowing only "well founded and justifiable claims" to be made (Varshney 2002). Under these codes, any health promoting claim on packaging must not be misleading and must be based on sound science. It should be clearly shown that by eating the food in normal quantities, it has physiological beneficial function such as lowering blood pressure or that a positive effect on a biochemical marker, such as, cholesterol which can be measured. Examples of functional food innovations are listed in Table 6.

Table 6 : Examples of Functional Food Innovations

Food	***Functional Benefits***
Fermented milk and yoghurts with probiotic cultures	Improve digestive functioning.
Margarine, yoghurt, cheese spreads	Plant sterols & stanols reduce cholesterol and lower the risk of heart disease.
Eggs rich in omega-3 essential fatty acids	3-4 eggs a week would provide the same amount of n-3 fatty acids as recommended. To help reduce the risk of heart disease.
Breakfast cereals	Added folic acid may help reduce the risk of babies being born with spinal bifida.
Bread, muesli, snack bars	Added isoflavones may help reduce the risk of breast and prostate cancers, heart disease and osteoporosis.

(Varshney 2002)

In 1991, Japan was the first country to legislate on health claims related to foods which has since been modified in 1997 to a more elaborate provision known as 'Foods for Specific Health Use' system (FOSHU). FOSHU provides for legally permitted health claims and there are a large number of functional foods in the Japanese market that are covered by this legislation. Health claims may not be made on food and beverages without approval by FOSHU system.

To obtain approval, applicant must prove that the health claim is valid. There are no well defined standards or regulations in the USA and the European Union, nor has been finalized by the Codex Alementarius. The US Nutrition Labelling Education Act. FDA permits specific structure-function claims under the Dietary Supplements Health Education Act and health claim under the Nutrition Labelling Education Act. In India, the Central Committee for Food Standards of the Ministry of Health has made a beginning with the proposed amendments (Rules 32-A to 32-D) to the Prevention of Food Adulteration Rules (Aiyar 2001).

At present, there is no comprehensive law and regulation to regulate manufacturing, processing and marketing of designer foods in general. Legal definition and regulation of these

categories of foods are yet to be developed (Anandh *et al* 2003).

Challenges Ahead

The world over it is among the fastest growing market, by either introducing new brands or repositioning existing ones with functional enhancement. These include main stream food and drink companies viz. Kellogg, Unilever, Nestle, Tropicana, Danone; Pharma and dietetic companies viz. Novartis, Abbott, Glaxo Smith Kline, Johnson and Johnson and companies specializing in single products like Calpis, Yakult. The last couple of years have witnessed the introduction of some nutraceuticals as well as functional foods in the Indian market also, either developed or manufactured indigenously or imported from abroad. But lack of scientific substantiation to prove designer food claims poses problem in promotion of this market. Variation in definition and product category and difficulties in food regulation and control are other big challenges (Aiyar 2001).

Conclusion

It is the responsibility of not only health care professionals, but also individuals to begin the conscientious effort to improve their diet. It is estimated that more than two third of the cancer may be prevented through lifestyle modification. There are certain guidelines from health organizations such as choose most of the foods from plant sources. Limit the intake of high fat foods, be physically active and limit consumption of alcoholic beverages etc. But in our day to day life we cannot incorporate so much restriction to our diet. It is better to have foods with not much bad effect to health. There comes the importance of designer foods where we are least concerned with harmful components. So it is now crucial necessity to have designer foods in our diet. Designer foods are thus growing revolution and are set to make wonderful changes in health and nutrition. Processing and manufacture of functional foods is hi-tech area for the future. Developed countries have already started moving in this direction as consumers are more health conscious there. Food technologists should adopt this category of food for conducting research in coming years and the one who takes the lead will be a sure winner in future.

References

1. *Aiyar A S 2001 . Functional foods –from medicine chest to kitchen cabinet. Indian Food Ind 20: 8-12*
2. *Akoh C C 1998 . Fat replacers, Food Technol 52: 47-53*
3. *Anandh A M, Lakshamanan V, Anjaneyulu A S R 2003. Designer meat foods. Indian Food Ind 22 : 40-45.*
4. *Bauman D E, Corl B A, Baumgard L H, Griinari J M 2001. Conjugated linoleic acid and the dairy cow. In Recent Advances in Animal Nutrition (eds Garnsworthy P C and Wiseman J . Nottingham University Press, Nottingham, UK, pp. 221-50*
5. *Carlye A 2004. Designer fruit. Fortune Small Business 12: 24-46*
6. *Cassens R G 1997. Residual nitrite in cured meat. Food Technol 51: 53-55*
7. *Cassens R G, Greaser M C, Ito T, Lee M 1979. Reactions of nitrite in meat. Food Technol 33: 46-57*
8. *Eynard A R, Lopez C B 2003. Conjugated linoleic acid versus saturated fats/ cholesterol: their proportion in fatty and lean meats may affect the risk of developing colon cancer. Lipids Health Dis, 2: 6, www.pubmedcentral.nih.gov.htm*
9. *Giese J 1996. Fat and fat replacers: balancing and health benefits. Food Technol 50: 76-78*
10. *Joshua R M, Sudheer K P, Sinija V R 2006. Designer foods. Processed Food Ind 10: 28-36.*
11. *Khanizadeh S, Ehsani-Moghaddam B, Tsao R, Desjardins Y, Gosselin A 2004. Strategy for breeding fruits with higher content in bioactive compounds, ISHS Acta*

Horticulture 744: International Symposium on Human Health Effects of Fruits and Vegetables. www.actahort.org/books/744/744_23.htm

12. *Lyons P H, Kerry J F, Morrissey P A, Buckley D J 1999. The influence of added whey protein, carrageenan gels and tapioca starch on the textural properties of low fat pork sausages. Meat Sci 51: 43-52*
13. *Murthy G L N, Kanawjia S K 2002. Designer milk: nutritional and technological significance. Indian Dairyman 54: 49-58.*
14. *Sabikhi L 2004. Designer Milk – An imminent milestone in dairy biotechnology. Current Sci 87: 1530-35.*
15. *Shallo H E 2003. Designer foods: egg products.*
16. *Surai P F, McPherson A, Speake B K, Sparks N H C 2000 . Designer egg evaluation in a controlled trial. European J Clinical Nutrition 54: 298-305*
17. *Surai P F, Sparks N H C 2001. Designer eggs: from improvement of egg composition to functional food. Trends Food Sci Technol 12: 7-16*
18. *U.S. Patent No. 5650558, Glutenin genes and their uses. Patent application No.08/785,716.*
19. *Varshney S C 2002. Role of functional foods in diet. Indian Food Ind 21 : 41-43.*

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Effect of Chia Seeds (Salvia Hispanica) Supplementation on Buckwheat Flour in the Development of Gluten Free Bread

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Abstract

Bread is the most often consumed cereal item, hence study was conducted to develop a bread which is most suitable to all types of person having disease such as celiac disease as well as other diseases. Most of the available reports on Celiac Disease are from northern India (Punjab, Haryana, Delhi, Rajasthan, and Uttar Pradesh) where wheat is the staple cereal in the diet. Therefore, the study was conducted to see the effect of chia seeds supplementation in the development of gluten free buckwheat bread. Chia seeds belongs to the mint family (Labiatae) and are considered a pseudo cereal. Chia seed is usually rich in omega 3 (ALA), protein and fat and its completely gluten free, chia seeds also have high levels of minerals such as calcium, iron, magnesium and phosphorus. And it's rich in dietary fiber (up to 30% of the total weight Chia seed is considered as a Dietetic Nutritional Supplement by the Food and Drug Administration (FDA). Chia seed and ground whole chia seed as a novel food ingredient intended for use in bread (EFSA, 2005) common buckwheat flour which is also equally nutritionally adequate were integrated at different proportions, with the aim of improving the nutritional value of buckwheat bread. The Buckwheat bread was optimized first with a different proportions of Rice flour (Buckwheat flour: Rice flour, 50:50, 60:40, 70:30, 80:20) and subjected to sensory evaluation, results indicate that 50:50 was overall most acceptable optimized proportion as compare to other proportions, hence 50:50 was selected as control in which chia seeds were supplemented at three different levels (5%, 10% and 15%).These breads were subjected to sensory evaluation and it was found that buckwheat bread (50:50) with 10% chia seeds was most acceptable as compare to control bread. Both breads control and buckwheat bread enriched with 10% chia seeds were analyzed for proximate composition, total antioxidant activity, specific volume and microbiological quality. Shelf life study was investigated at two different temperatures i.e. at room temperature (30-32°C) and refrigeration temperature (7°C) in which their moisture content, total antioxidant activity were assessed along with microbiological quality. The results showed that chia seeds supplementation at 10% has increased proximate composition of bread like protein, ash content, total antioxidant activity, and this supplementation also has increased the specific volume of bread. Hence incorporation of chia seeds at 10% is suggested. The shelf life estimated was 6 days at room temperature and 14 days at refrigeration temperature.

Keywords : BIS, GFB (Gluten free bread), LDPE,IS,TAA, Celiac Disease

Introduction

As rightly said by Hippocrates 'LET food be thy medicine and medicine be thy food', is certainly the tenet of today. Generally, wheat bread is a good source of irreplaceable nutrients and energy for the human body but people with celiac disease are unable to consume white bread because of the presence of gluten. Therefore with increasing awareness of the disease and importance of proper nutrition and healthy lifestyle there is a growing need for products that have improved nutritional composition with potentially preventive effects on health. Buckwheat is pseudocereal which does not contain gluten therefore can be used in the

production of gluten-free products. The removal of gluten from bakery products impairs dough's capacity to properly develop during leavening and baking, which results in poor loaf volume and structure because of batter like consistency of gluten free bread dough.

The main aim of this research is to produce gluten free buckwheat bread with supplementation of chia seeds, which has good loaf volume, and high nutrition value. Furthermore, extensive research on interfacing food science, nutrition, and health is needed so that a GFB (Gluten Free bread) with both good technological and nutritional properties can be prepared and made more available to those with celiac disease, which will help them adhere to a strict gluten-free diet, so as to increase their social inclusion, and improve their quality of life. Therefore it evolved the idea of developing buckwheat bread which is supplemented with chia seeds to exalt the quality of gluten free bread.

Though a lot of gluten free bread is already available in the market but the present research has been undertaken to develop bread which is culture specific and relevant in Indian context. Therefore blends of buckwheat and rice flours were prepared at different proportions. Therefore there is a need of preparing a gluten-free product which would contain rice and buckwheat flour and chia seeds which is known as nutritionally improved one because they contain high amount of fiber, protein minerals, and antioxidants. A bread rich in protein, antioxidants, polyphenols and mineral content which is not only suitable for celiac disease patient but to all kind of diseases, by virtue of incorporation of buckwheat and chia seeds which is in itself nutritionally suffice.

In this study we have also seen the effect of chia seeds in the development of gluten free buckwheat bread, because generally gluten free breads have poor bread loaf volume due to the absence of gluten which helps in retaining the structure of wheat or refined flour, so this study was carried out in order to improve the nutritive value and volume of gluten free bread. Shelf life of bread using physicochemical and microbiological analysis of bread.at two different temperatures (Room temperature 30-32° C and refrigeration temperature 7°C) were also identified. The acceptability of product by consumer preference trials were also assessed.

Material and Methods

The present study was conducted to develop the gluten free bread using buckwheat, rice flour, and chia seeds as major raw materials. The ratio of rice and buckwheat flour (50:50), (60:40), (70:30), (80:20) was optimize for making breads with different variations and the optimized bread were then taken as a control. After optimization of control bread, the optimized control bread was then incorporated with chia seeds at different variation (5%, 10% and 15%) to get the most desired product, which had a nice crumb and texture and flavor and overall enhanced nutritional quality, which were taken as experimental bread.

Material

Buckwheat flour and Rice flour was analyzed for water absorption power. Yeast (compressed) was analyzed by using (IS: 1320-1988), yeast Dispersibility in water was determined by using (IS: 1320-1988). Dough raising capacity was also determined by using (IS: 1320-1988).Sugar was analyzed for its purity by analyzing its Sucrose content and Sulfur dioxide content .Saltwas also analyzed for its purity by analyzing its Sodium chloride content. Calcium propionate was analyzed by (IS 6031:1997). Polypouchesmade of low density polypropylene of 160 gauges were used.

Methods

Chemical Analysis of procured raw material and developed bread were analyzed by using

Proximate Composition such as Moisture Content (AOAC, 1999), Total Ash (AOAC, 1999), Protein Content (AOAC, 1999), Crude Fat Content (AOAC, 1999), Total Antioxidant Activity (Akowuah et al., 2005), volume/mass ratio of breads were also assessed (IS 12711: 1989).

Microbiological Analysis were determined according to procedure given in ISI handbook of food analysis (Part 1 general methods.) Microbiological counts were determined according to the procedure given in: IS 5402: 2002 for total plate count, IS 5401 (Part 1): 2002 for coliform count, IS 1439:1996 for E.coli, and IS 5403:1999 for yeast and mould count. Organoleptic evaluation : Over all acceptability of product was rated on hedonic scale (9 point scale).

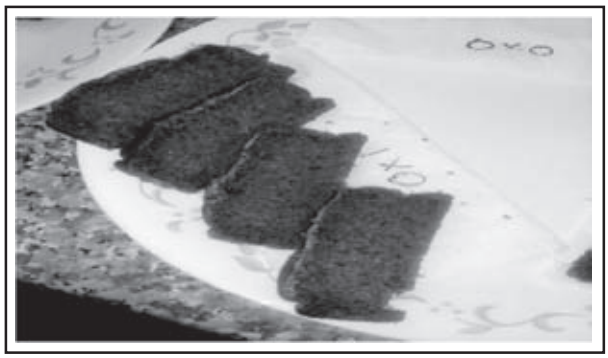
Shelf-life Study of the Product

The samples were packed in Low Density Poly Propylene bags of 160 gauge and were analyzed on 0,1,2,3,4,5,6,7,8 days (at room temperature) for Moisture Content AOAC, 2000), Microbiological parameters such as (Total plate count (TPC) (IS:5402:2002), Escherichia coli (E. coli) (IS: 14397:1996), Coliform count (IS: 5401 Part 1, 2002, Yeast and Mould (IS:5403-1999) along with Total Phenolic Content. The shelf life was also assessed at Refrigeration temperature, for Moisture Content, microbiological quality and Total Phenolic Content of the product on alternate days.

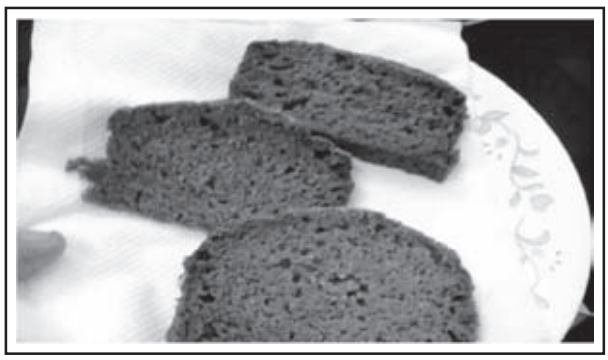
Result

The process were standardized, and breads were prepared with different proportions of (Buckwheat flour : Rice flour) 50:50, 60:40, 70:30 and 80:20 while other basic raw materials, and processing conditions were kept constant. Breads were then subjected to sensory evaluation by a selected group of panelists and it was found that 50:50 proportion of Buckwheat flour: Rice flour gained maximum acceptance score.

50:50 Bread (Control)

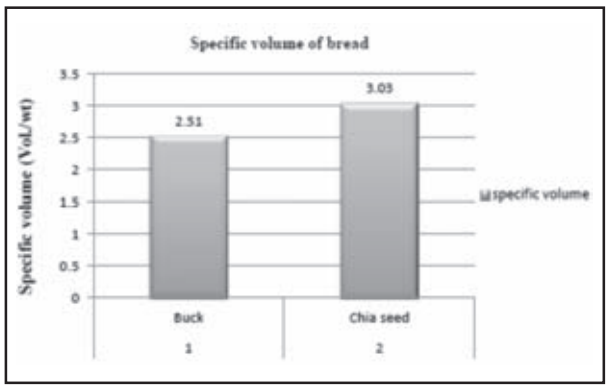


Control Bread with 10% Chia Seeds



Therefore 50:50 proportions were selected for supplementation of chia seeds at different proportions (5%, 10% and 15%). The buckwheat bread with a ratio of 50:50 was prepared differently in which chia seeds were supplemented at 3 different levels (5%, 10% and 15%) and other raw materials processing conditions were constant.

Graph 1 : Graphical representations of effect of (10%) chia seeds supplementations in the development of buckwheat bread (50:50) in specific volume of bread



The prepared breads with 3 different levels of chia seeds were subjected to sensory evaluation by a group of panelists and buckwheat bread (50:50) with a ratio of 10% of chia seeds was most acceptable. The prepared breads control (50:50, Buckwheat flour : Rice flour) and buckwheat bread (50:50, Buckwheat flour: Rice flour) with 10% chia seeds were analyzed for proximate composition, microbiological quality along with total antioxidant and total phenolic content. Shelf life of the product was evaluated at two different temperature i.e. room temperatures (30-32°C) and at refrigeration temperature (7°C). During the shelf life study of the product the product was analyzed for moisture content, microbiological quality and total phenolic content and the salient findings are as follows :

Table 1 : Proximate Composition of Developed Bread

S. No.	*Sample*	*Moisture Content (%)**	*Ash Content (%)**	*Protein (%)**	*Total Phenolic content (GAE/100g)**	*TAC (%)**	*Peroxides **	*Total Solids (%)*
1	Control[a]	38.55± 0.35	3.775± 0.021	3.245± 0.049	1.946± 0.002	74	0.445± 0.035	61.7
2	Experimental bread[b]	47.7± 0.1	4.63± 0.02	4.65±0 353	2.13415± 0.002	83	0.25±0.01 4	52.4

** Values indicate Mean ± SD of duplicate readings.*
a Indicate Buckwheat bread (50:50, Buckwheat flour : Rice flour).
b Indicate experimental bread with (50:50, buckwheat: rice flour, with 10% chia seeds).

Summary and Conclusion

The chia seeds bread has maximum amount of moisture, ash, protein total phenolic and total antioxidant properties (47.7+0.141, 4.63+0.028, 4.65+0.353, 2.13415+0.002 respectively) as compared to control bread (38.55+0.353553, 3.775 + 0.021213,3.245 + 0.049497, 1.946 + 0.002828 respectively). Whereas specific volume was least in control bread as compare to buckwheat bread with 10% chia seeds (2.51ml/g, 3.03ml/g respectively). And results shows that at room temperature chia seeds supplemented buckwheat bread has maximum amount of retention of TP content (1.0059 + 0.004243) as compare to control breads (1.0175 + 0.009) during the shelf life study of 7 days. At refrigeration temperature on 7th day (14 days alternatively) buckwheat bread supplemented with 10% chia seeds has maximum amount of total phenolic content 1.0065 + 0.003 as compare to control bread 0.747 + 0.00282. The TP content was higher for chia seeds (10%) supplemented buckwheat bread as compare to control breads during the shelf life study period at both temperatures.

Microbiological quality indicates that all microbiological parameters assessed at two different temperatures were within the specification range given by the EUROPEAN standards. And it can be infer that shelf life of the product was 7 days on storage at room temperature, while the shelf life has increased up to 14 days during storage of breads at refrigeration temperature.

The prepared buckwheat bread dough with chia seeds supplementation was analyzed for gluten content by ELISA testing and it was found that the prepared bread dough has 7ppm or 7mg/kg of gluten which is much below than the recommended by CODEX and FDA (min 20 ppm) which implies that the raw materials

used i.e. chia seeds and buckwheat flour were free of gluten, and due to which the developed bread were completely free of gluten. Cost of the product has been estimated as Rs. 30/-.

References

1. *Aleksandra Torbica, Miroslav Hadna Cev, Tamara Dapcevi c. Rheological, textural and sensory properties of gluten-free bread formulations based on rice and buckwheat flour. Food Hydrocolloids 2010; 24:626-632.*
2. *Bonafaccia G, Marocchini M, Kreft I. Composition and technological properties of the flour and bran from common and tartary buckwheat. Food Chemistry 2003; 80:9–15.*
3. *Codex Standard for Gluten-Free Foods. http://www.codexalimentarius.net/download/standards/291/CXS_118e.pdf. Accessed January 15, 2008.*
4. *Gallagher E, Gormley T. R, Arendt E. K. Recent advances in the formulation of gluten-free cereal based products. Trends in Food Science and Technology 2004; 15(3-4):143-152.*
5. *Stahel N. Dairy proteins for the cereal food industry: Functions, selection and usage. Cereal Foods World 1983; 28(8): 453–454.*
6. *Fessas D, Signorelli M, Pagani A, Mariotti M, Iametti S, Schiraldi, A. Guidelines for buckwheat enriched bread. Journal of Thermal Analysis and Calorimetry 2008;91:9-16.*

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Applications and Utilization of Coffee Processing Waste — A Review

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Abstract

Coffee is an evergreen shrub indigenous to Central Africa and Asia. Coffee Industries are a key sector in the global economy. After the processing of coffee, we obtain certain by-products which mainly comprise of: Spent Coffee Grounds [SCG],Coffee husk, Coffee Silverskin [CS] (epidermis of the coffee),Coffee Pulp[CP]. These by-products are of immense importance as they exhibit certain antimicrobial, anti-bacterial, pre-biotic properties and have food and health application too .Also, they are known to make some composting agents for fertilizing certain plants. They also have high fiber and phenol content. Therefore, it is required to recycle these by-products due to their potential uses in various industries. It is necessary to spread awareness regarding the applications of these by-products as it important from economical and environmental viewpoints. Many nutrients from these by-products can be used for enrichment in different foods or even medicines.

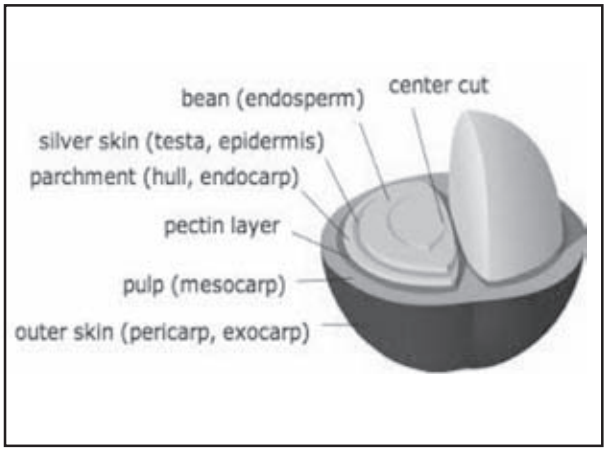
Introduction

Coffee is one of the most popularly consumed beverages in the world with a production of over 7 million tons of green coffee beans. The coffee tree belongs to the family Rubiceae, genus, COFFEA. There are many species of coffee but three species are of commercial importance: Coffea Arabica, with the best quality coffee beans; Coffea Robusta, with lower quality coffee beans; Coffea Liberica, with still lower quality coffee beans[1].

Coffee flowers are white clustered blooms with a sweet smell. The coffee berries are initially green in colour and turn red on ripening. During the processing of coffee, the husk, pulp, parchment and silver skin are removed .The quality of coffee depends upon the manner of processing. There are two basic methods of coffee processing :

1) Dry Method — This method incorporates the drying of berries followed by hulling.
2) Wet Method — This method involves fermentation for the removal of mucilaginous material.

Coffee is roasted because raw or green coffee has no characteristic aroma or flavor. Basically, the decomposition of chlorogenic acid products contribute to the aroma of coffee.Some chemical changes also take place during roasting like the decomposition of carbohydrates, caramelization, volatile fatty acids are escaped, waxes get cracked to form simpler ones.



Coffee by-products represent about 43% of the fresh weight of coffee pulp[5]. Coffee Pulp[CP] is a by-product obtained from wet method of processing or semi-dried processing.From the production of soluble coffee, a solid by-product is obtained known as spent coffee grounds [SCG], Coffee Silverskin {a thin seed skin}[CS] are produced during roasting and Coffee Husk,a fibrous mucilaginous material obtained before the roasting process. Due to their high organic material content and the presence of compounds such as caffeine ,tannins, and polyphenols[3], they can have negative effect on the environment due to their higher oxygen need for de-composition. Burning of these by-products lead to the production of greenhouse gases[16].

The main objective behind this article is to enlist the various uses of Coffee by-products which have not got much attention in the Indian subcontinent.

Spent Coffee Grounds

SCG are obtained during the treatment of raw coffee powder either with steam or hot water for the preparation of instant coffee. They have a high organic load followed by high humidity and a fine particle size. They are used as animal feed for ruminants, pigs, chickens and rabbits as they increase the lactation period[3]. SCG are used for pellet production due to their high calorific value (5000Kcal/kg).[4] When wet SCG was through through a process of ultrasound filtration in the presence of either binary or single solvent like n-hexane or methane,it was observed that SCG transformed into Fatty Acid Methyl Esters[FAME] which could then be used as a bio-fuel.[19] Bio-diesel from SCG has the advantage of having natural polyphenol anti-oxidants and therefore with higher oxygen stability.A research was carried out in which a soil sample was treated with composted SCG and this resulted in an enhancement of plant growth as compared to the controlled sample, leading to an increase in minerals especially, Nitrogen. SCG can act as soil conditioners.[6] It was found that the SCG have 500 times greater antioxidant activity as compared to that of Vitamin-C[4] which can play a very impotant role in food application.[4] They also have genoprotective effects in human cells. The wastes from espresso machines were collected and a solvent extraction procedure was carried out and more than 90% of the phenolic compounds were recovered.[9] Activated carbon production from SCG by alkaline extraction method is another important application. Charcoal can also be formed from coffee grounds by the method of carbonization with the addition of binders like starch.[7] During the brewing of coffee, potentially bio-active compounds like nicotinic acid, trigonelline, quinolinic acid, tannic acid are partially extracted which results in SCG with a higher content of these bio-active compounds.[9] SCG contain di-terpenes namely Cafestol and Kahweol. The former one has anti-inflammatory properties and when it is combined with the latter they it could possess anti-carcenogenic activity as well.[11] Around 10-15 % of oil can be extracted from SCG which gives a high biomass as well as produce poly(3-hydroxybutyrate). Therefore, they contain a high amount of free fatty acids which can be utilized by the bacteria culture. SCG along with microwave heating was used for removal of ammonia odor for gas cleaning deodorizing columns.[16] If oil were extracted from SCG (known as defatted SCG), then the fine granular powder obtained would be similar to sawdust which could be used as a filler in various compositions.[17] A protein substance called “Cafeolgumia” present in SCG can be used as a nutrient. The solid state fermentation of SCG act as a sole Carbon source.

Coffee Silverskin

They are obtained as a by-product of roasting with a high concentration of soluble dietary fiber (86%of the total anti-oxidant to the concentration of phenolic compounds)[3] and used as a therapeutic material for diseases like diabetes.[20] Proteins, extractives are also found

followed by glucose, arabinose, xylose, galactose, mannose. They have a high pre-biotic activity. These silverskins can be grounded to powder form for usage. Their surface layer contain fibrous tissues mainly cellulose and hemi-cellulose. During the roasting of coffee addition of sugar namely torrefacto, increases the anti-oxidant and anti-microbial activity of CS.[4] CS support the growth of bifidobacteria in vitro, which have some beneficial effects, increasing their metabolic activity.[11] CS are used as source of dietary fiber in combination with stevia which was used as a sweetening agent, to improve the nutritional quality, color, flavor and texture of biscuits made from wheat flour.

There was a great impact on rheological properties, water activity and viscosity of biscuits on adding CS.[5] They also contain bioactive compounds such as chlorogenic acid which prevent ageing, oxidative stress, control body weight and Caffeine which have cosmetic, food and health application.[10] CS extend their usability in compost processing and also as a part food additive due to their anti-microbial activity. It was also found that the inhibitory properties of CS was similar to that of disodium chromoglycate which an anti-allergen against hyalurodidase.[21] CS was magnetized with a ferrofluid containing magnetic nanoparticles, which could be used as an adsorbent for the removal of pollutants from waste water. Another adsorbent for this purpose is C which requires higher costs for usage.Therefore, CS can be used as an alternative.[22]

The most important minerals present in SCG and CS are micro-nutrients essential for human health. When a comparison was carried out between SCG and CS, it was found that CS has a higher level of ashes and is highly abundant in Potassium. Both of them have a high water holding capacity.[14] CS contain a large amount of chlorogenic acids(CGA) which reduce the risk of Atherosclerosis and various types of Cancer.[15]

Difference between Coffee Silverskin and Coffee Husk is just that CS is a by-product obtained from the roasting process whereas Coffee Husk is obtained prior to roasting.

Coffee Husk

They are used as a fuel and have a potential for fermentation for the production of variety of products. They act as a substrate for the growth of mushrooms and contain a high amount of carbohydrates.[3] For the removal of cationic dyes from aqueous solutions, they can be used as a sorbent. They also act as a substrate for production of aroma components [alcohols, esters, aldehydes, ketones][7] They are rich in caffeine and tannins, so, they can be used in energy drinks and energy bars. They can also be used to make smoothies, granolas and juices.[8] Coffee husks were treated with thermophilic fungus for the biomethanation process where the cow dung sample was used as 'control', after a few days it was discovered that the amount of bio-gas produced by coffee husk was more than that produced by the controlled sample.[23] They could also be used as potential colorants as a source of anthocyanins. They consist of lignocelluloses: cellulose (50%), hemicelluloses (38%) and lignin. Coffe Husk is composed of dried skin, pulp and parchment.[8]

Limitations

(1) High lignin content (~25%) with respect to animal feed is harmful.[3]

(2) If fresh SCG is used in excess, they can degrade the growth of plants.[6]

Coffee Pulp

It is the first product obtained during the processing of coffee, and comprise of 29% of the weight of whole coffee berry. It is mainly obtained from wet processing method of coffee. An experiment was carried out in which the production of coffee pulp molasses, which were

produced by hydrolyzing the coffee pulp for 4-6 hours with 6% HCl solution.[24] Pectin is a hydrocolloid widely used in food industry as a thickening and stabilizing agent. Pectin content of CP was found to be 1.9 times richer than coffee mucilage. Pectin is used as gelling agent in food industry. Though, these products contain pectin but are not used on fermentation system. For Example : Pectinase plays an important role in coffee berries processing. For the production of pectinase, natural pectolytic microflora that are present on the cherries are allowed to grow and metabolize.

This enzyme facilitates the hydrolysis of pectin envelope around the coffee bean and has an economical importance in the coffee processing industry and the CP act as substrate for the pectinase.[25] CP contain the highest amounts of lignin,lignified proteins and caffeine, so, caffeine, which has various applications, can be extracted from CP.Other uses of CP are similar to that of other by-products like mproduction of bio-gas,bio-fuel,anti-oxidant characteristics, etc.

Conclusion

All the by-products of coffee contain the same fuctional element but differ in proportion.It can be concluded that, the Coffee Spent Grounds, Coffee Silverskin and Coffee Husk, can have various applications in the agricultural sector, food industry, cosmetic industry, also in the poultry sector as they have the capability to increase the lactation period of many animals followed by an increase in their weight. Disease suppression from these by-products is also under study. More research work is being done on this topic as these products have a very high potential for numerous applications. The disposal of these by-products leads to the loss of nutrients.

These products are cost effective and they are not difficult to obtain.They are found in abundant quantities due to the fact that only 9% of the coffee bean is used for the preparation of coffee beverage and the rest is waste. These by-products can be used as substitutes for Carbon-source for generating bio-diesel.

References

1. *N. S. Manay, Coffee pg 131-132, 2008*
2. *Mussatto,S.I Machado,E.M.S, carneiro,L.M, Tixeira {Ethanol production by different yeast strains from coffee industrial wastes}*
3. *World Journal of biologysciences vol. 2,2014,Wolaita Sodo University,Habtamu Lemma Didanna {Feed value of coffee waste for livestock feeding}*
4. *Ana Jimenez-Zamora, Silvia Pastoriza, Jose A. Rufian Henares,University of Granada, Spain, Departmento de Nuticion Bromotologia {Revalorization of coffee by-products} 2015*
5. *Institute of Food Science and technology and nutrition {Use of coffee silverskin and stevia to improve the formulation of biscuits} Polish journal of food and nutrition science, 2014*
6. *Mountain Research Centre (CIMO), School of Agriculture-Polytachnic Institute Of Braganca, Apolonia, Apartado, Portugal By —Teresa Gomes, Jose Alberto, Pereira, Elsa Ramalhosa {effect of fresh and composted spent coffee grounds on lettuce growth} 2014*
7. *Wageningen UR Food & Biodoiesel Research, Jan E.G, Van Dam, Paulein Harmsen {Coffee Residues Utilization} 2010*
8. *Swedish University of Agricultural Sciences, By Ebba Bondesson {Analysis on the by-product coffee husk and its potential utilization} 2015*
9. *Alessia Panusa,Antonio Zuorro,Roberto Lavecchia,Giancarlo Marrosu and Rita Petrucci, Journal Of Agriculture and Food Chemistry {Recovery of natural anti-oxidants from SCG} 2013*
10. *Patent No. : EP2730171A1 {Coffee Silverskin}*
11. *III Symposium on Agricultural and Agro-Industrial Waste Management, Sao Pedro, SP, Brazil {Bio-active compounds of SCG} 2009*

12. *Institute of food science and technology and nutrition, Madrid, Spain*
13. *Obruca S., Petriks, Benesova, Svaboda, Eremka, Marova*
14. *Lina F. Ballesteros, Jose A. Teixeira, Solange I. Mussatto {Chemical, Fuctional and Structural Properties of spent coffee grounds and CS}, 2011*
15. *Mc Carty , M.F.A {Chlorogenic acid induced increase in GLP-1 production may mediate the impact of heavy coffee consumption of diabetes risk} 2008*
16. *Kawaski, et al 2006*
17. *Punnett, P.W Spent Grounds cause major soluble problem. Tea and Coffee Trade Journal 114(2):18, 41-42,1958*
18. *Valerio,L.Caffe E. Derinati [Coffee and derivatives] Hoepli,Milano,1927*
19. *M.Abdullah,A.B Koc,oil removal from waste coffee grounds using two phase solvent extraction enhanced with ultrasonication, Renewable energy, 50, 965-970,2013*
20. *Borelli, Esposito, Napolitano, Ritioni, Fogliano, 2004*
21. *Furusawa, M. Narita,Y,Iwaik,Fukunaga, T& Nakagiri,O, 2011,Inhibitory effect of hot water extract of coffee on hyaluronidase, Bioscience,biochemistry,biotechnology,1205-1207*
22. *Martinez,C.D ,M. Sobal,P Morales& L.A Saavedra,1992, properties of edible mushroom cultivation in developing countries, food lab news,8:1-23*
23. *Jaychandra T.,Vinugopal C.Appaiah KAA. Utilization of phytotoxic agrowaste-coffee cherry husk through pre-treatment by the ascomyecetes fungi Mycotypha for biomethanation. 2011*
24. *J.E Braham and R. Bressani, Institute of nutrition of Central America and Panama*
25. *Journal of food science technology, 1994, vol.31, No. 1, 22-26 (Production of pectinase from coffee pulp in Solid State Fermentation system)*

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Utilization of Sapota for Value-added Products

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Abstract

Sapota is one of the most important tropical fruit native to Centre and South America, especially Mexico. It grows in tropical regions of the world such as Centre and South America, West Indies, India and US. Sapota is rich in vitamins and minerals such as Folate, Vitamin A, Vitamin C, Pantothenic acid, Calcium Magnesium, Potassium and Phosphorous. Apart from the nutritional parameters Sapota also shows antioxidant activity due to presence of phenolic, tannins, carotenoids, compounds and fair amount of dietary fibre making it a good laxative, Sapota is a seasonal and highly perishable fruit. The shelf life of the Sapota needs to be enhanced through value addition and by application of different processing technologies. Value addition means conversation of raw material into value added saleable products which help in fetching better prices. The Sapota pulp can be used for preparation of value added products like Sapota Jam, Sapota powder, Sapota jelly, Sapotacandy,Sapota squash etc. with or without fortification.

Keywords : Sapota, Presenvation, Self-life, Value added products.

Introduction

Sapota is one of most important tropical fruit native to central and South America, especially of Mexico. It grows in tropical regions of the world such as central and South America, West Indies, India and US. Sapota is rich in vitamins and mineral content such as Folate, Vitamin A, Vitamin C Pantethonic acid, Calcium, Magnesium, Potassium, and Phosphorous. Apart from the nutritional parameters Sapota also shows antioxidant activity due to presence of phenolics, tannin, carotenoids compounds and fair amount of dietary fiber making it a good laxative. Sapota is a seasonal and highly perishable fruit. The shelf life of the Sapota be enhanced through value addition and incorporation of different processing technologies. Value addition means conversation of raw material into value added saleable products which help in hatching better price. Processing of Sapota by preparation of value added products with or without fortification is useful for shelf life stability of perishable Sapota.

Value-added Products of Sapota:

Sapota Powder : Sapota is processed into a value added powder by dehydration. Mature fruits contains around 72-78 % moisture content which is enough for the deterioration of any fruit. By removing of water from the fruit shelf life of Sapota can be stabled. For preparation of sapota powder the skin or peel of mature fruit is peeled off and fruit pulp is subjected to sulphitation in order to prevent fungal infection and color retention before drying. Fruit pulp is dipped for 3 min in 1 % potassium metabisulphite solution and then drained. The treated peeled sapota is cut into 5 mm thick sliced and dried into convection oven or vacuum oven (25 mm Hg Vacuum) at 65°C. The dried slices are then ground in a mixer grinder and further reduced in a ball mill so that 80 % of powder can pass

Table 1 : Nutritional value of Sapota fruit per 100 g (3.5 oz)

Parameters	*Results*
Energy	347kJ (83 kcal)
Carbohydrate	19.96 g
Dietary fiber	5.3 g
Fat	1.1 g
Protein	0.44 g
Vitamins	
Riboflavin (B_2)	0.02 mg
Niacin (B_3)	0.2 mg
Pantothenic acid (B_5)	0.252 mg
Vitamin (B_6)	0.037 mg
Folate (B_9)	14µg
Vitamin C	14.7 mg
Trace metals	
Calcium	21 mg
Iron	0.8 mg
Magnesium	12 mg
Phosphorous	12 mg
Potassium	193mg
Sodium	12 mg
Zinc	0.1 mg

Source : *USDA database entry*

through 105 µ sieve. The powder is mix with an equal amount of water and filter with muslin cloth to make clear juice.

Sapota Jelly : Mature fruits are properly washed with water after collection and cut into 5-8 pieces with stainless steel knives/cutter. After removing seeds, the seedless pulp is stored at -18°C for further use. 400 gram of Sapota pulp is homogenized with water into proportion of 40:60 (w/v) with the help of blender. The quantity of sucrose is depended on the Total soluble solid required for the final product. The

Table 2 : Antioxidant Activity of Sapota Fruit

Parameters	*Results*
Carotenoids	0.92 ± 0.06 mg/100 g
Total phenolics	134.6 ± 4.5 mg/100 g
Ascorbic Acid	10.52 ± 1.2 mg/100 g

Source *: Kulkarni et al (2007)*

fruit has initial 11°C, hence 56 % of sucrose need to be added. The sucrose/sugar shall divide into three equal parts and the first part shall add in crushed pulp. Then water is added in order to make the Brix up to 18-20°Brix. The whole mixture is heated up to the first boiling then second part of the sucrose containing 1.5 % pectin is added and boil the mixture. After second boiling the third part of the sucrose is need to be mix in the mixture so that the final TSS of the product reach up to 60°Brix. Then citric acid is added in order to prevent sucrose crystallization in the finished product. Heating shall be stopped when mixture Brix reach up to 65°Brix. Jelly is bottled (glass) in hot form and sterilized and cool. After cooling, the bottle is sealed and stored at room temperature for up to 3-4 months.

Sapota Jam : Jam may be prepared for enhancement of shelf life of Sapota. The major ingredients required for preparation of Jam were Sapota pulp, sugar, citric acid, pectin and sodium benzoate. Mature fruit is collected from the Market and pulp is extracted with the help of stainless steel knife. The pulp is blended by blending machine and can be stored at refrigeration temperature. For the preparation of one kg good quality of Sapota Jam , 450 gram sapota pulp, 550 gram sugar, 5 gram pectin and 5 gram citric acids are required. At first stage pectin is mixed with sugar in stainless steel pot then sapota pulp or juice is poured in to the pot and agitated. The mixture is heated until the TSS become 65%. In the end citric acid is added then stop heating the TSS of the final product shall be around 67%. The prepare jam is ready for bottling and parafinning. The processed

Sapota Jam can be stored at ambient temperature for a period of 4 months.

Sapota Squash : Sapota Squash is prepared with different concentration of juice such as 25 -35% and TSS of 45-50° Brix and acidity @ 1.0 %. However, Sapota squash prepared with 30 % juice, 50° Brix and 1.0 % acidity was recorded as highest sensory score for flavor and taste.

Sapota Bar **:** The pulp of sapota and papaya is extracted with the help of pulper. The pulp is then boiled 50% Spota pulp and 50% Papaya pulp with addition of 50% sugar, 2.5% pectin, 1% citric acid, 1% Maltodextrin and 6% Skimmed Milk powder. The mixture is poured in to Aluminium trays (smeared with butter) and dried at 60 ±2°C for 10-12 h. The cooled and dried fruit bar is cut in to rectangular pieces and wrapped in food grade polythene. Food enrichment and fortification are most simple and effective way to enhance the nutritional value of any food and solve the problem of micronutrient and mal nutrition. Fortified fruit bar has Protein and Fat contents of 1.85 % and 2.9 % respectively.

Sapota Wine : Fruits are selected for production of wine and properly washed with tap water and distilled water. Juice is extracted after removing the seeds. The juice is extracted from the pulp by pressing and straining it through muslin cloth. The juice is kept overnight under refrigeration and clear juice is obtained by siphoning. Now the Brix of juice is adjusted to 24° Brix with sugar acidity 0.9% with citric acid (pH 3.25 to 3.50) then add 0.1% diammoniumhydgrogen phosphate (DAHP) and KMS @ 50 ppm. After addition of DAHO and KMS juice is pasteurized at 82 to 85°C for 20 Min. Cool the pasterurized must and inoculate the must with starter culture i.e. *Sacchromyces cerevisiae var. ellipsoideus* @ 5% and incubate at 28 ± 2ºC for fermentation. After completion of fermentation dismantle the fermentation assembly after cessation of foaming and bubbling and pasterurize at 78°C for 20 min. Add 0.1 % Bentonite and keep for 1 week than filter and add KMS @ 85 ppm. The sapota wine has fairly longer shelf life. Overall acceptability of the wine is good when it prepared from mature fruits.

Sapota Candy : The good quality of ripe fruits are selected for candy preparation. The fruit is washed with tap water then skin is removed by steel peeler. The fruit is cut into eight slices and seeds are removed. The slices of sapota is steeped with initial syrup strength of 60° Brix with 1.0% citric acid. A treatment of 0.2% KMS is given for one minutes before steeping in syrups. The syrup concentration is increased up to 70° Brix and slice is steeped until the equilibrium is reached between slices. The slices in each treatment are drained free of syrup, rinse immediately with a tap water and shade dried for 24 Hrs. The prepared candies are packed in 250 gauge polyethylene bags and can be stored at ambient temperature.

Conclusion

As nutrient content of the Sapota is high and this fruit can be recommended to alleviate micronutrient malnutrition. The value addition of Sapota not only serve a longer shelf life but also support for better income generation for those who are engaged in collection and processing of this fruit. The studies done on Sapota so far revealed that the Sapota fruit is one of the healthiest fruit and can be used for preparation of value added products with longer shelf lives. The developed processed products may be commercialized for better income generation and increase the variety in fruit products. It opens Market opportunities for the developed value added products along with empowerment of rural sector through value addition of perishable fruit.

References

1. *Ahmad, T. ,Burhanuddin M. Haque M.A., Hossain M.A., Preparation of Jam from Sapota(Achraszapota), The Agriculturists 9(1 &2): 1-7(2011).*

2. *Carvalho Vania Silva, Damiani Clarissa, Asquieri Eduardo Ramirez, Orsi Daniela Castilho, Nishi Adriana Candida Faustino, Development and Antioxidant capacity of Sapota pulp Jelly, maio/Jun 2012.*
3. *Ganiyal G.M., Hanna M.A, Devadattam, D.S.K., Pocessing of Sapota(Sapodilla): Powdering, Journal of Food Technology 3(3): 326-330, 2005.*
4. *Hiremath, JB and Rokhade A.K., Preparation of Sapota Candy , Inter. Journal of Food, Agriculture and Veterinary Sci. , 2012, Vol- 2(1), Jan-Apr, pp 107- 112.*
5. *Kulkarni Anand P., Policegoudrar. S. and Aradhya S.M., Chemical Composition and Antioxidant activity of Sapota(Achrasspota Linn) Fruit, Journal of Food Biochemistry, 31 (2007) 399-414.*
6. *Pawar C.D, Patil A.A and Joshi, G.D. Quality of Sapota wine from fruits of differentialmanturity, Krataka J. Agric. Sci. 24(4): (501-505) 2011.*
7. *Relekar P.P., Naik, A.G., Padhiar B.V., Effect of Recipe on Quality Changes in Sapota Squash during storage , International Journal of Horticulture 2013, Vol- 3, No- 6, 22-27*
8. *Take Ajaykumar M., Adhukar G Bhotmange and Pratima N Shastri, Studies on Preparation of Fortified Sapota- Papaya Fruit Bar, Journal Nutr Food Sci. 2012, Vol- 2, Issue-6.*
9. *Vania Silva Carvalho1, Clarissa Damiani2, Eduardo Ramirez Asquieri2, Daniela Castilho Orsi2, Adriana Cândida Faustino Nishi, Development and Antioxidant Capacity of Sapota Pulp Jelly (Quararibeacordata VISCHER), Cienc. agrotec., Lavras V. 36 n3, p341-347, maio/ jun 2012.*

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Plant Based Approach : Achilles Heel in Tuberculosis Treatment

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Abstract

Tuberculosis (TB) is an airborne disease caused by Mycobacterium tuberculosis that usually affects the lungs leading to severe coughing, fever, and chest pains. Tuberculosis is one of the most prevalent infections of human beings and very challenging for our society. It contributes illness and death around the world, making itself the most vulnerable disease. The current TB epidemic is being sustained and fuelled by two important factors: the human immunodeficiency virus (HIV) infection and its association with active TB disease and increasing resistance of Mycobacterium tuberculosis strains to the most effective (first-line) anti-TB drugs. Modern drugs used for TB treatment are not only less efficient due of less susceptibility of TB bacteria but also have so many side effects that they are harmful for our body and should not be in high amount. These drugs also kill gut flora of our alimentary canal which are very essential for our system, effecting immunity against large number of opportunistic microbes, hence making a way for them to harbor and cause infection which is less likely in normal conditions. The bioavailability of these drugs is also less as they are not natural products; they are thrown out of our system by biotransformation so they are commonly less effective. As treatment of TB requires at least 6 months, and drugs are very costly many people leave the course in the middle of the treatment, causing severe TB infection at later stage. All these reasons demands a new drug or different way to treat TB, therefore nowadays people turn towards natural products as they are cost effective, widely available and helpful for chronic disease treatment. The ancient books Charak Samhita and Sushruta Samhita contain observational documentations about the system's effectiveness. Yajurveda recommends numerous medicinal plants like pippali, vasak, drakshasava etc. It also advises sufferers to move to higher altitudes.

Introduction

Herbal medicines are inexact and largely unproven science. In Indian society, plants are worshipped as sacred as well as are used for different treatment of diseases.

Uses of different medicinal plants were also described in different texts like sushrut samhita, charak samhita and also in Vedas (mostly in yajurved).

So history of herbal medicines goes back many centuries. Many common drugs we use today, are derived from plant-based sources.

Advantages and Disadvantages of Ayurvedic Medicines

Every substance have both advantages as well as disadvantages. Before going further, we should consider both and then make suitable decision. There are many advantages of ayurvedic medicines and their treatment; they are very effective for treatment of chronic diseases like arthritis, dropsy, ulcer, piles, tuberculosis etc. Being natural products, they have negligible side effects on our body as our system is very well prepared for them and their bioactivity as well as bioavailability is also larger with respect to the synthetic drugs.[1] As the

source of these products are plants, which are easily and widely available and can be easily extracted, they are cheaper than synthetic one.

On the other hand, herbal medicines do have some disadvantages. They cannot treat sudden and serious diseases and illness like heart attack, appendicitis, broken leg etc; effectively. These medicines are primarily used as preventive measures rather than cure. They are mostly slow acting and less effective for emergency. Another big problem is lack of dose instructions. The information available from texts solely describes the uses of plants but not the dose required for treatment of certain illness. This may be due to the fact that dose required depends on the body responsiveness, plant strains and the healer's way of treatment, i.e; how we are making the medicines using plant products (like, potions).[2]

Plant identification is also a very crucial point because harvesting herbs in the wild is risky and run a very real risk of poisoning themselves if anyone cannot correctly identify the herb, or use the wrong part of the plant.

A Case in Point : Tuberculosis

Tuberculosis (TB) is an airborne disease caused by *Mycobacterium tuberculosis* that usually affects the lungs leading to severe coughing, fever, and chest pains. Tuberculosis is one of the most prevalent infections of human beings and very challenging for our society.[3] It contributes illness and death around the world, making itself the most vulnerable disease. The current TB epidemic is being sustained and fuelled by two important factors: the human immunodeficiency virus (HIV) infection and its association with active TB disease and increasing resistance of *Mycobacterium tuberculosis* strains to the most effective (first-line) anti-TB drugs.[4]

Other factors include population expansion, poor case detection and cure rates in impoverished countries, active transmission in overcrowded hospitals, prisons, and other public places etc. Active disease patients with sputum smear positive pulmonary TB are the main source of infection in a community.[5]

Latent TB Infection is asymptomatic, which is defined as a state of persistent bacterial viability, immune control, and no evidence of clinically manifested active tuberculosis.

There are many kinds of tuberculosis. The primary disease is pulmonary TB as primary infection occurs to lungs causing active pulmonary TB. But mostly TB bacillus remain dormant and activated after some time, or after active TB disease(which has been treated and patient was cured but not completed the course) cause latent TB disease which includes pulmonary infection (pleurisy, milliary, cavitary etc) and extra pulmonary infection(mostly in immunocompromised patients — mostly in HIV patients).[6,7,8] Extra pulmonary TB occurs due to dissemination of bacillus into the blood streams and inhabiting different organs like lymph nodes, renal, adrenal, peritoneal etc.

For TB treatment, many drugs have been used over decades or probably century, starting with streptomycin, an antibiotic purified from *Streptomyces griseus* — was discovered almost 70 years ago, to several other drugs like para-amino salicylic acid, isoniazid, pyrazinamide, cycloserine and kanamycin discovered around 1950s. These drugs are used in different combination and had a treatment duration of 18 months or more.[9][10]

Nowadays at least six months treatment is required in which rifampicin, isoniazide, streptomycin and several other drugs are given. But many patients develop resistant M.tb called MDR TB. MDR-TB is when the TB bacteria that a person is infected with, are resistant to two of the main TB drugs isoniazid (INH) and rifampicin (RMP). This means that the drugs don't work. Those strains, which are resistant

to first line antibiotic treatment, are known as **MDR TB strains (multi drug resistant tuberculosis)** and thus, different drugs are used to treat patients affecting from MDR TB. [23-25]

Treatment of multi drug resistant TB (MDR TB) is more difficult than the treatment of drug susceptible TB. It requires the use of "**second line**" or reserve drugs that are more costly and cause more side effects. Also the drugs must be taken for up to two years.

Second line drugs include different categories of drugs. These categories are : Injectable agents — kanamycin, capreomycin, amikacin and streptomycin; Oral bacteriostatic second line agents — para-aminosalicylic acid(PAS), cycloserine, terizidon, thionamide and protionamide; Fluoroquinolones — ofloxacin, levofloxacin and moxifloxacin; Agents with an unclear role — clofazilin, amoxicilin, linezolide, thioacetazone, clarithromycin etc.

But second line drugs are also not enough to treat TB completely as they have further attained resistance not only against rifampicin and isoniazide but also at least three out of the six classes of second line drugs. TB caused by these resistant strains is known as XDR TB. There is no specific drugs to treat this TB and medicines are prescribed to the XDR TB patients by performing drug susceptibility tests. A drug Bedaquilin has been recently discovered having anti-tubercle activity against XDR TB but cannot be used due to the greater side effects therefore should be used if other drugs are not available.[11-14]

Ayurvedic Approaches for TB

As we can conclude from above information that modern drugs used for TB treatment are not only less efficient due of less susceptibility of TB bacteria but also have so many side effects that they are harmful for our body and should not be in high amount. These drugs also kill gut flora of our alimentary canal which are very essential for our system, effecting immunity against large number of opportunistic microbes, hence making a way for them to harbor and cause infection which is less likely in normal conditions. The bioavailability of these drugs is also less as they are not natural products; they are thrown out of our system by biotransformation so they are commonly less effective. As treatment of TB requires at least 6 months, and drugs are very costly many people leave the course in the middle of the treatment, causing severe TB infection at later stage.

All these reasons demands a new drug or different way to treat TB, therefore nowadays people turn towards natural products as they are cost effective, widely available and helpful for chronic disease treatment. The ancient books *Charak Samhita* and *Sushruta Samhita* contain observational documentations about the system's effectiveness.

In **Rigveda**, this disease is referred as **yakshma**. In **Atharvaveda** it was called **balasa**. **Sushrut samhita** (600BC) recommends breast milk, various meats, alcohol and rest as treatment of disease. **Yajurveda** recommends numerous medicinal plants like **pippali, vasak, drakshasava** etc. It also advises sufferers to move to higher altitudes.

In the present study, treatment response of 99 patients treated with ATD as an adjunct with **Aswagandha** (*Withania somnifera*) and a multi-herbal formulation described in ***Chikitsa-sthana*** of **Charaka samhita** i.e. **Chyawanprash** were investigated. Hematological profile, sputum bacterial load count, immunoglobulin IgA and IgM, blood sugar, liver function test, serum creatinine were the assessed parameters besides blood isoniazid and pyrazinamide, repeated after 28 days of treatment.[15]

Modern TB-drugs were administered to about 2766 patients and the **cure rate** turned out to be **11.42%** and the **death rate 40.9%**. When a

group of patients on modern anti-TB drugs received supplementary Ayurvedic drugs, the **cure rate** was **41.3%** and the **death rate** was **3.8%.** Studies have also been conducted to assess the role of Ayurvedic treatment in resistant cases.

Formulations like **Vasantamalati, Kanchanabhra rasa, Rajamriganka rasa, Bhallataka (Semicarpus anacardium) rasayan, Mallasindura, Vasa** (***Adatoda vasica***) are under use for tuberculosis treatment. In the present study **Aswagandha**, a well-known immuno-modulator with potential anti-stress activity and ancient Ayurvedic formulation **Chyawanprash**, which is used in Ayurveda for the treatment of cough, cold, tuberculosis and also for immune protection, are also used as an adjunct to anti-tubercular drugs as an add-on therapy.[16-21]

Many scientist across the globe are are experimenting on different plants which are indicated or subjected as playing a role in tb treatment, (whether a large or small) in ayurvedic texts, and seeking important products which can be very effective against tuberculosis.[26]

Many are also considering the synchronization of synthetic and natural products which will probably increase drug efficacy and reduction of side effects on patients.

Acalypha indica, Adhatoda vasica, Allium cepa, Allium sativum and *Aloe vera* are the plants on which current anti-tubercle activity study is going on. In one study, water extracts of these five plants was found to exhibit anti-tubercle activity against MDR-TB strains. Further studies are aimed for isolation and identification of bioactive substance which exhibits anti-tubercle activity.

Adhatoda vasica nowadays known as *Justicia adhatoda,* from which, Vasicine has been recently isolate, which is a bioactive compound having anti-tubercle activity. Analogues of this compounds are also being designed and to be tested for anti-tubercle activity.[22,23]

Conclusion

Our country has diverse life forms. There is no doubt that we have indigenous plants and ample amount of sources for different medicinal products. Plants are natural and our body(alimentary canal) is familiar to them, that's why there is less likely to have any kind of side effect. Tuberculosis is a very old disease whose history goes on to thousands of years. Still it is deadly as well as new for our mankind. During 20th century, many anti TB drug were designed which were very effective but due to the course of time, TB bacillus developed resistance. Now our world is again seeking new drugs or other alternatives for TB treatment.

Ayurvedic texts have mentioned TB and its cure by homemade therapies and natural products, but this field is yet, undiscovered. Initial discoveries for natural anti-TB products came to be highly promising and experimentation for the bioactive compounds are still going on making us optimistic about their favorable outcome..

References

1. *Chopra, R. N., Chopra, I.C., Handa, K. L. and Kapur, L. D. 1958. Chopras's Indigenous drugs of India; 2nd edition U. N. Dhur & sons Pvt. Ltd., Calcutta.*
2. *Congress, V. S. 1983. Plants: The potentials for extracting protein, medicines, and other useful chemicals, Washington. Data base on Medicinal Plants used in Ayurved. 5:295-303.*
3. *Houghton, P. J., Woldemariam, T. Z., Watanabe, Y. and Yates, M. 1999. Ativity against Mycobacterium tuberculosis of alkaloid constituents of Angostura bark, Gaalipea officinalis. Planta.Med. 16(3):250-254.*
4. *Aldovini, A., R. N. Husson, and R. A. Young. 1993. The uraA locus and homologous*

recombination in Mycobacterium bovis BCG. J. Bacteriol. 175:7282–7289.

5. *Alland, D., I. Kramnik, T. R. Weisbrod, L. Otsubo, R. Cerny, L. P. Miller, W. R. Jacobs, Jr., and B. R. Bloom. 1998. Identification of differentially expressed mRNA in prokaryotic organisms by customized amplification libraries (DECAL): the effect of isoniazid on gene expression in Mycobacterium tuberculosis. Proc. Natl. Acad.Sci. USA 95: 13227–13232.*
6. *Andersen, P. 1994. Effective vaccination of mice against Mycobacterium tuberculosis infection with a soluble mixture of secreted mycobacterial proteins. Infect. Immun. 62: 2536–2544.*
7. *Smith Issar, Mycobacterium tuberculosis Pathogenesis and Molecular Determinants of Virulence; Clinical Microbiology Reviews, July 2003, p. 463–496 Vol. 16, No. 3*
8. *K. G. Purushotham, P. Aurn, J. Johnsy Jayarani and R. Vsantha Kumari, Deptt. of Industrial Biotechnology, Dr. M. G. R. Educational and Research Institute, Screening of four Indian medicinal plants for in-vitro antimycobacterial activity*
9. *Salomon CE1, Schmidt LE, Natural products as leads for tuberculosis drug development, PUBMED*
10. *Cole, S. T., and D. R. Smith. 1994. Toward mapping and sequencing the genome of Mycobacterium tuberculosis, p. 227–238. In B. R. Bloom (ed.), Tuberculosis: pathogenesis, protection, and control. American Society for Microbiology, Washington, D.C.*
11. *Chan, J., K. Tanaka, D. Carroll, J. Flynn, and B. R. Bloom. 1995. Effects of nitric oxide synthase inhibitors on murine infection with Mycobacterium tuberculosis. Infect. Immun. 63:736–740.*
12. *Chan, J., X. Ran, S. W. Hunter, P. J. Brennan, and B. R. Bloom. 1991. Lipoarabinomannan, a possible virulence factor involved in persistence of Mycobacterium tuberculosis within macrophages. Infect. Immun. 59:1755-1761.*
13. *Chan, J., Y. Xing, R. S. Magliozzo, and B. R. Bloom. 1992. Killing of virulent Mycobacterium tuberculosis by reactive nitrogen intermediates produced by activated murine macrophages. J. Exp. Med. 175: 1111–1122.*
14. *Nicole Fogel, Tuberculosis: A disease without boundaries; Elsevier Tuberculosis 95 (2015) 527e531.*
15. *Keshavjee S, Farmer P. Tuberculosis, drug, resistance, and the history of modern medicine. N Engl J Med 2012;367 (10):931e6 [Internet] [cited 2014 Nov 2] Available from: http://www.nejm.org/doi/full/10.1056/NEJMra1205429.*
16. *World Health Organization. c1948. Tuberculosis fact sheet. In:Geneva (Switzerland): WHO global TB programme; 2014 Oct [Internet] [cited 2014 Nov 2]; [about 5 screens].*
17. *http://www.who.int/mediacentre/factsheets/fs104/en/.*
18. *Comas I, Gagneux S. The past and future of tuberculosis research. PLoS Pathog 2009;5(10):e1000600 [Internet] [cited 2014 Nov 2] Available from: http://www.plospathogens.org/article/info%3Adoi%2F10.1371%2Fjournal.ppat.1000600.*
19. *Goldman L, Schafer AI. Tuberculosis: disease overview. In: Goldman L, Schafer AI, editors. Goldman's cecil medicine: expert consult premium edition. 24th ed. St. Louis (MO): Saunders Elsevier; 2011.*
20. *Berry MPR, Blankley S, Graham CM, Bloom CI, O'Garra A. Systems approaches to studying the immune response in tuberculosis. Curr Opin Immunol 2013;25(5):579e87 [Internet] [cited 2014 Nov 2] Available from: http://www.sciencedirect.com/science/article/pii/S0952791513001313.*
21. *Advances in the development of new tuberculosis drugs and treatment regimens Alimuddin Zumla, Payam Nahid & Stewart T. Cole Nature Reviews Drug Discovery 12, 388–404 (2013) doi:10.1038/nrd 4001.*

22. *Early tuberculosis treatment monitoring by Xpert MTB/RIF", European Respiratory Journal, May 1 2012 //erj.ersjournals.com/content/39/5/1269.extract#*
23. *Boshoff, H. I. M. & Barry 3rd, C. E. Tuberculosismetabolism and respiration in the absence of growth. Nature Rev. Microbiol. 3, 70–80 (2005).*
24. *Stewart, G. R., Roberston, B. D. & Young, D. B.Tuberculosis: a problem with persistence. Nature Rev.Microbiol. 1, 97–105 (2003).Focuses on the biology of persistence in mycobacteria.*
25. *Janin, Y. L. Antituberculosis drugs: ten years of research. Bioorg. Med. Chem. 15, 2479–2513 (2007). Discusses antitubercular small molecules, from early discovery compounds.*
26. *Thokchom P. Singh, Okram M. Singh, and Huidrom B. Singh, Adhatoda vasica Nees: Phytochemical and Pharmacological Profile, The Natural Products Journal, 2011, 1, 29-39.*

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Current and Potential Sources of Oil Seeds in India

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Abstract

Oils and fats are important parts of our diet. They have important role to play in the functioning of our body. But yield of oilseeds in India is not enough to meet the demands of our country and lots of oil needs to be imported, which eventually causes loss of wealth of our country. Many oils like olive oil are becoming popular day by day due to its health benefits but they are costly. Population of India needs good quality oil in affordable prices. To combat these problems of production and cost there is an urgent need to explore our country's wealth to find potential oil sources.

Introduction

Our body needs a whole lot of nutrients to function properly which includes carbohydrates, proteins, fats, vitamins, minerals and water. But out of all these, the nutrient that people are most concerned about these days is fats.

Fats and oils have always been thought as a danger element. Many people have this misconception that consuming fats and oils will harm their body. But the fact is anything taken in excess causes harm to our body and anything taken in a balanced way nourishes our body and same goes for fats and oils.

Fats are of two types, namely saturated and unsaturated. Saturated fats do not have double bonds and their higher intake is believed to increase blood cholesterol levels which can lead to arteriosclerosis and heart diseases, whereas unsaturated fats reduce blood cholesterol levels.[1][2]

In fact they are important source of our energy requirements. They furnish 2.25 times more energy than proteins and carbohydrates. The are important source of fat soluble vitamins that is Vitamin A, D, E, K and play vital roles in functioning of our body.[2]

In spite of these well known merits of fats and oils, consumption of dietary fats in India is very low. Our per capita intake is of order 4-5kg/annum as against 40-50kg/annum in advanced countries.[2]

The main reason behind this nutritional lack is low productivity of oil which in turn affects the cost of oils.

According to the data of oil production and its demand domestic edible oil production is estimated to be 10.55MT against the projected demand of 16.34MT there will be gap of 5.79 MT in 2016-2017 which will be met through imports.[3]

Thus there is a need to couple conventional breeding methods with biotechnological tools to combat this problem.[4]

The objective of this article is bring in notice good quality oils and to even highlight the

potential sources of oil to meet the future demands.

Why Olive Oil?

Olive oil is one of the most popular oils these days and that to for all the good reasons. It is obtained from olive, which is a traditional tree crop of Mediterranean basin.

Olive oil contains 55-83% of oleic acid, 3.5-21% linoleic acid, 7.5-20%palmitic acid, 0.5-5% stearic acid, 0-1.5% alpha linolenic acids. and minor amounts of polyphenols, hydrocarbons, sterols, volatile compounds etc.[5][6] It contains large percentage of unsaturated fatty acids especially oleic acid which along with polyphenols reduce LDL's, lowers risk of CVD's, diabetes, obesity, breast and digestive cancers etc.[7][8]

It is healthy oil and so it has become popular over the years but the negative factor about it is the price which is quiet high in comparison to other oils. People want an economical option as well.

Mustard Oil

The oil which is cheap yet healthy is mustard oil. Mustard oil has 21% polyunsaturated fats (6% omega-3 alpha-linolenic acid and 15% omega-6 linoleic acis),it has about 60% monounsaturated fatty acids (42% erucic acid and 12% oleic acid). It has 12% saturated fats.[1] Some varieties have very high amount of erucic acid and glucosinolate in seeds. After India collaborated with Sweden in 1970's and Canada in 1990's improved mustard oil varieties with low erucic acid were produced.[4] It is one of the most commonly used oils in India.

Rapeseed Oil

Rapeseed oil is produced from rapeseed, which belongs to the same family as that of mustard. Rapeseed oil is rich in omega-3 fatty acids which accounts to be 8% of total fatty acids.It also contains many cardio protective nutrient including Vit-E and polyphenols.[9] RO is potential substitute of olive oil since it has similar fatty acid composition as that of OO.It has low saturated fatty acid content.[10]

It is one of the main competitors of olive oil as it is consumed in large amounts in Non-Mediterranean countries due to its good fatty acid composition and low cost.

Main fatty acids (g/100 g)	***Rapeseed oil***	***Olive oil***
Palmitic acid (16 : 0)	3.6	7.5-20.0
Oleic acid (18 : 1)	61.6	55.0-83.0
Linoleic acid (18 : 2)	21.7	3.5-21.0
a-Linolenic acid (18 : 3)	9.6	0.0-1.0

[10][11]

Alpha linolenic acid is high in RO but about 1% is present as trans isomer of ALA which is produced during deodorization process.[10]

Other Important Oils

There are many other oils which have great potential in the future, these oils can help in solving the demand crisis that are ongoing in India.

Rice Bran Oil

Rice bran oil is obtained by solvent extraction or super critical fluid extraction of rice bran.

India is the second largest producer of paddy hence we can very well judge its potential in future.[12]

It contains 30% linolenic acid, 44% oleic acid, 1.25% linoleic acid and23% saturated acids. It also contains gamma oryzanol and ferulic acid which increases the stability of oil at higher temperatures (Gertz et a 1200) and increases the smoke point.[13](Ghosh2007)

Even after heating the oil at 180±2 degree Celsius, not much change was observed in fatty acid composition but their was a loss of 9% PUFA. No trans fatty acids were traced.[13]

Rice bran oil has many health benefits, it reduces blood cholesterol levels,reduces menopausal symptoms, it finds many use in cosmetic industry due to its anti-ageing properties and it has am protective role in UV light induced lipidper-oxidation. But the most important role is that it acts as antioxidant which is believed to be 4 times as effective at stopping oxidation as vitamin-E.[14]

It is a by product of rice industry. 4000MT of paddy produces about 6MT of edible grade oil. Out of total production of oil 50% of edible grade and 50% is left unutilized for various reasons.[15]

Tree Borne Oil

About 25 varieties of tree borne origin are present in the country which have the capability of producing oil uoto 3 Mt. Out of which 40% is from sal (*Shorea robusta*).[2]

According to research the four seeds of forest origin were screened namely *Adina cordifolia, Anogessious latifolia, Anthocephalus Cadamba and Callitris glauca.*

It was found that they contained oil content from 0.4-4.4%. (Table 1)

It was observed that *A. cordifolia* was found be rich a source for linoleic acid (74.6%). Oleic acid and palmitic acid were found to be 11.4 and 9% respectively.

Table 1

S. No.	***Plant Name***	***Oil Content (%)***
1	*Adina cordifolia* (Bandaru)	**4.4**
2	*Anogessious latifolia* (Thirman)	**0.40**
3	*Anthocephalus cadamba* (Kadamba)	**0.80**
4	*Callitris glauca*	**2.0**

Fatty acid composition of *A.lantifolia* contained 54.6% linoleic acid, 17.5% oleic acid, 15.8% palmitic acid and 2.2% lauric acid as major fatty acids, myristic and stearic acids were in minor quantities.

In A cadamba and C glauca seed oils 38.6% and 28.4% of linoleic acid was present respectively. The oleic acid content of seeds were 32.6% and 24.1% respectively.[16]

The oil content in these species was low. Though more research could be done to find out high yielding varieties as these seeds have high amount of good quality fatty acids and could help reduce the gap between demand and supply.

Kokum / Garcinia Oil

Garcinia is an under-utilized medicinal crop belonging to the family Guttiferae (Clusiaceae). It is a large genus of polygamous trees or shrubs, distributed widely in the tropical Asia, Africa and Polynesia. It consists of 200 species, out of which, 35 species are found in India.[17]

It contains saturated and unsaturated fats in equal ratios. It has very high melting point i.e. 40

degree Celsius which makes it good for confectionary uses.

Table 2 : Oil Contents in Various Oil Seeds

S. No.	*Oil seed*	*% Oil*
1	Mustard	35
2	Palm kernel	36
3	Sunflower	32
4	Sesame	50
5	Garcinia	30 -40

This table shows garcinia oil is an important source of fatty acids**.**

In various species of gacinia the iodine value varies from 37.4-51.8 which is high, indicating that it is less probable to rancidity.It contains important fatty acids ie palmitic acid, oleic acid,stearic acid, linoleic acid etc in different % in different species.[17]

Kernel / Chironji

Chironji (*Buchanania Ianzan*) is an evergreen moderate sized tree belonging to family Anacardiaceeae. It contains 41.79% saturated fats and 58.2% unsaturated fats. The oil content of the seed is 35-50%. Oleic acid is the main fatty acid (55-60%).[18]

Fatty Acid Composition of Chironji Oil[18]

Fatty Acid	*Amount (%)*
Myristic acid C14:0	2.90
Palmitic acid C16:0	31.42
Stearic acid C18:0	7.47
Oleic acid C18:1	53.71
Linoleic acid C18:2	4.50

Palm Oil

Palm oil is the most efficient oilseed crop in India. Its yield can go up to 8 tones per hectare.

Palm oil is rich in Vit A and E. Its free of trans fatty acid. It has balanced composition of saturated and non saturated fatty acids. It contains 40% MUFA and 10% PUFA.

It is highly stable during frying due to synergistic effect of beta-carotene and tocotrienol.[19]

Conclusion

It can be concluded that indigenous oils of India have great future potential. They contain good amounts of healthy fatty acids but the problem is they are either not well explored or there is lack of technology to explore them and take out their best yield. There is a need to bring awareness about different oil seeds in our country, we need to couple conventional breeding and technology to improve quality and quantity of oils in our country and bridge the gap between its demand and production.

References

1. *Sengupta A, Ghosh M (2012). Comparison of native and capric acid-enriched mustard oil effects on oxidative stress and antioxidant protection in rats. British Journal of Nutrition, 107, 845–849, First published online on 1 November2011 doi:10.1017/ S0007114511003874*
2. *N. Shakuntala Manay, M. Shadakshara Swamy (2008). Foods Facts and Principles, Third edition.*
3. *Jha G K, Pal S, Mathur V. C., Bisaria G, Anbukkani P, Burman R.R, Dubey S.K (2012).Edible oilseed Supply and Demand Scenario in India : Implications of Policy. Division of Agriculture Economy, Indian Agriculture Research Institute. ISBN 978-81-88708-90-1.*

4. *Singh BK, Thomas L, Bala M, Singh VV, Singh D, Priyamedha (2015).Status and perspective of canola quality rapeseed-mustard cultivation in India : a review. Journal of Brassica, 6 (1) : 142-151, January 2015.*
5. *Beltraa G, Rio CD, Saa Nchez S, Martianez L (2004). Influence of Harvest Date and Crop Yield on the Fatty Acid, Composition of Virgin Olive Oils from Cv. Picual. J. Agric. Food Chem. 2004, 52, 3434-3440.*
6. *Vasilescu I, Eremia S A.V, Albu C, Radoi A, Litescu S-C,Radu G-L (2015).Determination of the antiradical properties of olive oils using an electrochemical method based on DPPH radical. Food Chemistry 166 (2015) 324-329.*
7. *Fito M et al (2000). Protective effect of olive oil and its phenolic compounds against low density lipoprotein oxidation. Lipids 2000;35:633-8.*
8. *Buckland G, Gonzalez CA (2015). The role of olive oil in disease prevention: a focus on the recent epidemiological evidence from cohort studies and dietary intervention trials.British Journal of Nutrition. Volume 113 supplement S2, April 2015, pp S94-S101.*
9. *Gladine C, Combe N, Vaysse C, Pereira B, Huertas A, Salvati S, Rossignol-Castera A, Cano N, Chardigny J-M.Optimized rapeseed oil enriched with healthy micronutrients: a relevant nutritional approach to prevent cardiovascular diseases. Results of the Optim' Oils randomized intervention trial. Journal of Nutritional Biochemistry 24 (2013) 544-549.*
10. *Hoffman R, Gerber M(2014). Can rapeseed oil replace olive oil as part of a Mediterranean-style diet? British journal of Nutrition (2014), 112, 1882–1895.*
11. *Przybylski R (2011) Canola/rapeseed oil. In Vegetable Oils in Food Technology: Composition, Properties and Uses, 2nd ed., pp. 107–136 [FD Gunstone, editor]. Oxford: Wiley-Blackwell.*
12. *Patel M, Naik S (2014). NGamma- oryzanol from rice bran oil –A review. Centre of Rural development and technology, Indian Institute of Technology, New Delhi 110016. Journal of Scientific and Industrial Research, Vol 63, July 2004, pp 569-578.*
13. *Latha R B, Nasirullah D.R (2014).Physico-chemical changes in rice bran oil during heating at frying temperature.Food Sci Technol. 2014 Feb; 51(2): 335-340.*
14. *Cuvelier ME, Richard H and Berset C, Comparison of the antioxidative activity of some acid- phenols : structure activity relationship, Biosci Biotech Biochem 56 (1992) 324-330*
15. *Kusum R., Bommayya H., Fayaz Pasha P. and Ramachandran H. D. Palm oil and rice bran oil: Current status and future Prospects.International Journal of Plant Physiology and Biochemistry Vol. 3(8), pp. 125-132, August 2011.*
16. *Mohini Y, Kaki SS,Jabeen T, Reddy JRC, Rao B V S K, Reddy B V P, Prasad R B N (2014). Oil Content and Fatty Acid Composition of Four New Minor Tree Borne Oilseeds. Journal of Lipid Science and technology, Vol 46,No.2, April-June 2014,ISSN0973-6379*
17. *Parthasarathy U, Nandakishore O.P, R. Kumar R S and Parthasarathy V. A(2014). A Comparison on the Physico-Chemical Parameters of Seedbutters of Selected Indian Garcinia SPP. Journal of Global Biosciences. ISSN 2320-1355. Volume 3, Number 6, 2014, pp. 872-880.*
18. *Sahu S N, Jaiswal S G, Naik S N(2015). Physico-chemical, Thermal and Oxidative Properties of Wild Chironji (Buchanania lanzan Spreng.) Kernel Oil.Journal of lipid science and technology, Vol 47, Jan –March 2015.*
19. *Mba O I, Dumont M J, Ngadi M (2015). Palm oil: Processing, characterization and utilization in the food industry – A review.Food Bioscience, Vol10, 1 June 2015, Pages 26–41.*

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Traditional Plants and their Importance — A Review

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Abstract

With the growing population, there is a need to introduce new plants as over-reliance on a handful of major food crops is unsustainable. About 95% of the world's food energy comes from only 30 major species whereas about 7000 species are known to be used for food and are domesticated. Usage of traditional crops can overcome this situation. There is a misconception that traditional crops are poor man's diet. However, the usage of traditional plants can form an important food group for upper income group, too. The nutritional benefits, its importance and the usage of four traditional plants from different regions of India have been overviewed. The reasons for underutilization of such crops are also discussed.

Introduction

Forests are the integrated part of human life which provides fodder, shelter, medicines and many more things. One such gift of forest for humans is wild edible plants and herbs. Forest has a rich and diverse habitat of plant resources for welfare of human beings. In today's world despite of primary reliance of agricultural societies on domesticated plants and animal for food, the consumption of wild plant has not totally eradiated infact it is increasing with time.

Traditional knowledge gained from nature in the laboratories of life and crystallized over millennia this knowledge survives usually among the indigenous local communities these are not always confined to rural or remote areas, but also to some urban areas. The wild plants are sometime also called emergency food as when regular food is not available generally at time of calamity such as flood, tsunami, etc. wild plant are eaten by the people. [1] Wild sources of food, in general, remain particularly important for the poor and landless, and are especially important during times of famine or conflict when normal food supply mechanisms are disrupted and local or displaced populations have limited access to other kinds of food. Different parts i.e. flower, fruits, roots, leaf, whole plant, of wild plants are used in food recopies. However, the micro and macro element present in the wild plants plays a crucial role in the complete development and metabolism of body, it enhances the immunity and strength of the food. The nutritional level of wild plant can nurture healthy mind and body and also prevent humans from common modern lifestyle disorders. Wild plants are not only in the food but also in medicines.[2] According to the WHO estimate, 80% of the world's population primarily relies on traditional medicine, a major part of which involves the use of plant extracts or their active ingredients. The commercialization of medicinal wild plants have increased many folds by their large usage in various sectors such as pharmaceuticals, phytochemicals, food supplements, herbal remedies, etc.

The traditional method of usage of wild plants is rich and unique in the world. Different types of wild plants grow in different regions of India and also the usage of plant varies from one region to another.

Solanum nigrum

Black nightshade *(Solanum nigrum. L)* is an annual herbaceous plant (and may sometimes be perennial) which can reach up to 100cm in height. The stem may be smooth or bear small hairs (trichomes).It's flowers are white in colour and bears a round fleshy berry up to 2cm in diameter and yellowish when ripe. Numerous brown seeds are present. It is a common species in arable lands, near rivers and old walls.[3]

Table 1: Proximate of Composition *Solanum nigrum* L. Var. *virginicum* leaves and seeds in

Parameters	%Dry Matter of Leaves	%Dry Matter of Seeds
Caloric value (Kcal)	355.04±0.19	43.54±0.19
Ash content	10.10±0.02	6.05±0.04
Crude fat	4.60±0.01	12.18±0.02
Crude Protein	24.90±0.02	17.63±0.01
Crude fibre	6.81±0.01	6.29±0.01
Carbohydrate	53.51 0.01	55.85±0.03
Moisture content	84.70±0.01	76.86±0.04

Values are mean±S.D of triplicate determinations

Table 2: Elemental Composition of *Solanum nigrum* L. Var. *virginicum* leaves and seeds

Mineral Elements	Composition (Mg-/100g) of Leaves	Composition (Mg-/100g) of Seed
Calcium, Ca	17.33±0.03	11.82±0.02
Magnesium, Mg	247.59±0.01	201.36±0.01
Iron, Fe	13.01±0.01	12.91±0.01
Zinc, Zn	0.07±0.01	0.05±0.01
Potassium, K	42.89±0.02	37.19±0.02
Sodium, Na	2.71±0.02	2.11±0.02
Manganese, Mn	1.52±0.02	0.86±0.01
Phosphorus, P	75.22±0.02	62.50±0.00
Sulphur, S	8.55±0.01	14.49±0.01

Values are mean±S.D of triplicate determinations

*(**Source** : Akubugwo et al: Nutritive Value of S. nigrum Seed and Leaves)*

S. nigrum is being used as a medicine and as regular food in various parts of South india, Himalayan region, Thar desert, Assam and various other parts of India.[4, 5]

In a preliminary investigation and research it has been concluded that the S. nigrum has significant anti-inflammatory and anti-convulsant activity. This may be due to the presence of flavonoids.This herb has a vast medical uses. It is antiseptic, anti-inflammatory, expectorant, cardiotonic, digestive, diuretic, laxative, diaphoretic, sedative, swelling, cough, asthma, in curing cardiopathy, leprosy, haemorrhoids, nephropathy, ophthalmopathy, dropsy and general debility and its juices are used for abdominal pain and also for skin diseases.[7]

S.nigrum has also been used as a hepatoprotective and anti-flammatory agent in Chinese medicines as has been studied by Hui-Mei Lin et al. [9,13]

It has also known to have high antioxidant activity,[8,11] used for treatment in jaundice. [12] It also found to be having anti-diabetic properties[10] and anticancer properties.[5]

Chenopodium alba

Commonly known as *"bathua"* in India, this is an important vegetable and grain crop in hilly regions. The nutrient composition of the Himalayan grain chenopod is much better than wheat, barley, maize and rice. (Tapia et al.,1979; Pratap,1982; Cusack, 1984; Wood,1985). The grain protein quality is considered to be equal to that of milk. It contains high lysine (6g per 100g protein, methionine (2.3g per 100g protein) and cysteine (1.2g per 100g protein).[14]

Bathua acts as a laxative, anthelmintic for hookworms and roundworms and as a blood purifier.[15] It possesses anthelmintic activity [16] and hepatoprotective benfits.[17] Some studies also show inhibition to the growth of breast cancer cells.[18]

In another study bathua leaves showed antibacterial activity against five human pathogenic bacteria, including Salmonella typhimurium, Proteus vulgaris, and Pseudo-monas aueruginosa.[19]

Cleome viscosa

Cleome viscosa is a herb which is grown in the Garhwal Himalaya, north India. The local name for this herb is jakhaiya. It is grown as seed with Oryza sativam and he Eleusine coracana this seed is generally used as condiment in place of cumin. Until 1980's the use of these seed was less.[20] Due to its unique taste and odor the consumption of this herb has increased many folds. But in some parts of garhwal it is still considered to be a weed as it is never sown. It's a weed which grows during kharif season along

with a variety of traditional crops.the leaves of Cleome viscose is used as green vegetable and seeds as condiments. It is cheaper than cumin hence used by poor people. It has a piquant flavor and hence it is used in preparation of pickles, sausages, curries, and pulses. The leaves are rubefacient and vesicant (the wealth of India 1976). Leaves are also used in wounds and ulcers. Seeds are used in rubefacient, vesicant and anthelmintic properties. The decoctions of roots provide febrifuge. The juice of leaves is mixed with ghee is utilized for the treatment of inflammation in ear (The Wealth of India 1979). *The composition of edible portion of the weed is follows : Moisture = 80.41%; Ash = 3.75%; Calcium = 0.881%; Phosphorus= 0.073%; Iron = 2445mg/100g; and Ascorbic acid = 203.6mg/100g.*[20]

Flemingia strobilifera and Flemingia vestita

There are around 15 species belonging to Flemingia occur in India. *Flemingia strobilifera* is one of them which is an important medicinal plant commonly known as Kusrunt in Hindi. It belongs to the leguminosae family. It is found in Himalayas, Assam, Chittagong, Siam and Malacca. The root of this plant is used in epilepsy, hysteria, also to induce sleep and to relieve pain. The leaves are reported to be used as vermifuge for children. It also have analgesic effect and anti-inflammatory effect. It also have antimicrobial and antioxidant activity.[21] Leaves contain leptosidin glucoside, leptosin, also phloridizin and naringin. Roots contain chalcones, n-triacontane and β-sitosterol (Ghani, 2003). Quercitrin, rutin and quercimeritrin have been obtained from leaves, stems and flowers (Rastogi & Mehrotra, 1993). Another important plant belonging to **Flemingia** is *Flemingia vestita* which is grown in slopes of Himalayas. It is a wild herb commercially cultivated in Meghalaya. It is traditionally used as ananthelmintic (that expel parasitic worms on human). Its root has a nut-like or fruit-flavor. In nutritional term it is rich in protein and phosphorus. The edible root-tuber peel of Flemingia vestita and its major active component, genistein, have been earlier shown to have a vermifugal/vermicidal effect on cestodes in vitro by causing a flaccid paralysis and alterations in the tegumental architecture and activity of several enzymes associated with the tegumental interface of the parasite.[22,23] Despite of its increasing demand in market it is not extensively studied and analysed.

Restriction in the Usage of Wild Plants

With the increase in the usage of the herbs globally, there has been an increase in concern towards the quality of herbs. There are several factors due to which the herbs, despite of having numerous advantages, are not used extensively in every field. One factor which decreases its usage is it's contamination with heavy metals, mycotoxins, pesticide residues, polycyclic aromatic hydrocarbons (PAHs) and fumigants. These contaminants can accumulate during the cultivation, storage and processing of herbs and may have adverse effects on consumer health. [24]. These contaminants can interfere with hormones and cause endocrine disruption, infertility and immune suppressive, carcinogenic and teratogenic effects. Myotoxins addition have a legal limit given by European legislation[24]

Other factors could be that farmers do not want do grow wild plants and herbs as it is less profitable than cultivation of crash crops. Moreover with increasing population and expansion of the settlement area, portions of the forests and swamps are encroached and this makes the wild plants unavailable to humans. And also in the remaining fertile land cultivation of crash crop is preferred over the wild herbs. And also due to lack of conservation policy and due to the wrong belief, that wild plants and herbs are less nutritious and only fit for consumption by the humans. Moreover, with the changing lifestyle, people prefer “junk foods” which take lesser time for preparation, and are believed to possess better nutrition.[25]

Conclusion

India has a wide variety of flora having potential to replace the current commercial crops and to provide food for it's people. Different states have different traditional plants and their uses and characteristics differ from region to region.A lot of food that are considered to be weed are actually being used traditionally even now in some regions as food and as medicines. The underutilization of these is due to their contamination with heavy metals, myotoxins and other metals or it can be due to very less research work and unawareness among the people. Also, these plants are believed to be poor man's food as their cost is lesser than the commercial crops. In the present time, where people are becoming more concerned and aware about nutrition and health, these plants can be grown commercially as they have better nutritional benefits than the existing commercial crops. There are a lot of research work and studies on the benefits of such plants. However. No work is done on production, breeding and usage. These plants being weeds are resilient to various kinds of environment and climatic conditions. Very few improvements are to be done to check their contamination and to increase

References

1. *Mr. Ashok K Jain and Ms. Preeti Tiwari, Nutritional value of some traditional edible plants used by tribal community during emergency with reference to central india, Indian journal of traditional knowledge, volume no. 11 , January 2012*
2. *Nandini N, Shiddamallayya N, Rama Rao V and Venkateshwarlu G, wild vegetables in food security of tribal & rural population of karnataka, journal of science, vol. no. 5, 2015*
3. *Kavitha. J, Bioactivity guided isolation and Evaluation of Anti-allergic activity of Solanum nigrum and Solanum xantho-carpum Liin. Berries, may 2010*
4. *Chellaiah Muthu, Muniappan Ayyanar, Nagappan Raja and Savarimuthu Ignacimuthu, Medicinal plants used by traditional healers in Kancheepuram District of Tamil Nadu, India, journal of ethnobiology and ethnomedicine, volume 2, 2006*
5. *K Aruna, VM Sivaramakrishnan, Anti-carcinogenic effects of some Indian plant products, Food and Chemical Toxicology, volume 30,1992*
6. *Akubugwo et al: Nutritive Value of S. nigrum Seed and Leaves, Pakistan Journal of Nutrition, volume 6, 2007*
7. *Anwar Khan et al, Solenum nigrum as Potent Therapy: A Review British Journal of Pharmacology and Toxicology, volume 3, 2012*
8. *Nataraj loganayaki et.al, Antioxidant activity of two traditional Indian vegetables: Solanum nigrum L. and Solanum torvum L, 2010*
9. *Hui-Mei Lin, Hsien-Chun Tseng, Chau-Jong Wang, Jin-Jin Lin, Chia-Wen Lo, Fen-Pi Chou, Hepatoprotective effects of Solanum nigrum Linn extract against CCl4-iduced oxidative damage in rats, volume 171(3), 2008*
10. *MK Rai, A review on some antidiabetic plants of India — Ancient science of life, 1995 — ncbi.nlm.nih.gov*
11. *Lee SJ, Lim KT. Antioxidative effects of glycoprotein isolated from Solanum nigrum Linne on oxygen radicals and its cytotoxic effects on the MCF-7 cell. J Food Sci 2003;68:466-470*
12. *Folk medicine from Chittoor District, Andhra Pradesh, India, used in the treatment of jaundice-KR Reddy — International Journal of crude drug research, 1988 — Taylor & Francis*
13. *Raju K, Anbuganapathi G, Gokulakrishnan V, et al, EfFect of dried fruits of Solanum nigrum LINN against CCl4-Induced hepatic damage in rats, Biol Pharm Bull, volume 26, 2003*
14. *V. Ramanatha Rao, A. H. D. Brown, M. Jackson, Managing Plant Genetic Diversity, December 2001*

15. *Kirtikar KR and Basu, BD. "Indian medicinal Plants", International Book Distributor, Vol III, 2ndEdn:pp 1964-1965.*
16. *JM Wdmonds, JA Chweya, Black nightshades : Solanum nigrum L. and related species, 1977*
17. *Jain, Nilesh Kumar, and Abhay Kumar Singhai, Hepatoprotective activity of Chenopodium album Linn : in vitro and in vivo studies. Journal of Experimental and Integrative Medicine, volume 2, 2012*
18. *Oxidative medicine and cellular longevity, volume 2, 2009*
19. *International journal of applied biology and pharmaceutical technology, Volume: 2: Issue-3: July-Sept -2011*
20. *R. K. Maikhuri, R.L.Semwal, K.S. Rao, S. Nautiyal, , and K.G. Saxena, Cleome viscosa, Capparidaceae: a weed or a crash crop? volume 54, 2000*
21. *Swati Madan, Sumeet Gullaiya, Gayendra Nath Singh, Yatin Kumar, Flemingia Streobilifera : Review on Phytochemistry and Pharmacological Aspects, International Journal of Phytopharmacology, volume 4, 2013*
22. *Veena Tandon, Bidyadhar Das, Nirmalendu Saha, Anthelmintic efficacy of Flemingia vestita (Fabaceae): effect of genistein on glycogen metabolism in the cestode, Raillietina echinobothrida,research gate, volume 52, 2003*
23. *Tropical legumes : resourses of future, by National Research Council, 2002*
24. *Vandana Tripathy, B.B. Basak, Thania Sara Varghese, Ajoy Saha, Residues and contaminants in medicinal herbs — A review, Phytochemistry Letters-science direct, letter 14, 2015*
25. *Mr.Victor Ayam, Allium hookeri, THW. Enum. A lesser known terrestrial perennial herb used as food and its ethnobotanical relevance in Manipur,Department of BotanyVolume no.11, 6 October 2011*
26. *Rekha Sinha & Valeria Lakra, Edible weeds of tribals of Jharkhand, Orissa and West Bengal,volume 6, 2016*
27. *Taranisen Panda, Traditional knowledge on wild edible plants as livelihood food in Odisha, India,journal of biologyand earth science, volume no. 4, 2014*
28. *Andreas W. Ebert,Potential of Underutilized Traditional Vegetables and Legume Crops to Contribute to Food and Nutritional Security, Income and More Sustainable Production Systems, journal of sustainability, volume 6, 2014*

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Process Optimization of Ready to cook Frozen Mushroom Tikki

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Abstract

Oyster mushoom shreds have poor adhesive and cohesive properties due to lack of starch in them. Tikki is an Indian snack delicacy generally made of potatoes with other spices and flavoring ingredients. Mushrooms were used instead of potatoes to develop a novel product from mushrooms without the use of potato for binding. End product is a frozen partially cooked mushroom tikki. Three parameters were chosen as variables (shred size, par-frying time and corn flour dosage). Analysis was done for sensory, textural and nutritional characteristics with fat absorption being the prime indicator. The results demonstrated that lower shred size and higher par frying time and dosage of corn flour resulted in optimized product with good overall acceptability.

Keywords : Mushroom tikki, fat absorption, sensory properties, nutritional properties

Introduction

Mushrooms are well known for their health benefits. Mushrooms being low in fat with no cholesterol, having proteins of high biological value and being rich in dietary fiber, minerals, vitamins and other bioactive agents are considered to be next generations health food. Mushrooms contain appreciable amounts ofdietary fibers (Manzi et al.,2001; Manzi et al., 2003). Zhang et al (2001) emphasized on many functional components that are identified in mushrooms having various physiological roles such as cholesterol metabolism, immune system modulation and inhibition of tumor growth etc. Many phenolic substances have also been identified in mushrooms which are probably responsible for its antioxidant properties (Yang et al., 2002).

Mushrooms are known to have effective anti-cancerous, antibacterial, antiviral and immune-modulating activities (Wasser and Weis, 1999; Yang et al., 2002; Ribeiro et al., 2007). Mau et al. and Hirano et al. have attributed the protective roles of mushroom consumption to their ability to capture metals, inhibit oxidative enzymes and scavenging free radicals.

Tikki is a fried pattied product made of potato which is a widely accepted and putative snack product in India cherished by both children and adults. The concept of making tikki a nutritional snack by using mushroom as the main ingredient instead of potato can work towards enhancing the nutritional status of the society.

Also the negative effect on nutrition of families turning to dual income with both partners working can be eliminated by making ready to eat processed nutritionally rich snacks like mushroom tikki. Processing of mushrooms into ready to eat products with high consumer acceptability will serve thedual purpose of prevention of post-harvest losses and utilization of mushrooms along with improving health status of consumers (Bindvi and Mridula, 2014).

Materials and methods

Raw Materials

Oyster mushrooms were taken from Directorate of Mushroom Research, Chambaghat, Solan, Hmachal Pradesh-173213. Other ingredients such as spices, corn flour, frying oil and bread crumbs were purchased from easy day store from local market in Solan.

Mushrooms were graded and washed followed by blanching at 85°C for 4-5 min, blanched mushrooms were sliced and shredded as per the size taken for trials as given in Table 1.

Tikki preparation

Mushroom shreds of specific sizes are blended with corn starch as per Table 1. The blend is further mixed with spices as per recipe and formed into uniform 10g tikkis using a mould and compressor. The tikkis are dipped in 5% corn starch solution and rolled in bread crumbs. The tikkis are then parfried at 175°C in Sanco commercial fryer for time as given in Table 1. The parfried product is kept on drain tray wire mesh, cooled, packed and then frozen in deep freezer at -35°C. The product is then kept frozen until sensory and nutritional value experiments.

Table 1 : Design Expert Variables and Responses for RTC Mushroom Tikki

S.No	*Size (mm)*	*Corn starch (%)*	*Parfrying time (sec)*	*Color frozen*	*Color fried*	*Fat absorption*	*Crispi-ness*	*Compre-ssion*	*Taste*
1	10	3	45	8.2	7	45.14	7.2	1.9862	7.9
2	7	5.5	30	7.5	8	42.33	8.4	1.805	8.2
3	7	5.5	30	7.4	8.2	41.57	8.1	1.7961	8.3
4	4	3	15	6	6.8	38.87	6.9	1.2682	7.4
5	4	8	15	6.2	6.7	39.85	8.6	1.281	8.5
6	7	5.5	30	7.7	8.1	43.33	8.2	1.9549	8.1
7	10	8	15	6.3	6.2	37.99	8.8	2.69	8.2
8	4	8	45	8	6	44.37	8.1	1.6245	8
9	4	3	45	8.5	6.8	45.78	6.8	1.378	7.8
10	7	5.5	4.77311	5	7.5	37.65	8.2	1.8851	8
11	7	5.5	55.2269	8.5	6	46.2	8.4	1.964	8.2
12	12.0454	5.5	30	7.2	8	41.59	8.6	2.9602	7.8
13	1.95462	5.5	30	7.4	8.2	44.76	7.8	0.674	8.1
14	7	9.70448	30	7.4	5.8	41.56	8.7	2.58	8.2
15	10	8	45	8	6.7	46.12	8.1	2.79	8.3
16	7	5.5	30	7	8.1	43.77	8.3	1.816	8.1
17	7	5.5	30	7.2	8	42.89	6.9	1.652	8.1
18	7	1.29552	30	7.2	6.8	42.63	6.8	1.4269	7
19	10	3	15	6	6.7	40.23	7.1	1.849	7.9
20	7	5.5	30	7.4	7.4	41.63	8.4	1.508	7.6

Sample preparation for analysis

Frozen tikki samples are fried at 175°C for 3 min in Sanco commercial fryer. The samples are then drained off excess oil by placing on drain tray wire mesh for 5 min prior to serving for sensory evaluation. Whole tikki samples were used for sensory and textural evaluation. For chemical composition, samples were cooled and then crushed in pestle mortar prior to analysis.

Color

Color is an important characteristic of fried products and is related to degree of doneness. Crisp brown color of fried products adds to the palatability. Variation in parfrying time and corn starch concentration affects the color of end product. For analysis fried tikki sample was crushed in pestle mortar and extracted with water. OD of the extracts was taken at 420 nm and absorbance was related to color of the product (Ranganna, 2005).

Sensory analysis

A semi trained panel of 10 scientists and technical professionals from ICAR-DMR, Solanevaluated the tikki samples for appearance (fried and frozen product),taste, crispiness and overall acceptability. Ranking was done on a 9 point hedonic scale ranging from 1 to 9 as dislike extremely to likeextremely. Samples were coded in randomorder using 3 digit random number selections.The evaluation was done at room temperature in normal light. Plain drinking water and puffed rice was given to panelists to eat after every sample to neutralize the taste after every sample.

Texture profile analysis

Texture analysis was done to evaluate the compression of tikkis. Compression analysis was done using texture analyzer from Stable Microsysterms — whole tikki samples of diameter 5 cm were taken for texture analysis and probe 32 of diameter 25 mm for compression analysis was used for evaluation. Pretest and test speed was set to be 50 mm/min and post-test speed was 10 cm/min. The analysis was done in triplicates and values were averaged.

Nutritional analysis

Moisture, crude fiber and ash were analyzed using AOAC (2000) methods. Protein was analysed using Kelplus Elite EX Micro Kjeldhal method using conversion factor 6.25 (for plant products). Fat absorption is one of the key parameters and was analysed by Soxhlet plus method.

Experimental Design and Data Analysis

Central composite rotatable design (CCRD) was used to design experiments with three variables at two levels having six centre points. The variables taken for present research work included mushroom shred size, corn starch concentration and parfrying time in the range of 4-10 mm, 3-8% and 15-45 sec, respectively. RSM which involves design of experiments was used for the selection of levels of variables in the experimental runs as shown in Table 1, fitting mathematical models and finally selecting variable levels by optimizing the response was employed in the present study (Khuriand Cornell 1987).Constraints andcrieteria for optimization of tikki processing were selected as shown in table 2. For the response variables the equation could be given as :

$$Y = \beta_0 + \sum\beta_i X_i + \sum\beta_{ij} X_i X_j + \sum\beta_{ii} X_{i2} + \varepsilon \text{ ..... (1)}$$

Where Y is the response, β_0 is the model constant; β_i is the linear effect of factor Xi; β_{ij} is the cross product of factor Xi and Xj and β_{ii} is the quadratic effect of factor Xi; ε is the residual error. Design Expert 8.0.4 software was used to generate the design of the experiments, to fit model by multiple regression and to analyze the response surfaces. The response surfaces were

drawn by plotting y as a function of two variables by keeping the third variable constant. The regression analysis of the responses was conducted by fitting linear and quadratic models as suitable in the case of the respective responses.

Results and discussion

Color

Color is an important parameter to mark the acceptability of food products. Color values of samples were expressed as OD at 420 nm as mentioned in Table 3. The color values increased with increasing par frying time and enrobing corn starch concentration. (Cunningham, 1989) also found frozen stored enrobed patties had significantly higher color scores than uncoated chilled patties even after 45 days due to higher initial color values from incorporation of skimmed milk powder, whole egg liquid and carboxy-methyl-cellulose. Biswas et al. (2003) also found that color values of frozen pork patties improved on enrobing.

Sensory analysis

Color (frozen)

Color of parfried frozen tikki was analyzed by a panel of 10 members of scientific grade and evaluated on hedonic scale. The average scores are mentioned in Table 4. Sensory score for colour (frozen tikki) ranged from 6.0 to 8.5. The data fitted the following quadratic model equation :

Color (frozen) = +7.37-0.039*A+0.985*B +1.03*C+0.050*AB-0.050*AC-0.15*BC-0.013 $*A^2$-0.013$*B^2$-0.21$*C^2$ ..... (1)

Where A, B and C are mushroom shred size (mm), corn starch (%) and parfrying time (sec) respectively.

Model F value of 51.18 implied that model was significant.

Fig. 1 shows the response surface plot for the color (frozen) as influenced by the parfrying time and corn starch concentration in the batter. It is evident that the color acceptability of the frozen product increased with increase in both parfrying time and corn starch concentration with parfrying time having the major effect.

Color (fried)

Full fried tikki is the end product just prior to consumption and its color will have a major effect on acceptability of the product. The scores for color acceptability of full fried tikki ranged from 5.8 to 8.2. The equation follows a quadratic model as :

Color (fried) = +7.98-.622*A-0.25*B-0.18 *C+0.013*AB+0.19*AC-0.062*BC-0.033$*A^2$ -0.6$*B^2$-0.51$*C^2$ ..... (2)

Where A, B and C are mushroom shred size (mm), corn starch (%) and parfrying time (sec) respectively.

The Model F-value of 7.06 impliedthat the model was significant.

Fig 2a and 2b demonstrates the effect of mushroom shred size and parfrying time on color (fried) and mushroom shred size and corn starch concentration on color (fried) respectively.

Texture profile analysis

Crispiness

Crispiness of tikki was analyzed by sensory panel on a hedonic scale from 1 to 9 from dislike extremely to like extremely. The scores of crispiness ranged from 6.8 to 8.7. The equation follows a linear model as :

Crispiness = +7.92+0.16*A+0.64*B-0.063*C .... (3)

Where A, B and C are mushroom shred size (mm), corn starch (%) and parfrying time (sec) respectively.

Figure 1 : Effect of Parfrying time and corn starch on color of frozen tikki

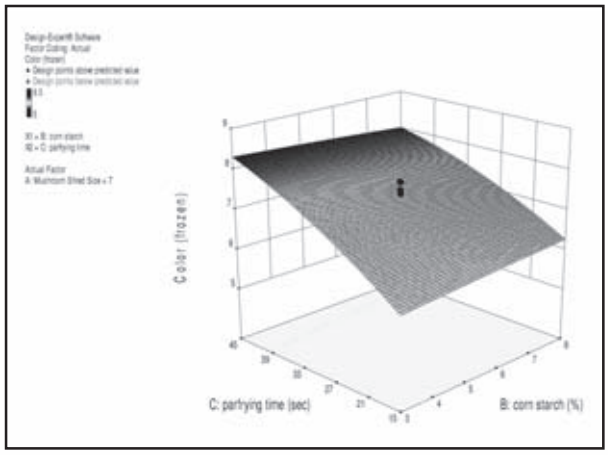
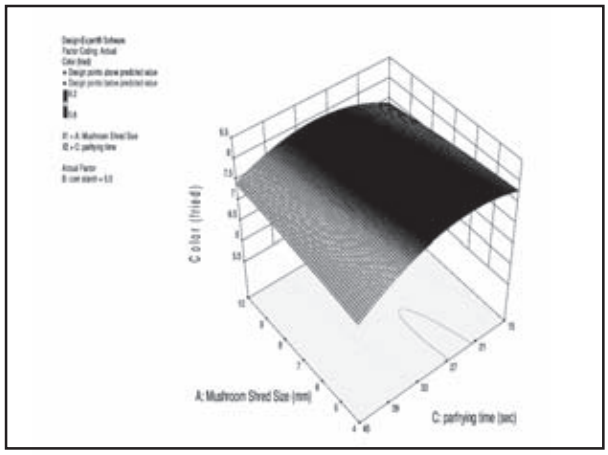
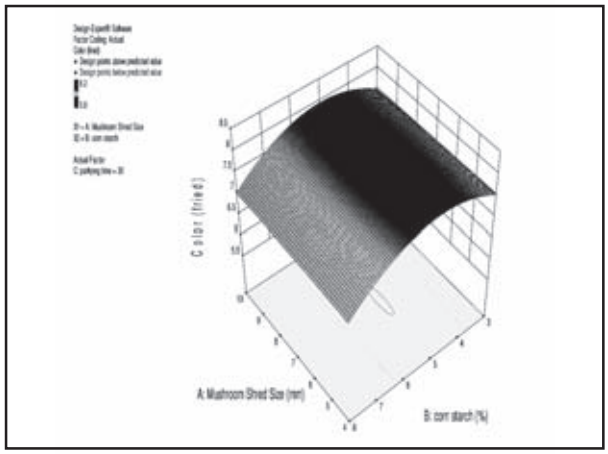


Figure 2 : a) Effect of shred size and parfrying time on color of friedtikki b) Effect of shred size and corn starch on color of fried tikki



2 (a)



2 (b)

Figure 3 : Effect of corn starch and shred size on crispiness

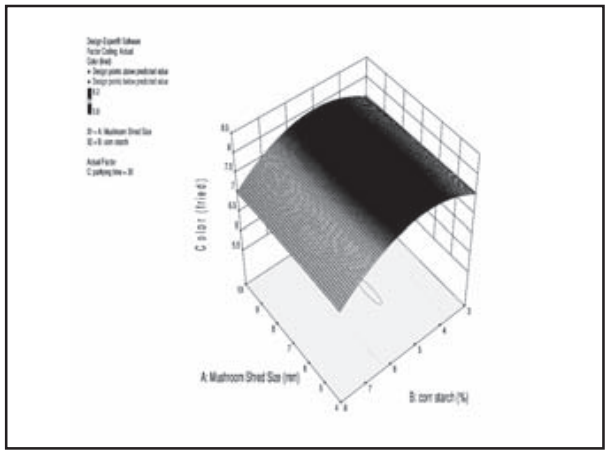
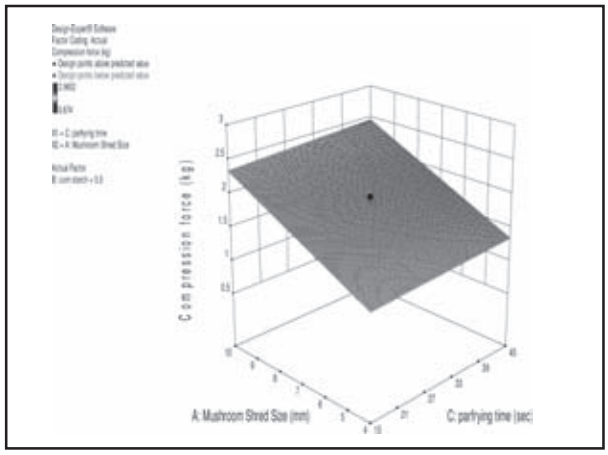
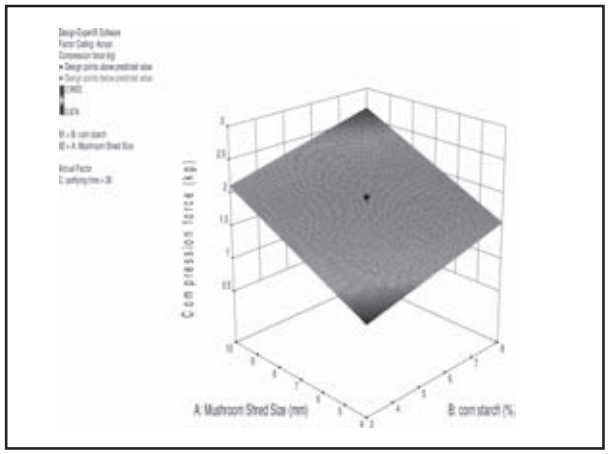


Figure 4 : a) Effect of parfrying time and shred size on compression b) Effect of corn starch and shred size on compression



4 (a)



4 (b)

Figure 5 : Effect of corn starch and shred size on taste

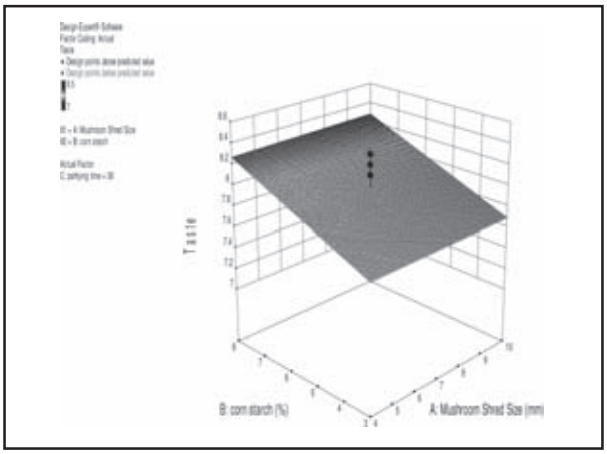
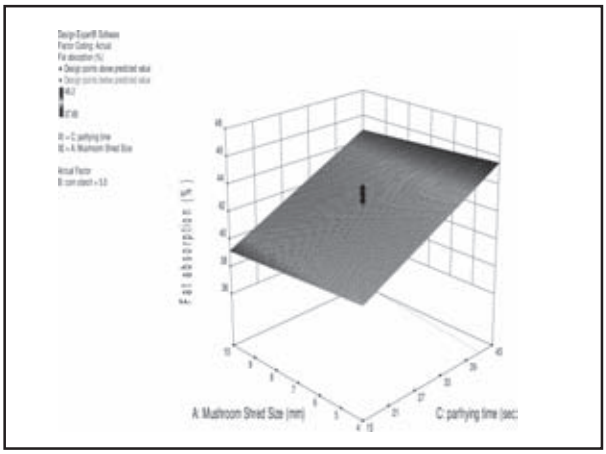


Figure 6 : Effect of shred size and parfrying time on fat absorption



The Model F-value of 10.30 implies the model is significant.

Fig 3 demonstrates the effect of corn starch and mushroom shred size on crispiness of mushroom tikki.

Compression

Compression force is defined as the minimum force required to get 5 mm compression of the product was analyzed by texture analyzer (Stable microsystems) probe 32 of diameter 25 mm for compression analysis was used for evaluation of sample of diameter 5 cm. the compressibility values ranged from 1.26 to 2.96 kg. The equation followsa linear model as :

Compression force = +1.84 + 0.56*A + 0.28*B + 0.060*C ..... (4)

Where A, B and C are mushroom shred size (mm), corn starch (%) and parfrying time (sec) respectively.

The Model F-value of 41.63 implies the model was significant.

Fig 4a and 4b depicts the effect of mushroom shred size and parfrying time on compression force and mushroom shred size and corn starch concentration on compression force respectively.

Taste

Taste of full fried mushroom tikki was scored on hedonic rating. The scores ranged from 7.6 to 8.5 (Table 1). The equation for taste follows a linear exponential model as follows :

Taste = +7.99+6.990E-003*A+0.29*B +0.025*C ..... (5)

Where A, B and C are mushroom shred size (mm), corn starch (%) and parfrying time (sec) respectively.

The Model F-value of 6.03 implies the model is significant.

Fig 5 depicts the effect of corn starch and mushroom shred size on taste of tikki and it is evident that corn starch concentration has a major positive effect on taste of the product.

Fat absorption

Fat absorption in the product varied due to different composition of the trials as well as different parfrying times.

Freezing a parfried product also leads to less fat absorption during full frying and thus fat absorption becomes a key parameter for quality

of tikki. The fat content of full fried tikki ranged from 37.65 to 46.2%.

Fat absorption = +42.41-0.35*A-0.26*B +2.84*C ..... (6)

Where A, B and C are mushroom shred size (mm), corn starch (%) and parfrying time (sec) respectively.

The Model F-value of 40.23 implies the model was significant.

Fig 6 describes the effect of mushroom shred size and par frying time on fat absorption of tikki.

Conclusion

Shred size in inversely proportional to the textural and sensory properties of mushroom tikki. Smaller the shred size better were the quality characteristics of tikki. Corn starch gives a positive result with increasing concentration upto a certain limit beyond which it tends to harden the product.

Increasing parfrying time increased the fat content in the final product but gives a preferred product on sensory evaluation. Desirability values show that shred size of 4.5 mm, corn starch concentration of 6.3% and parfrying time 30 sec gives optimum product with desirability of 7.861.

References

1. *AOAC. 2000. Official Method of Analysis of AOAC, International, Washington, 17th ed., Vol. 2, Association of Analytical Chemists.*
2. *Bindvi A&Mridula D 2014(Nutritional &censory properties of mushroom fortified corn extrudates. Mushroom Research. 23(1); 69-77.*
3. *Manzi P., Aguzzi A. and Pizzoferrato L. 2001. Nutritional value of mushrooms widely consumed in Italy. Food Chemistry 73: 321-325.*
4. *Manzi P., Marconi S., Aguzzi A. and Pizzoferrto L. 2004. Commercial mushrooms : nutritional quality and effect of cooking. Food Chemistry 84: 201-206.*
5. *Riberio et al. 2006. Contents of carboxylic acid and two phenolics and antioxidants activity of dried Portuguese wild edible mushrooms. Journal of Agricultural & food chemistry.54;8530-8537.*
6. *Yang J.H., Lin H.C. and Mau J.L. 2002. Antioxidant properties of several commercial mushroom. Food Chemistry 77: 229-235.*
7. *Zhang M., Cheung P.C.K. and Zhang L. 2001. Evaluation of mushroom dietary fiber (nonstarch polysaccharides) from sclerotia of Pluerotus tuber regium (Fries) Singer as a potential antitumor agent. Journal Agr. of Food Chemistry 49: 5059-5062.*

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Poster Presentation

at

National Conference on Advances in Food Science & Technology

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Shaheed Rajguru College of Applied Sciences for Women

(University of Delhi)

Vasundhara Enclave, Delhi - 110096

S. No. Title of Poster / Author/s / Abstract

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1. Application of Ultrasound in Food and Dairy Industry
   Ashish Khare, Dr. A. B. Lal and M. K. Salooja
   Abstract: In this research communication effort were made to identify appropriate pre-treatment to remove seed coat from tamarind seed and to observe the effect of pre-trement on physicochemical properties of seeds. Three pre-treatment methods were employed with different soaking, boiling and drying temperatures. The result reveals that method III having higher heating temperature and longer drying time has maximum de-coating compared to other methods. The different pre-treatment had a significant effect on physicochemical properties of seeds with varying bed thickness of tray drying.
   Keywords: Thickness, soaking and drying.

2. Comparitive Study on Dehydration of Yam by Sun-Drying or Tray-Drying Method
   Shraddha Saxena, Sakshi, Nishtha Kapoor and Ritika
   Abstract: Jimikhand, also known as elephant foot yam and its scientific name is Amorphophalliuspaeoniifolius. It has many medicinal properties and is beneficial in curing and prevention of many health diseases like heart problems, digestion problem, diabetic problem etc. It is a source of many vitamins and minerals that are essential for our body. Due to its medicinal and nutritive properties and due to its potential production it can be included in the category of cash crop. It is high in enzymatic activity and bulky to be handled, so the process of dehydration can be done to know about the dehydration rate of yam which can be further utilized for product processing of yam like yam chips. Comparison of dehydration of yam by tray dryer (at 70^{a}C) and sun drying method was done. On the basis of our results and observations based on various parameters like (i) rate of drying, (ii) final product quality, (iii) rehydration ratio, (iv) time of drying. So it was concluded that tray dried product was superior to sun dried product. This was an initial study; further research is needed to establish the process parameters in details.

3. Corn Starch based Film
   Shatakshi, Kritika Gupta and Shrishti Kashyap
   Abstract: Corn starch based films can be a replacement for the synthetic polymers that are widely used in food packaging. The use of these synthetic polymers is not only a serious health hazard but also pose a great risk to the environment which is degrading day-by-day. These polymers are made from petroleum and its by-products. The use of these polymers can be replaced by corn based edible films as starch is a natural polymer and is found in

plenty in the nature. At the same time, it is renewable and cost effective and also possesses film making properties. This study presents the synthesis of corn starch based edible films by using the glycerol as a plasticiser, therefore, these films also shows plastic like properties. These films are prepared by varying concentration of glycerol i.e. 0%, 15%, 30%, 41.5% & 45% w/w. It is observed that though corn starch based edible films are innately brittle having poor handling, barrier, mechanical and processing properties, these problems can be remedied by addition of certain additives/fillers.

It was observed that with the increasing concentration of glycerol that acts as a plasticiser, the properties of the film such as handling, transparency, clarity, mechanical and processing properties were improved. On the basis of sensory evaluation conducted, it was found that the film with 45% glycerol concentration had better appearance and handling properties. This is a preliminary study and further research needs to be done to establish process parameters.

4. Effect of Fat on Sensory Attributes of Reduced Calorie Eggless Muffins

Bhopal Singh, A. K. Singh, P. N. Raju and Rekha Rani

Abstract: Muffins are sweet, high-calorie baked products, appreciated by consumers due to their taste and soft spongy texture. Fat is the major ingredient in muffin, known to play significant important role in texture formation, palatability as well as appearance of the product. To evaluate the effect of fat on sensory attributes, eggless muffins were prepared with shortening (T1) and white butter (T2) alone or with blend of shortening and butter [25:75 (T3), 50:50 (T4) and 75:25 (T5)] at the rate of 16% that was optimized on the basis of preliminary trials. It was observed that the colour and appearance (7.86±0.09), body and texture (8.07±0.07), sweetness (7.79±0.21), flavour (8.00±0.13) and overall acceptability (8.00±0.07) scores of control muffin were higher than eggless muffin (T1) prepared with shortening but there was no significant ($p>0.05$) difference for all the sensory attributes between the control and eggless muffins made with shortening. On the other hand, Butter added eggless muffins (T2) were not significantly ($p>0.05$) different in colour and appearance, but scored significantly ($P<0.05$) lesser for body and texture, sweetness, flavour and overall acceptability in comparison to control and T1. Increasing the proportion of butter in blend resulted in lowering of body and texture, sweetness, flavour and overall acceptability scores.

5. Effect of Fat Replacer — Inulin on Sensorial and Rheological Attributes of Law or Reduced Fat Cream Cheese

Anandita Debanth, S.K. Kanawjia, Yogesh Khetra, Venus Bansal, Latika Bhandari and Jui Lodh

Abstract: Today's upward consumer awareness and interest to follow healthy nutrition and dietary strategy in achieving health benefits from foods have led to the development of low fat or fat free products. Cream cheese is one of the high fat products, commonly used as spread. The presence of fat in cream cheese plays an important role on its sensorial and rheological properties. Reduction in milk fat can cause serious textural problem in cream cheese. Therefore, to obtain the desirable textural quality similar to full fat cream cheese, inulin was added in low or reduced fat cream cheese as a fat replacer at the rate of 0.25 g for 1 g of fat replacement. From the study on sensorial and rheological attributes, it was observed that upto 50% replacement of fat in cream cheese was acceptable. Though

the increase in inulin content in cream cheese increased the viscosity at a constant shear rate of 100 s-1 of cream cheese, there was no significant ($p>0.05$) difference was observed upto 50% fat replacement. At 100 s-1 shear rate the viscosity of control cream cheese and inulin added cream cheese with 50% fat replaced were found to be 11.70 ± 1.10 Pas and 28.15 ± 1.75 Pas, respectively. Similarly, in case of apparent viscosity at a shear rate in the range of 0-100 s-1 there was no significant ($p>0.05$) difference was observed between control cream cheese and inulin added cream cheese with 50% fat replaced. With the change in rheological attributes, sensorial scores of cream cheese changed subsequently. It was observed that upto 50% replacement of fat in cream cheese flavour and body and texture score decreased non significantly ($p>0.05$).

6. Effect of Irradiation of Food and Subsequent Shelf Life Analysis
Anjali Sharma, Athira Menon, Divya Sharma and Isha Sharma
Abstract: Food irradiation is the process of exposing food stuffs to ionizing radiations. The irradiation process involves passing food through an irradiation field; however, the food itself never contacts a radioactive substance. Food irradiation improves the safety and extends the shelf life of foods by reducing or eliminating microorganisms and insects. Also, the ionizing radiation used by irradiators is not strong enough to disintegrate the nucleus of even one atom of a food molecule. According to 2005 survey, the quantity of irradiated foods in the world was 405,000ton and comprised 1,86,000 ton (46%) for disinfection of spices and dry vegetables, 82,000 ton (20%) for disinfestations of grains and fruits, 32,000 ton (8%) for disinfection of meat and fish, 88,000 ton (22%) for sprout inhibition of garlic and potato and 17,000 ton (4%) of other food items. To treat the food, they are exposed to a radioactive source, for a set period of time to achieve a desired dose. Most irradiated food is processed by gamma radiation; however the usage of electron beam and X-ray is becoming more popular as well.
In the present study, samples of bread and strawberries were irradiated with X-ray and gamma rays after some basic pre-processing and shelf life was analysed by physical and microbiological procedures. Bread and strawberries were selected because they are highly perishable and intensive study on prolonging their shelf life is necessary. Bread samples were irradiated with an X-ray beam of 40mA and stored at different temperatures of 4°C, 25°C and 35°C. Strawberry samples were given a basic pretreatment by dipping in Potassium Sorbate and then irradiated with Gamma rays with an intensity of 1.5KGy and stored under refrigerated conditions. Physical parameters studied were color, texture, aroma and overall appearance. Microbiological analysis carried out by standard plate count method for microbial count. The expected results from this study are an increase in shelf life of these highly perishable items and a subsequent reduction in their microbial load. This is a preliminary study and further research needs to be carried out to establish standard procedures and methods.

7. Evaluation of Gluten Free Whole Grain Flat Bread during Storage
Akansha Pahwa and Amarjeet Kaur
Abstract: Celiac disease is becoming an increasingly recognized autoimmune disease caused by a permanent intolerance to gluten. To overcome this problem, gluten-free whole grain flat bread was prepared using formulations; whole maize flour (100 per cent), whole sorghum

flour (100 per cent), combinations of whole maize: soybean flour (3:1), whole maize: soybean: sorghum (2:1:1) flour, whole maize: soybean: sorghum (1:1:2) flour and whole sorghum: soybean (3:1) flour after conducting preliminary trials on each formulation. Further, additives like xanthan gum (0, 0.25, 0.50, 0.75 and 1 per cent), guar gum (0, 0.25, 0.50, 0.75 and 1 per cent) and potato flour (0, 5 and 10 per cent) were incorporated for the preparation of flat bread. Out of these, four formulations which were selected for making flat bread were packed in Low Density Polyethylene (LDPE) along with control (whole maize flour). They were stored with and without incorporation of preservatives at ambient and refrigerated conditions to study shelf life. It can be observed that hydrocolloids and potato flour led to moisture retention in flat bread crumb. At refrigerated storage, higher moisture retention was observed. Peroxide value (meq/kg) and free fatty acid content (% oleic acid) of flat bread was found to be higher at ambient condition. Average growth of yeast, mold and bacteria was less in flat breads containing additives, mainly due to the presence of bound water. Flat breads without incorporation of preservatives remained acceptable till 3 days at ambient and refrigerated conditions. Preservatives like calcium propionate and potassium sorbate at 0.2 percent level of incorporation were effective to obtain flat bread with shelf life of 7 days at ambient condition and 9 days at refrigerated condition.

8. Food Preservation by High Hydrostatic Pressure
Shashi P. Pandey
Abstract: Consumers have a growing preference for convenient, fresh-like, healthy, minimal processed food products with natural flavor and taste and extended shelf life. The use of high hydrostatic pressure (HHP) for food processing is finding increased application within the food industry. One of the advantages of this technology is that it does not use heat, sensory, and nutritional attributes remain virtually unaffected, thus yielding product with better quality than those processed with traditional methods. HHP have the ability to inactive micro-organism as well as enzymes responsible for shortening the life of the product. Generally the pressure applied varies from 400 MPa to 1000 MPa. HHP can modify the functional properties of components such as proteins, fats which in turn can lead to the development of new products. Fruit juice, meat product, sliced ham are some of the products currently available in market.
Keywords: Food preservation, Microbial inactivation, new technologies.

9. Incidence and Characteristics of Psuodomonas Species isolated from Spoilt Fresh Produce
Parul Thapar and Seema Garcha
Abstract: The pectolytic fluorescent Pseudomonas spp. have been previously reported as a cause of post harvest rots of celery, chicory, lettuce, cabbage and potato. Development of the soft rot disease caused by Pseudomonas marginalis is optimal at low temperatures (between 5°C and 25°C), the bacteria develops at 0°C and it can induce the soft rot at 5°C on onion. The emergence of antibiotic-resistant bacteria has been attributed to factors such as the overuse of antibiotics, use of antibiotics in the food industry and an increasingly immuno-compromised population. In the present study, isolation of Pseudomonas from spoilt fresh produce was done using three selective media- King's Medium B, Crystal Violet Pectate (CVP) Medium and Mac-Conkey Agar. The microscopic, cultural, biochemical

characteristics and anti-microbial resistance of the isolates were compared to reference Pseudomonas NCDC 105. The isolated Pseudomonas species were resistant to antibiotic Penicillin and some of the strains were resistant to Chloramphenicol, Carbenicillin and Streptomycin. Therefore, during the treatment of food-borne diseases caused due to Pseudomonads, the prescription for these antibiotics should be done carefully.

10. Innovative Packaging
Shobha Mehta and Sonali Dua
Abstract: We are aiming to achieve a breakthrough in the field of packaging technology by resolving the most common problem of moisture being gained by the product, once the seal is left opened. The desired qualities of the product are its taste, crisp, texture and color and these properties are need to be maintained, so for that we are designing a film which is porous and the pores are filled with the crystals of rock salt (an absorbent), by the use of high pressure technology. Through this packaging material we rendered the product a secured moisture free atmosphere. So even if left opened , the food material will remain protected since the absorbent will keep the inner atmosphere dry by forming a protective dry atmosphere layer over the material, hence preventing microbial growth and maintaining the overall sensory attributes

11. Lecithin — Health Benefits in Human Body
Shrishti
Abstract: Lecithin is a fat nutrient that is essential in the cells of the body. Lecithin are usually phospholipids composed of phosphoric acid with choline, glycerol or other fatty acids usually glycolipids or triglycerides. Lecithin, originally obtained from egg yolk, is now frequently used for health benefits that occur naturally in a number of plants and animals. Soy lecithin is one formulation that has become popular as a supplement for lowering levels of bad cholesterol and triglycerides. The benefits arising from (lecithin) phosphatidylcholine relate to its unique structure that is essential for supporting membrane integrity of every cells in our body. Lecithin finds its use in various field including food, animal feed, pharmaceuticals, cosmetics and variety of other industrial applications. Lecithin is also a poly unsaturated phosphatidylcholine (PPC) which act as a good source of energy besides forming biological membrane. It our body, phosphatidylcholine.in the blood is found in various lipoproteins such as VLDL, LDL and HDL.Other food sources of lecithin are-tofu, miso, soy milk and soy curd, cauliflower, lettuce, sunflower, rapeseed, wholegrains, liver, legumes meat, peanuts etc. Lecithin is also used in ice cream, margarine and chocolate products.In our body, lecithin help to decrease cholesterol level, clear the toxin out of the body, helps to digest fat, resistance to infection, it plays an important role in mucosal lining speciallyin upper part of digestive tract.

12. Newer Approaches for Isolation and Separation of Pure Catechins and Spectroscopic Studies
Kalai, Rajalakshmi P. and Nagarjan S.
Abstract: The tea catechins (15-20%, w/w from green tea) reportedly possess potential bio active properties, such as anti-oxidant, anti-bacterial, anti-cancer, anti-inflammatory action etc. The isolation of these catechins is significant and hence conventionally they are extracted

by brewing with hot water at optimum conditions. In general the extract contains catechins, caffeine, chlorophyll and theaflavins and thearubigins. However presently the experiments were carried out to isolate catechins by various methods such as liquid-liquid extraction (7.3%), soxhlet method (8.3%) and microwave assisted extraction (7.5%) by standardizing the extraction time and temperature etc. The extracts from all these methods were subjected for the removal of chlorophyll and caffeine by solvent extraction with chloroform. Further ethyl acetate extraction facilitates the extraction of catechins and the organic layer was concentrated using rotary evaporator which contains total catechins. The total catechins were subjected to various chromatographic techniques such as thin layer chromatography followed by high performance liquid chromatography (HPLC) analysis under standard analytical conditions indicated that these fractions enriched with the respective ingredients. Subsequently these were subjected to column chromatography after chemical derivatization and individual catechins were separated. These purified constituents were analyzed by ESI-MS (negative mode) and NMR. It was observed that catechins extracted from Soxhlet method gave better yield and purer catechins than liquid-liquid, microwave and conventional brewing methods.

13. Optimization Opf Bitter Masking Properties of O/W/O Based Herbal Spread Using Sodium Casienate and Sodium Casienate's Conjugate as Emulsifier

Heena Lamba, Latha Sabikhi and Sathish Kumar

Abstract: With the changing times, people now lead busier lifestyles and focus less on their eating habits. As a result, deficiencies and chronic diseases like cardiovascular diseases are increasing at an alarming rate. The role of food and its components as means to alleviate these ailments has been an area of research for over three decades now. Herbs comprise of an integral part of Indian system of medicine since ages. Guggul is a herb that has remarkable cholesterol reduction properties, though its potential to be used in food still needs to be tapped. Its application in food is limited owing to its bitter taste and aromatic odour. Double emulsion could be used as a technique to mask the unaccepted flavour and strong odour of guggul by compartmentalising the herb extract. In this study, guggul encapsulation has been tried in O/W/O based spread matrix made by double emulsification. Preliminary studies were carried out to select the ratio of the phases (9:21:70, 16:24:60 and 25:25:50) and level of ingredients (sodium caseinate, salt and polyglycerolpolyricinolic acid i.e PGPR) based on the lowest bitterness scores as compared ($p>0.05$) to control. Matrix of the double emulsion spread was then optimized using RSM software, with the variables in the following range: sodium caseinate (2.36-4.72%), salt (3.15-4.72%), PGPR (0.4-0.8%) and speed (18000-22000 rpm). The designed matrix was able to encapsulate 0.788% guggul extract (5 mg guggulsterones/serving) giving sensory scores comparable to control ($p>0.05$). Sodium caseinate-based conjugates (1.22%) were also tried in the same matrix replacing sodium caseinate as emulsifier. No significant changes ($p>0.05$) were observed in sensory scores and bitterness perception of both the spreads. While on storage in PET containers at 4-7° C, sodium caseinate spread exhibited significantly ($p<0.05$) higher stability over two months as compared to conjugate-based spread. The bitterness of guggul was successfully masked with greater stability by encapsulating in an O/W/O double emulsion with sodium caseinate as emulsifier.

Keywords: Guggul, double emulsion, delivery system, functional spread.

14. Optmaization of Process for Extraction of Chalta Extracts using Microwave
Garima Gandhi, Dr. Anil Kumar, Dr. S. K. Sharma, Dr. V. K. Shah and Dr. P. K. Omre
Abstract: Fruit of chalta (Dilleniaindica L.) having wide range of functional and neutraceuticals but due to lack of awareness and technological advances gets wasted. Pharmacologically, it has been reported that D. indica shows activities like antileukemic, anti-inflammatory, antioxidant, antiproliferative, antidiabetic, antimicrobial, antifungal, antidiarrheal, cytotoxic, hepatoprotective and many more. This study was thus initiated in order to acknowledge the wide range of triterpenoids, flavonoids, tannins and various other phytoconstituents present in the fruit. The present investigation was undertaken to optimize process variables for extraction of chalta extract with the help of microwaves. The level of process variables were optimized by Central Composite Rotatable Design (CCRD) of Response Surface Methodology (RSM) and prepared extract was subjected to physico-chemical and sensory analysis. The independent variable were taken as microwave treatment time and extraction time and various responses including yield, TSS, acidity, Vitamin C content, DPPH radical scavenging activity(IC50), total phenolic content, reducing sugars and sensory responses were obtained. Results revealed that in case of microwave treatment, effect of microwave treatment time was found highly significant ($p<0.01$) on acidity, Vitamin C, TSS, color and aroma of the extract at linear level and for TPC and IC50 at quadratic level and it had significant ($p<0.05$) effect for yield and consistency also. Extraction time was found to influence acidity, reducing sugar, TPC and TSS of the extract significantly ($p<0.05$) at linear level and vitamin C and consistency at quadratic level. Optimum levels obtained were microwave treatment time was 4.72 minutes with 15 minutes extraction time. Chalta extract so obtained may further be used to popularize consumption of processed chalta products. Since the extract so obtained is rich in nutritive properties, processed drinks from chalta can be a healthy alternative to the current carbonate drinks.

15. Optimization Process Parameter for Phenolic Extraction with High Antioxidant Potential from Red Amaranthus
Sneha Sehwag, Aditya Thatte and Mdhusweta Das
Abstract: The study aimed to optimize the process parameters for extraction of anthocyanin rich phenolic extract with high antioxidant potential from red amaranthus (Amaranthusgangeticus) leaves using response surface methodology (RSM). Process parameters, i.e., solvent: solid, pH, and time were taken as independent parameters and anthocyanins yield (AY), total phenolic content (TPC) and antioxidant activity (AA) were analyzed as dependent parameters. The multivariate regression models for AY, TPC and AA as a function of process parameters were generated and validated statistically. The optimized conditions derived using RSM was 1 g amaranthus powder extracted with 16.08 ml solvent with 4.19 pH for 4.19 h at 60°C to yield 643.206 mg gallic acid/ 100 g dry matter, 68.87% radical scavenging activity for 13.6 ìg dry matter and 1.2 g malvidin 3 glucoside/ 100 g dry matter of extract. A positive and significant ($p<0.05$) correlation was observed between TPC, AY and AA of red amaranthus.
Keywords: Amaranthusgangeticus, total phenolic content, antioxidant activity, response surface methodology, optimization

16. Pitted Jackfruit Chutney
Vidisha and Pinki
Abstract: Jackfruit belongs to mulberry and fig family (moraceae), it is native to parts of south and southeast Asia, but worldwide less accepted by north Indians. In recent decades, people are very conscious about their health and looking for the alternative sources of high dietary fibers and low calorie food, jackfruit is a good sources In B complex group of vitamins which is known to have potential of pyridoxine, Niacin, Riboflavin, Folic acid and free from saturated fats or cholesterol. Keeping in view the study is undertaken to prepare a jackfruit chutney is made from the edible portion of jackfruit,jagerry syrup, coconut oil, citric acid, moongdaal, cardmomum. The boiled jackfruit mixed with prepared jagerry syrup, coconut milk and standardized citric acid allowed to cook till get end point .The prepared chutney poured in sterilized bottle for increasing the shelf life. Jackfruit along with it characteristic starchy flavor, it contain phytonutrients like lignans, Isoflavin and saponins that contain anticancer and anti-ageing properties and also proved to be favorable in eliminating cancer causing free radicals and prevent constipation in human.

17. Powdered Alcohol
Piyush Dagar
Abstract: Powdered alcohol-a term so easy to read and understand but yet so complicated and controversial. With the emergence of Sato Foods Co. Ltd. in Japan, this term came into the ears of global citizens. As soon as it reached the shelves of the supermarkets it was an instant eye catcher. Quoted as a powder to mask the food odors and help retain natural juices of fish and meat it is still being produced and sold in high amount as a food additive. The emergence of this powder quickly spread in the world taking it all the way from Japan to Germany, but the company virtually vaporized after the critics faced. The wave of powdering alcohol reached Netherlands and students produced another product leading to a similar product in US. Palcohol saw a major boost and a very big support from the youth along with a strong opposition from parents and critics for the fear of being sold to minors and being misused in many other ways then intended but miraculously the product got a green from the United States Alcohol and Tobacco Tax and Trade Bureau (TTB) in 2104. The producers were not even finished celebrating and the statement was issued for its ban in many states in USA saying that the label approvals were issued in error. While the future of this controversial product is unclear, it is certain that the actions of TTB have put powdered alcohol into the spotlight from its shadowy past and there is no turning back yet globally it might be a product for fun consumption for younger generations.

18. Process Parameters for Sweet Potato Wine
Vishu Bhardawaj, Sanib Kumar Paul and Himjyoti Dutta
Abstract: The was done to understand the potential of reconstituted sweet potato (Ipomoea batatas) juice as wine raw product and study the effect of storage period and temperature on sensory and optical attributes of wine. The extracted sweet potato juice was first treated with crude amylase solution at 5% v/v to hydrolyze the starch into fermentable sugar. The process continued by adding distilled water, sucrose syrup and 0.1M oxalic acid at different concentrations to attain samples of final total soluble solids concentration (TSS) and pH in

the range of 18 - 30º Brix and 4.0 - 5.5, respectively. All the samples were fermented at 20 to 35ºC with different inoculums size till TSS and ethanol percentage remained constant for three consecutive days. The reconstituted juice with initial TSS content of 22?Brix and pH of 4.5, fermentation process temperature of 25ºC and inoculum size of 10% (v/v) for the fermentation period of 240 h produced wine with highest ethanol percentage of 9.6. Sensory evaluation revealed that the wine had a very good taste and aroma with good body. The wine also had acceptably good after-taste and color. The changes in total color difference (ΔE) and browning index of the wine were prominent during storage.

Conclusions: The study revealed that the sweet potato has a tremendous potential to be used as a raw material for wine production with very good physicochemical, optical and sensory attributes. Further work to improve its clarity and pH would certainly lead to a newer dimension in the use of sweet potato as a potential source for quality wine production. Probable alternatives for quality improvement of the wine can be enzyme treatment, addition of natural pigments and acidulants or blending with other fruit juices/ wines at a suitable ratio. This study establishes the scope for further research in the area of alcoholic fermentation of this root vegetable.

19. Proccesing, Isolation and Stabilization of Bioactive Molecules from Garlic
S. Nagarajan, Swetha H. and Sarna Rani Bhagat

Abstract: Garlic (Allium sativum, Alliaceae) is an extensively used spice worldwide. It is used universally as a food flavouring agent, in traditional medicine and as a condiment in various food products. A strongly flavoured species contain hundreds of constituents which also include atleast 23 identified Sulphur compounds which gives the strong odor. Allicin is one of the active ingredients, and it readily degrades to diallylsulphide (DAS), diallyldisulphide (DADS), diallyltrisulphide (DATS) and s-allyl cysteine etc. In order to stabilise the active ingredients the garlic has been subjected to various types of processing and drying using microwave oven (245 - 800W) hot air oven (80°C and 90°C) and microwave conveyor (400-1200W) at different power levels. The isolated volatile oil from these samples subjected to GC and GC-MS analysis and also for column chromatography to enrich bioactive volatile components. Preliminary studies carried out on the preparation of complexes using zein protein for fractionated garlic components to be used in controlled delivery models by the membrane model which was characterized by SEM analysis.

20. Protein based Edible Films
Manisha Singh and Preeti Shukla

Abstract: Edible films have received considerable attention in recent years because of their advantages over the synthetic films. Edible films can be prepared from protein, polysaccharide and lipid materials. Among them, protein-based edible films are the most attractive. These films have impressive gas barrier properties compared with those prepared from lipids and polysaccharides. The mechanical properties of protein-based edible films are also better than those of polysaccharide and fat-based films because proteins have a unique structure (based on 20 different monomers) which confers a wider range of functional properties, especially a high intermolecular binding potential. Protein-based edible films offer alternative packaging without adversely affecting the environmental costs. The structure of proteins

can be modified by various physical and chemical agents such as heat, mechanical treatments, pressure, irradiation, lipid interfaces, acids, alkalis and metal ions. Such agents are often used in the formation of protein films and coatings to optimize the protein interactions, protein configurations and resulting film properties. Protein films and coatings can enhance the nutritional quality of foods based on the protein content and the potential for incorporation of nutritional supplements. However, the poor water vapor resistance of protein films and their lower mechanical strength in comparison with synthetic polymers limit their application in food packaging. This limitation can be overcome by producing composite films, thus improving the mechanical properties. The proteins can be combined with carbohydrates or lipids or both and/or with synthetic polymers and natural polymers to manufacture composite films. These heterogeneous films are applied either in the form of an emulsion, suspension, or dispersion of the non-miscible constituents, or in successive layers or in the form of a solution in a common solvent for example, casein-lipid emulsion coatings were fruitful in plummeting moisture loss from skinned carrots and zucchini. The method of application affects the barrier properties of the films obtained. Protein film forming materials include collagen, gelatin, wheat gluten, keratin, casein, corn zein and the proteins from fish (myofibrillar), egg white, whey, soy, peanut and cottonseed. These films have a wide range of uses. The films can be used for individual packaging of single servings, small portions of foods particularly products that currently are not individually packaged for practical reasons such as nuts. Laminated films that comprise casein did protect dried and vegetables from moisture absorption and oxidation. They can function as a carrier for antimicrobial and antioxidant agents. In a similar application they can also be used on the surface of food to control the diffusion rate of preservative substances from the surface to the interior of the food. The films can enhance the organoleptic properties of packaged foods provided that various components (such as flavorings, colorings and sweeteners) are used. These films can be used as food contact layer in multilayer packaging materials together with other polymers., protein-based edible polymer may be able to substitute synthetic polymer films.

21. Prototype Design of Wireless Microbial Sensor for Food Pathogens

Jitender Kumar, Ravinder Sigh, Rishab Tiwari, Kapil Sharma, Md. Aslam, Dr. Amit Kumar and Dr. Shalini Sehgal

Abstract: These days everyone is becoming health conscious and more worried about the existing quality of food products. The product like raw/processed milk and street ended food samples such as Paani-Puri are more likely to get contaminated by biological form (microorganism). Such eatables may get contaminated at various levels of the food processing. Keeping this in view, there is a need of detection of microbial contaminates which adversely affect the child growth and health of adult in real time to reduce the health issues. We hereby propose a prototype design for a low cost, real time monitoring sensor that will detect the presence of microorganisms and other physico-chemical parameters such as impedance, conductivity, temperature, Ph etc. that will affect the growth of microorganisms. Through this sensor, we will be able to predict the shelf life of the agri-products on the basis of the data acquisition. The developed proposed device will be much more useful for farmers and food stack holders to know their product storage time limit. The prototype consists of a sensor unit composed of carbon electrodes followed by Whetstone Bridge excited by an

oscillator and followed by instrumentation amplifier AD 620. This is done to enhance the signal strength for the proper data acquisition. The output of this amplifier then rectified and fed to controller unit (AtMega 16). The controller unit is programed for the display and Bluetooth transmission of observation.

The present prototype design for microbial sensor gives result in real time and detect of Microbes & others physico-chemical parameters at low cost, and with portability which make it suitable in all environmental conditions. This sensor could find applications in agriculture field because of Bluetooth interface which make it convenient use even by smart devices like phones etc.

22. Safety and Quality Assurance in Wine Manufacturing

Devieka Gautam and Alok Saxena

Abstract: The present study summarizes the application of Hazard Analysis Critical Control Point (HACCP) system in winery which has to be performed following the principles of HACCP. For assuring safety and quality assurance in winemaking, efforts have to be made to list CCPs' involved during the whole process of manufacturing of wine (Changzheng et al., 2007). With the aim to ensure safety (chemicals, pests and metal parts) and prevent quality hazards (appearance, flavour, and consumer acceptability), the CCPs' are determined (Martinez-Rodriguez & Carrascosa, 2009). These CCPs' are identified during stages of growing and harvesting of grapes, its fermentation and stabilization followed by ageing and bottling (Yue et al., 2006). Based on that, the most significant factors responsible for CCPs' posing high risks are determined. Finally, critical limits are established and preventive measures are proposed for the safe distribution of the final product.

Conclusions: This paper deals with all possible quality and safety hazards based on HACCP approach, and also discuss the possible critical factors and their critical limits or essential controls.

23. Shelf Life Study of Thermally Processed Micronutrients fortified Starch Based Milk Dessert

Akansha Wadhera, Ashish Kumar Sigh, R. R. B. Singh, P. N. Raju and Sumit Arora

Abstract: Increasing consumption of processed dairy products in India has necessitated the diversification of product profile for the manufacturer to sustain in the market place. There are many desserts such as kheer and payasam popular in India. Dairy desserts can be described as a dispersion of gelatinized starch in a continuous medium containing milk proteins as well as a gelling agent. Since, such desserts are enjoyed throughout world, hence, a need was felt to develop similar product fortified with micronutrients. Deficiency of both calcium and Vitamin D is a global health problem. In this study, milk dessert was prepared using potato starch, hydrocolloids, sugar and buffalo milk. It was fortified with calcium at a concentration of 200 mg/ 100 g of the product and Vitamin D at a concentration of 200 IU/ 100 g of the product to meet 50% of Recommended Dietary Allowance (RDA). The mix for the dessert was prepared and it was filled in tin cans and thermally processed at 121ºC for 20 min. After cooling, it was stored at two different temperatures (10ºC and 37ºC) to study the effect of storage temperatures on the storage days. It was observed that in case of desserts stored at 10ºC, retrogradation was seen after 120 days but they were acceptable in terms of sensory upto 150 days. Samples stored at 37ºC did not show appreciable retrogradation

even upto 180 days of storage but were found to be unacceptable in terms of microbiological quality after 150 days. Hardness and cohesiveness increased significantly for the desserts stored at 10ºC after 135 days of storage. HMF content for samples at both the temperatures increased but the increase was significantly higher after 75 days of storage to 180 days (137 µmol/g to 183 µmol/g) at 37ºC. Also, L* and a* value gradually decreased at both the temperatures as the storage days increased whereas b* value increased significantly. Storage modulus and loss modulus increased at both the temperatures throughout storage period.

24. Storage Stability of Fruit Beverages
VidhuYadav, Ritu Devtalla and Deepshika Kataria
Abstract: The connection between diet and health is an integral part of healthy lifestyle. Due to increased prevalence of chronic degenerative diseases, consumers are more aware of their food consumption. Antioxidants are our first line of defense against free radical damage, and are critical for maintaining optimum health and wellbeing. Fruit juices being rich sources of antioxidants can fulfill the consumer demand for healthy food. In order to get the maximum nutritional benefits, it is important for the consumers to know the effect of refrigerated storage on the antioxidant properties and stability of fruit juice/beverage under refrigerated storage after opening the packs. The main objective of this study was therefore, to determine the changes of antioxidant activity and total phenolic compounds during storage at low temperature (refrigerator) to be used as a guideline for consumers to appropriately handle the packed fruit beverages. Packed beverage of apple (Malusdomestica), grapes (Vitisvinifera) and pineapple (Ananascomosus) of two brands viz, A and B were randomly selected and were stored at 5?C for a period of 5 days after opening the packs. During the storage period of 5 days, the products were evaluated for physico-chemical parameters(total soluble solids, pH, titratable acidity), antioxidant properties(ascorbic acid, total phenols, total tannins) and microbiological quality(total plate count) on 0th, 3rd and 5th day of storage. After analyzing all the samples, a statistically significant ($p<0.05$) increase in total soluble solids, pH and total plate count and a statistically significant ($p<0.05$) decrease in titratable acidity, ascorbic acid, total phenol and tannins was observed in the samples of both the brands after refrigerated storage period of 5 days. In conclusion, keeping packed fruit beverages in refrigerator for 5 days after opening the packs resulted in variations in parameters examined.

25. Study of The Efficacy of Flavor Enhancer and Bitter Blocker on Taste induced Saltiness Enhancement and to Reduce Sodium Content in Cheddar Cheese
Yogesh Khetra, S. K. Kanawjia, Ritika Puri, and Anindita Debnath
Abstract: Excess dietary sodium has been associated with hypertension and other health ailments. Sodium chloride (NaCl), added in foods principally for flavour and preservation, is the major source of sodium in foods and therefore the part of it has been replaced with potassium chloride (KCl) in several foods. However, the inherent bitterness of KCl does not allow complete or higher level of replacement. Odour induced saltiness enhancement (OISE) is an emerging technique in the area of sodium reduction in foods wherein salt associated odours or flavours are used to enhance saltiness intensity in foods.
Results: Present study envisaged to evaluate the potential of flavours to enhance saltiness of a solution prepared by using NaCl and KCl in the ratio of 1:3. Three flavour enhancers

were used in the study. With the aim to reduce the inherent bitterness of KCl in the solution, addition of bitter blockers were also tried. The solutions containing NaCl, KCl, flavour enhancer and bitter blocker were presented before a panel of trained judges for evaluating saltiness and bitterness intensities (on 10 point scale). A control with only NaCl was also used in the study. Taste induced saltiness enhancement of the solutions were calculated and it was witnessed that flavours were effective in enhancing the saltiness of the solutions. Bitterness was profoundly decreased in the solutions containing bitter blockers. One each of flavour enhancer and bitter blockers along with a mixture of NaCl and KCl were used in Cheddar cheese manufacturing. The results suggested approximately 78% reduction in the overall sodium content of Cheddar cheese without jeopardizing the quality of cheese.
Conclusion: Flavour enhancer, bitter blocker and KCl can be used in combination to achieve the goal of maximum sodium reduction in Cheddar cheese.

26. Turmeric Volatile Oil Analysis GC and GC-MS and Qualitative Evaluation of Various Grades
Sarna Rani Bhagat, Swetha H. and Nagarjan S.
Abstract: Turmeric (curcuma longa L), derived from the rhizome family Zingiberaceae, is one of the primary component and commonly used spice. Turmeric has been used in traditional medicine for various ailments and the studies indicate that it possess anti-inflammatory, hepatoprotective, antitumor, antiviral activities, anticancer activity and is used in gastrointestinal and respiratory disorders. Turmeric rhizome contains two major classes of secondary metabolites viz., phenolic curcuminoids and essential oil. Essential oils are complex mixtures of volatile secondary plant metabolites. The grounded curcuma rhizome has been subjected to Moisture (Dean-Stark apparatus) and Clevenger-hydro distillation method (volatiles) with different varieties of bulb and finger. The results indicate that the percentage of volatile oil which contains up to 6.25% and moisture up to 7.28% in bulb samples as compared to finger samples volatile oil which contains up to 1.5% and moisture up to 2.45%. The qualitative and quantitative analysis of volatiles for different varieties were determined by GC and GC-MS analysis. Through GC and GC-MS analysis, Ar-Turmerone was found to be the major volatile component in the bulb as well as in the finger samples. The results indicate that the Bulb variety of turmeric contains large amount of essential oil which has the potential application in the food and pharmaceutical industries. However the analytical profile and components were identified in various grades and their profiles were compared.

27. Utilization of Flax Seeds for the Development of Extruded Snacks
Charul Chardhry, R. B. Grewal and Rakesh Gehlot
Abstract: Flaxseed is an emerging nutrition crop as it is a leading source of alpha-linolenic acid, phenolic component lignan and high quality proteins. Flaxseed incorporation in the diet is particularly attractive for the development of food with specific health benefits. A number of extruded Ready-to-Eat (RTE) snacks are available in the market but flaxseed incorporated extruded snacks has not been yet established. The acceptability of a food product depends on its physical, sensory and nutritional characteristics. The present study was carried out to evaluate effect of flaxseed on extruded snacks. Extruded snacks were evaluated for

physical properties (Bulk density, expansion ratio, sectional expansion index and hardness), sensory and nutritional properties. It was observed that bulk density and hardness increases with increase in level of flaxseed while expansion ratio and sectional expansion index decreases. Taste, texture and overall acceptability of the value added RTE snacks decrease with increase in concentration of flaxseed. However, value added RTE snacks prepared with incorporation of flaxseed were adjudged 'liked slightly' to 'liked very much'. Protein, ash and crude fiber content of acceptable extruded snacks were found higher as compared to control. Thus flaxseed can be utilized for the development of healthy extruded snacks.
Keywords: Flaxseed, extruded snacks, texture, protein, crude fiber

28. Vitamin-D fortification of Milk
Kajal and Afreen Jahan
Abstract: Vitamin D deficiency in India is one of the most common nutritional deficiency in the world. Vitamin deficiency is endemic in India, in spite, of abundant sunshine & several socio economy and cultural constrant. Poor vitamin D Is possible due to poor sun exposure, dark skin complection, environmental pollution , vegetarian food habits, absence fortification and poor intake of vitamin D supplements. In human body calcium and phosphorus represent building material for bones. The suppliers of these bone mineral is the hormone calcitriol, which originate from vitamin-D itself made by sunshine in human skin. So, vit-D inhance the absorption of calcium and phosphorus from the diet. The vit-D deficiency causes rickets in children and will precipitate and exacerbate osteopenia, osteoporosis and fracture in adults. Vit-D deficiency also has been associated with increasing risk of common cancer, autoimmune disease hypertension and infection disease. To over come these world wide problems we have to take some important step like we have to consume food naturally rich in vit-D. which are limited and normally indian are mostly vegetarian. So, they will not consume vit-D rich food then we have to look another option. Other steps of fortification are fortified milk with vit-D which helps to prevent vit-D deficiency. Other example of fortification are flour fortification with folic acid and universal salt iodisation to prevent iodine deficiency. Our main focus is on vit-D fortification with milk. Since fortification of milk with vit-D is a viable population based strategy for the general population and it efficacious in improving vitamin d status .there are many types of fortification. Vitamin D is a fat soluble vitamin. We can easily fortified it with milk and milk product like yogurt, cheese etc. We can mainly spray dried and water soluble form of vitamin D3, best suitable for milk fortification.

29. A Facile Chromatographic Method for The Isolation and Characterization of Catechins from Green Tea
Rajlaxmi, Kalai, Selvi I. and Nagarjan S.
Abstract: Tea (camellia sinensis) is commonly consumed refreshing beverage worldwide and it possess characteristic aroma in addition to potential bioactive molecules such as catechins and some of the alkaloids which include caffeine, theobromine and theophylline. The separation of the catechins from the tea extracts is significant in terms of exploring their potential health benefits. Though some of the chromatographic methods have been explored using sophisticated instruments such as Preparative HPLC etc, each of them had

some of the drawbacks such as long time for resolution etc. Therefore, in the present study the development of simple thin layer chromatographic method has been standardised for the preparative separation of the individual tea catechins from green tea extract. The total Catechins were dissolved in methanol and applied to preparative TLC plates measuring (20x20cm) using silica gel G using ethyl acetate: chloroform: acetic acid in various proportions. The four coloured bands were observed under uv (254 nm) and were separated and pooled into fractions which were analysed by physical and spectral studies and found to be Gallic acid (grey colour), EC (pale yellow), EGC (orange) and EGCG (pink) by comparing with standards. The separated components were further characterised by HPLC and NMR spectroscopic methods. Further it was analysed by ESI-MS with analytical conditions.

30. Carbohydrate-containing Food and its Glycemic Content
Savita Budhwar
Abstract: The prevalence of type 2 diabetes has increased rapidly during the past decades in the United States. Although an increase in the prevalence of type 2 diabetes has been observed in all age groups, it has been found to be most dramatic in younger age groups. The quality of carbohydrates can influence the digestion rate and thus the blood glucose response.The glycemic index is a measure of the change in blood glucose following ingestion of carbohydrate-containing foods. Some foods result in a marked rise followed by a more or less rapid fall in blood glucose, whereas others produce a smaller peak along with a more gradual decline in plasma glucose The glycemic index is a ranking of carbohydrate exchanges according to their effect on postprandial glycemia.

31. Preparation and Nutritional Evaluation of instant Drumstick Kadhi
Meenakshi Garg, Dikha, Rahul and Sushmita Dey Sadhu
Abstract: In the modern world where people are becoming more and more concerned about their health and keep a tab on what they are eating and awareness about the nutritional aspect of the food product has also increased, developing a product considering these things in mind is the need of the hour. Consumers today don't want to rely on supplement tablets in order to avoid deficiency diseases that may occur due to lack of vitamins, they now prefer incorporating as much as they can in the diet. So in this project Instant Drumstick Kadhi is developed by drying the fresh kadi in Tray Dryer at controlled temperature keeping the health and nutritional benefits in mind. Different parameters related to nutrition, drying , water-activity were studied. It was found that the product provided 77.35 Kcal, 1.42g of fat and 3.91g of protein. It is a rich source of Vitamin A, Calcium& Iron. It can provide Vitamin C as high as 213% of the daily requirement. The drying and rehydration ratios were found out to be 7.35:1 & 6.3:1 respectively which showed concurrence with similarly dried products. The water activity of the product was 0.35 which lies in the safe range. Sensory evaluation of the product was also done by a panel of semi trained members.. Hence results showed that this product can be recommended to such patients who have disease manifestations which eat up Vitamin C reserves in the body & also to those having disorders like Scurvy. As a whole, this product can be consumed by people having normal diets as well and can serve as a source of Vitamin A, C minerals like Calcium, Iron, Potassium.
Keywords: Drumstick, vitamin C, water activity, sensory evaluation.

32. Nutritional Evaluation, Formulation and Storage Stability of Crab Apple Leather
Anita Kumari
Abstract: The present investigation was undertaken with aim to analyze physico- chemical parameters and to develop leather/bar from highly nutritious underutilized fruit (crab apple) of Himachal Pradesh. The fruit contain good amounts of vitamin C and pectin content. The nutritional components in crab apple leather during storage were studied. The TSS, pH, ascorbic acid, total and non-reducing sugars decreased while acidity and reducing sugars increased with the increase of storage interval. The prepared product was evaluated organoleptically to a panel of members at different storage intervals and the product was acceptable even up to storage interval of 9 months at ambient conditions. The colours, taste, flavour and consistency of the product was found to be good.

33. Effect of Bulk and Nano-Zinc Oxide particles on Physio-Morphological Changes in Pisum Sativum
Lakhwinder Kaur and Shweta Pathania
Abstract: Nanotechnology is emerging as the technological platform for the next wave of development and transformation of agri-food systems. Nanoparticles (Nano Scale Particles = NSPs) are atomic or molecular aggregates with at least one dimension between 1 and 100nm, that can drastically modify their physico-chemical properties compared to the bulk material.The aim of this study was to compare the effects of bulk and nano-Zinc oxide (ZnO) on seed germination and shoot – root growth of PisumSativum. For Seed germination test four concentrations viz. 250, 500, 1000 and 2000 mg/L of both bulk and NPs each were used. The results showed that with increase in the concentration of zinc oxide nanoparticles the % of germination decrease.Result indicated that zinc oxide nanoparticles were differentially influenced the levels of seed germination, seedlings growth were found to be maximum at 250mg/L and 500mg/L.Unlike the growth of the seedling was decreased gradually with increasing the concentrations of each zinc oxide nanoparticles and bulk zinc oxide up to the 2 mg/L. The present study showed that the use of the zinc oxide nanoparticles can reduce the quality of the seed germination and seedling length incomparison with control seedlings.Control group showed the maximum seed germination, seedling length,shoot and root growth. The study showed that with increasing the concentration from 250mg/L>500mg/L>1000mg/L>2000mg/L the shoot or root length decreases. It was concluded that the zinc oxide nanoparticles affect the physiological expression of plant.
Keywords: Nanoparticle, Zinc oxide, Bulk particle.

34. Effect of incorporation of Cauliflower Leaf Powder on Sensory and Nutritional Composition of Chapati
Himshikha, Himanshu Gaur, Kalpana Yadav, Leeza Chawla and Shivani Mehla
Abstract: The study is about utilisation of cauliflower leaves for fortification of chapatis.The food processing industry produces large quantities of waste products. Over one million tonnes of vegetable trimmings from the vegetable processing industry are produced every year which can be used for value addition.
Among vegetables, cauliflower (Brassica oleraceae var. Botrytis) is the most popular cole vegetable grown extensively in India. It belongs to family Brassicaceae. It is rich in nutrients

but has highest waste index. The edible portion of cauliflower is curd (head), whereas, its leaves which are generally thrown away as waste are also rich source of iron and â-carotene and thus can be utilized in various value added products. The leaves contribute about 50% of the total production of cauliflower. The leaves of cauliflower are available only for a short period but these can be dried or stored for use during lean season.

Dehydrated leaves are also rich source of â-carotene and various minerals which can be used in sparce season. Keeping in view the aforementioned facts, the present investigation were undertaken to examine the effect of blending cauliflower leaf powder and wheat flour on sensory properties and proximate composition of chapatis.

Cauliflower (Brassica oleracea) leaves were obtained in a single lot from local market. The leaves were separated from their stalks, washed under running tap water and were sun dried for 1 to 2h by spreading on filter paper followed by drying in tray dryer at 60°C for 4 to 6 h. The dried leaves were ground to fine powder, passed through seive and packed in polybags for further use.

Chapati were prepared at 10, 20 & 30% flourt wt. Basis. Sensory evaluation and proximate analysis was done. 10% composition was found best wrt to sensory aspects as other has a bitter after taste.

35. Application of Ultrasound in Food & Dairy Industry : A Review

Ashish Khare, Dr. A. B. Lal and Dr. M. K. Salooja

Abstract: Consumer demands for processed foods that maintain their original quality attributes are increasing. These demands require the development of innovative processing techniques that minimize the adverse effects of processing. Conventional heating methods for pasteurizing or sterilizing not only kill or reduce the microbes but also reduce the nutritional and organoleptic quality of foods. Ultrasound equipment has long been synonymous with obstetrics, more specifically, the determination of intrauterine health problems. In recent years, the food industry has discovered that ultrasonic waves have a wide variety of applications in the processing and evaluation of food products. It is used in food industry for many purposes including analysis methods and food processing such as freezing, cutting, drying, tempering, homogenization, degassing, antifoaming, filtration and extraction. Ultrasound can be used as a promoter or alternative to food processing. There may be numerous advantages of using ultrasound for food processing such as effective mixing, increased mass transfer, reduced energy, reduced temperature and increased production rate. Due to the elimination of microorganisms and enzymes without destroying nutrients of foods, ultrasound can be used as an alternative method to thermal treatments in the food preservation. Additionally, low power ultrasound is thought to be an attractive non-thermal method due to overcome problems which occur during heat treatments such as physical and chemical changes, nutritional loss and change in organoleptic properties. Nowadays, its emergence as green novel technology has also attracted the attention to its role in the environment sustainability. Ultrasound applications are based on three different methods : Direct application to the product; Coupling with the device; and Submergence in an ultrasonic bath.

Keywords: Ultrasound, shelf life, Organoleptic properties, non-thermal, novel technology.

36. Development of Sugar Free Cookies with Biodegradable Packaging Material for Diabetics
Eram S. Rao, Prem Lata Meena and Manjeet Singh Barwah
Abstract: Overweight and obesity are well known risk factors for diabetes and cardiovascular diseases. India has been recently declared as the 'diabetic' capital of the world. One in every five persons in India suffers from diabetes and other related disorders. Use of alternative sweeteners can help manage weight and normal blood glucose level (Huntyetal. 2006). Cookies are prepared with high amount of sugar, fat and refined flour which is not only high in calories and have a high glycemic index (GI) but are also low in fibre. Therefore, development and standardization of low calorie, low glycemic index and high fibre cookies using different intense sweeteners was done. Quality evaluation using semi- trained subjects was performed to establish acceptability of the product. The shelf stability of a product is also closely associated with its packaging. In India, biodegradable polymeric films which are economical as well as eco-friendly are in great demand. Therefore, development of a flexible packaging material with good moisture and oxygen barrier properties which is also biodegradable was undertaken. The biodegradable terpolymer was synthesized with chemical reaction of Lactic acid, Phthalic anhydride and Ethylene Glycol. The chemical and physical properties of obtained resin were determined using acid value, hydroxyl value, viscosity, number average molecular weight, and FTIR.

37. Naturally Occuring Plant Pigments, their Properties and Effects of Processing
Chaynika Verma, Kadambini Pandey and Simran Rajput
Abstract: Plant pigments are the most important aspect of fruits and vegetable as they provide them aesthetic value and influence consumer acceptability. They show high structural diversity and therefore generate a wide range of colours seen in plants. The major plant pigments are broadly classified on the basis of presence or absence of nitrogen as chlorophyll, carotenoids, anthocyanin and betalains.Chlorophyll is involved in photosynthesis and is also known for its antioxidant properties. It is a bright green colour pigment, which is stable to light but, on application of heat and in acidic condition convert to olive green to brown colour compound pheophytin. Carotenoids are responsible for the characteristic yellow, orange and red colours of various kinds of fruits and vegetables and play important biological roles as accessory light-harvesting components of photosynthetic systems, photo protecting antioxidants, and regulators of membrane fluidity. They are insoluble in water and may be found free in fat droplets along with chromoplast; hence they are not prone to leaching in water. However, they are fairly resistant to heat treatment and change in pH but very sensitive to oxidation. Anthocyanins are the most abundant flavonoid pigment. They exhibit a high colour diversity from red, purple, pink, magenta to blue and blue black due to the degree of oxygenation of the anthocyanidins (the central chromophores of the anthocyanins) and the nature and number of substituents(e.g. sugar moieties) added to these chromophores. They are major colorants used in food industry. The loss in the content of anthocyanin increases with increase in temperature. Anthocyanins undergo change in colour from red to violet to blue under alkaline conditions. Betalain pigments are water-soluble vacuolar yellow (betaxanthins) and violet (betacyanins) pigments that replace anthocyanins in most plant families of the order Caryophyllales. They are utilised both as food dyesand food additives. They were earlier known as

'nitrogenous anthocyanins'. Betalains are more stable to pH and temperature as compared to anthocyanins. Destruction of betacyanin increases with the change in temperature and ph. However betalain content and its anti- oxidant properties enhances during some microwave treatments. The pigments respond to different processing methods by change in colour or loss of biological activity.

38. Size Dependent Efficacy Study of Silver Nano Particles against Food Spoilage Microbes
Indu Arora, Deepa Joshi, Dr. Jasjeet Kaur and Dr. M. Samim
Abstract: Antimicrobial property of Silver has been known since ancient times. It exhibits broad spectrum antimicrobial activity against fungal, bacterial and viral agents. Food, being an excellent substrate for the all microorganisms undergoes fast spoilage and therefore food decay and its bacterial contamination have emerged as a major cause of concern worldwide. The lack of preservation and processing methods has been one of the major contributors to this problem. Therefore, Food industry desires for safe and effective preservatives. Silver nanoparticles too like silver are known to have antibacterial, antifungal and antiviral activities and can be effectively used against bacteria causing food spoilage. In our work, a stable aqueous dispersion of Silver Nanoparticles of different diameters was prepared in aqueous medium at low temperature. These nanoparticles were characterized using UV-Visible, FTIR spectroscopy, TEM and XRD techniques. The antimicrobial activity of these nanoparticle of varied sizes were tested against against food spoiling microbes viz. Bacillus and Pseudomonas by disc diffusion assay and minimum inhibitory concentration (MIC) of these particles were determined.

39. Designer Foods and their Importance
Karishma Kundu
Abstract: Designer foods are type of food stuff that are usually supplemented with various combinations of nutrients and are beneficial in reducing lifestyle disorders. They are generally produced by fortification or nutrification. The technology plays a major role. With advancement in technologies like biotechnology, bio fortification and various other like technologies of fermentation etc. helps to gain popularity of these foods. They are the food which provides health benefits beyond traditional nutrients. According WHO facts sheet of 2009, lifestyle diseases that accounts for 59% of 56.5 million deaths annually and 45.9% of global burden of diseases are cardiovascular diseases, diabetes, obesity, various respiratory and gastrointestinal diseases, cancer etc.

40. Synthesis and Characterization of Biodegradable Polyester for Food Packaging
Prem Lata Meena, Manjeet Singh Barwa and Eram S. Rao
Abstract: In India, biodegradable polymeric films which are economical as well as eco-friendly are in great demand. Therefore, development of a flexible packaging material with good moisture and oxygen barrier properties which is also biodegradable was undertaken.In recent year's biodegradable packaging have raised great interest. The terpolymer were synthesised by condensation reaction of lactic acid, ethylene glycol and pthalic anhydride. The film formed are used in packaging of biscuit, cookie etc .Overweight and obesity are well known risk factors for diabetes and cardiovascular diseases. India has been recently

declared as the 'diabetic' capital of the world. Cookies are prepared with high amount of sugar, fat and refined flour which is not only high in calories and have a high glycemic index (GI) but are also low in fibre.Therefore, development and standardization of low calorie, low glycemic index and high fibre cookies using different intense sweeteners was done.The chemical and physical properties of obtained resin were determined using acid value, hydroxyl value, viscosity, number average molecular weight and FTIR.

Keywords*:* biodegradable, biopolymer, terpolymer.

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