National Seminar on

NUTRICON 2018
Food Adulteration: Terror on My Plate

Proceeding & Book of Papers

J.D. BIRLA INSTITUTE

Department of Food Science & Nutrition Management

Affiliated to Jadavpur University

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23rd to 24th March 2018

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Edited by

Dr. Adrija Sarkar

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About
J.D. BIRLA INSTITUTE

J.D. Birla Institute, Kolkata, is a leading educational institution in Kolkata is affiliated to Jadavpur University, a university of distinction and one of the finest in the country. In fact, it is the only college affiliated to this prestigious university. The institute has also been accredited with an 'A' grade by NAAC in 2010, and is currently preparing for its third cycle several rating agencies. The Institute completed its Golden Jubilee in 2013 and currently has about 1800 students.

The College offers a range of graduate and post-graduate academic courses in the fields of Applied Sciences, Commerce and Management. The Institute completed its Golden Jubilee in 2013 and currently has about 1800 students. B.Sc (Hons) course in Food Science & Nutrition Management was introduced 2009 and the post-graduate (M.Sc) course in Food & Nutrition in 2013.

The FSNM Department as it is called in short is based on applied science and technology and is geared to meet the emerging needs and challenges of a contemporary society. The course offers students with ample opportunities to assess their abilities, aptitudes & interest in the field of food and nutrition and introduces them to variety jobs and careers. The curriculum includes studies on food science, nutrition, dietetics, nutritional biochemistry, meal planning, food preservation, food processing and culinary science besides skill development through projects, term papers and seminars. A 6-week Internship in the final year is one of the most significant aspects of the course. Students undergo vocational training at various organizations within the city or outside to gain practical experience. The college also has state of the art laboratories and excellent infrastructure to conduct the course.

The Food Science & Nutrition Management Department is organizing a two-day National Conference on "Nutricon 2018: Food Adulteration: Terror on My Plate" on 23rd March to 24th March 2018. The seminar aims to bring together leading academicians and industry personnel to exchange and share their experiences and research outputs on various novel aspects of food adulteration like current technologies for detection of adulterant in food stuff and its impact on consumer health; prevention of food adulteration and laws related to food adulteration.

55 Years of Educational Excellence

J.D Birla Institute has volunteered to obtain the National Assessment and Accreditation Council (NAAC) rating since 2004. During the recent re-accreditation procedure in2010, the NAAC peer team awarded the Institute with 'A' Grade (CGPA – 3.11), the highest possible grade, highlighting the Institute's constant quest for self-improvement and excellence.

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As a private unaided educational institution, **'Vidya Mandir Society'**, an educational trust managed by the S.K. Birla Group, sponsors the college.

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The J.D. BIRLA INSTITUTE ETHOS

An educational institution of distinction, J. D. Birla Institute (Departments of Sciences and Commerce) places high value on providing its students with fulfilling educational experiences in their chosen discipline and achieve their individual goals.

Since 1962

Our VISION

To establish ourself as a leading college providing higher education of higher standards with integrity, consistency and due diligence

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To prepare the future generation with academic excellence and practical skill-set needed to face global challenges and lead the country into the world of the future.

Our LOGO

The Institute's logo represents a well-known shloka from the Brhadarnyaka Upanishad (*Brhadaranyaka Upanishad – I.iii.28*).

"Asato ma sadgamaya
tamaso ma jyotirgamaya
mrtyorma amrtam gamaya"

Lead us from all that is untrue and unreal to what is real and true.
Lead us from darkness to light, ignorance to knowledge.
Lead us from death to immortality

Our OBJECTIVES

- To acquire knowledge and skills in the pursuit of academic excellence aimed at advancement into higher education, research and extension activities.
- To educate within a dynamic system structured towards varied professional and vocational applications for career design and development.
- To work proactively towards individual and group goals within an integrated setting of diverse socio-cultural members.
- To attain self-reliance through balance of freedom and discipline within the body, mind and spirit.

PROGRAMME SCHEDULE

DAY-1: 23rd March 2018 (Venue: JD Birla, Main Campus)

09:00 am to 09:45 am	:	**Display of Posters**
10.00 am to 11.00 am	:	**Inaugural Session**

CHIEF GUEST
Shri Manoj Kumar Agarwal, I.A.S.
Principal Secretary, Food & Supplies Department, Government of West Bengal

KEYNOTE SPEAKER
Dr. Balwinder Bajwa
CEO and Director, Edward Food Research & Analysis Centre Limited (EFRAC)

10.00 am to 10.05 am	:	Welcome Song
10.05 am to 10.10 am	:	Greeting of the Guests
10.10 am to 10.15 am	:	Lighting of Lamp
10.15 am	:	Seating of Guests on the Dias
10.15 am to 10.20 am	:	Welcome Address by Principal
10.20 am to 10.35 am	:	Address by Chief Guest
10.35 am to 10.55 am	:	Keynote Address
10.55 am to 11.00 am	:	Vote of Thanks by Dean of Academics
11.00 am	:	National Anthem
11.00 am to 11.45 am	:	**Tea**
11.45 am to 1.00 pm	:	**PLENARY SESSION-1:** Food Adulteration & Consumer Awareness *Food Risk, Reality & Perception* **Dr. V. Sudarshan Rao** Deputy Director (Retd.), National Institute of Nutrition Chairman, FSSAI Scientific Panel on Food Additives *Consumer Awareness on Food Adulteration* **Sri. D.P. Guha** Joint Director, Food Safety and Standard Authority of India
1:00 pm to 1:30 pm	:	**Lunch**
1:30 pm to 2:45 pm	:	**PLENARY SESSION-2** *Detection & Prevention of Food Adulteration* *Detection of Adulterants* **Dr. Alok Srivastava** Chief Scientist & Head, Food Safety & Analytical Quality Control Laboratory (FSAQCL) Head, Food Protectants & Infestation Control Department, CSIR-CFTRI (Central Food Technological Research Institute), Mysore Director, Referral Food Lab (RFL) *Detection of Dairy Adulterants* **Dr. Rajan Sharma** Principal Scientist, Department of Dairy Chemistry, National Dairy Research Institute, Karnal (Haryana)
2:45 pm to 3:00 pm	:	**Tea**
3:00 pm to 4:15 pm	:	**PLENARY SESSION-3** **Food Adulteration: Industrial Perspective** *Food Laws* **Mr. Prasanta Baidaik & Shri Prasenjit Batabyal** Technical Officers, Food Safety and Standard Authority of India *Adulteration in Tea* **Dr. T.C. Chaudhuri** Technical Expert, Quality Council of India Quality Assurance Advisor Ex-Director (Research) & Hon. Advisor, Tea Board of India

PROGRAMME SCHEDULE

DAY-2: 24th March 2018 (Venue: JD Birla, Main Campus)

10:30 am to 11:45 am	:	Paper Presentation: Session-1
11:45 am to 12:00 am	:	Tea & Judging of Posters
12:30 am to 1:15 pm	:	**Lunch**
1:15 pm to 2:30 pm	:	Paper Presentation: Session-2
2:30 pm to 2:45 pm	:	**Tea**
3:00 pm to 3:40 pm	:	***Valedictory Session*** Summing up of the Seminar by the Convener Announcement of Awards Vote of Thanks by the HOD National Anthem

ORGANIZING COMMITTEE

Committees		**In-charge**
Overall in Charge	:	Ms. Damanjeet Kaur
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PROFILE OF RESOURCE PERSONS

CHIEF GUEST

Shri. Manoj Kumar Agarwal

Shri. Manoj Kumar Agarwal, an IAS Officer of 1990 Batch, West Bengal Cadre is presently serving as the Principal Secretary and Commissioner, Food & Supplies Department of the Govt. of West Bengal. Earlier he has served as District Magistrate - Uttar Dinajpur; District Magistrate - Burdwan; Secretary - Technical Education & Training Department; Secretary - North Bengal Development Department; Secretary - Youth Affairs Department; Principal Secretary - Personnel & Administrative Reforms Department and has also held the charge of Divisional Commissioner - Jalpaiguri Division and the Principal Secretary - GTA, (Darjeeling) and the Managing Director - West Bengal Highway Development Corporation Limited.

KEYNOTE SPEAKER

Dr. Balwinder Bajwa

Dr. Balwinder Bajwa, CEO & Director Edward Food Research & Analysis Centre Limited did his Ph.D in Molecular Genetics and Executive Business Management from IIM-Kolkata. He has several publications in various journals and a rich professional experience of 18+ years in the field of regulatory affairs, quality assurance, R&D in processing and manufacturing in various domains. He has been instrumental in designing and executing one of the country's most sophisticated & ultramodern Lab project - EFRAC.

PROFILE OF RESOURCE PERSONS

Food Risk, Reality & Perception

Dr. V. Sudarshan Rao

Dr. V. Sudershan Rao is currently the Chairman, Scientific Panel on Food Additives (FSSAI) and Deputy Director (retd) National Institute of Nutrition, Hyderabad, India. He has worked on various aspects of food safety including household food safety and has developed PCR kits for food borne disease investigations, has conducted total diet study to assess risk associated with chemical contamination of food, investigated food risk perceptions and consumer behavior in using the food labels. Dr. Rao has developed a COMBI based training package for street food vendors to improve safety of street foods. He has more than 100 publications on various aspects of food safety in peer reviewed journals and conference proceedings, 20 chapters in books and 10 reports. He was awarded the Kejriwal Award by All India Food Processors Association, New Delhi in 1997 for his work on HACCP and Platinum award for his strategy on Street Foods from Futuristic Cities in 2010. He is an expert member of Joint FAO/WHO Expert Committee on Food Additives - International Dairy Federation, Bureau of Indian Standards.

Consumer Awareness on Food Adulteration

Shri. Deba Prasad Guha

Mr. D. P. Guha is currently the Joint Director of Food Safety and Standards Authority of India (East). He completed his B.Tech in Food Technology from Jadavpur University in 1981 and joined Calcutta University as a Research Associate. He started his carrier from Central Food Laboratories Ghaziabad and since last 36 years he has been serving in various capacities at the Ministry of Food Processing and at Food Safety & Standards Authority of India.

Detection of Adulterants

Dr. Alok Kumar Srivastava

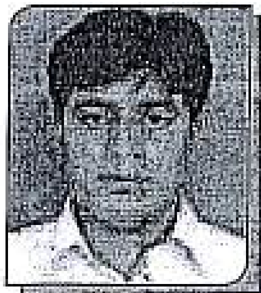
Currently the Chief Scientist and Head, Food Safety and Analytical Quality Control Lab and the Director - Referral Food Lab (RFL) at CFTRI Mysore, under authorization of FSSAI, Dr. Srivastava is a Ph.D in Food Science from University of Mysore and the Recipient of CSIR-DAAD fellowship for 2 yrs at Germany. During 30 years service, he developed knowledge in fields of cereal science & technology, baking, rheology, food fortification, oilseed processing, protein quality, food safety, food contaminants, food analytics and quality management. Dr. Srivastava has 30 research publications in national/ international peer reviewed journals, 25 presentations in National / International conferences, 6 book chapters, 5 patents, 5 process / technology development to his credit and has been received the Best Paper awards in ICFOST 1998 and 2004. He is also the recipient of Merit Award in CSIR Inter-Laboratory "Leadership Development" program and has guided 2 Ph.D students in their R&D projects. He is also a qualified Lead Assessor of ISO, EIC & NABL Quality Management System. Currently Dr. Srivastava is the Editor of Indian Food Industry Journal of AFST (2007-2010) and a Member of Scientific Panel of FSSAI on 'Food Contaminants' and "Method of Analysis" and Chairman of BIS Sectional Committee (FAD28) on Methods for Food Products.

PROFILE OF RESOURCE PERSONS

Detection of Dairy Adulterants

Dr. Rajan Sharma

Dr. Sharma is presently working as Principal Scientist at Department of Dairy Chemistry, National Dairy Research Institute, Karnal (Haryana). He has 21 years of experience in the field of milk quality and analytical dairy chemistry. He has guided 7 Ph.D scholars. Two of his research innovations have been granted patents. Eight of technologies developed by his group at NDRI have been commercialized by dairy industries. He has contributed more than 75 research articles in various journals. Dr. Sharma has been awarded NRDC Meritorious Invention Award for the innovation of a test for detection of detergent in milk by National Research Development Corporation in 2014. He has received Low Cost Technology Development Award in 2016 from Association of Food Scientist & Technologies (India), Mysore; the Erasmus Mundus Visiting Professor Scholarship from Sefotechnut, Belgium for Dublin Institute of Technology (Ireland) in 2012; the Indo-US Norman E. Borlaug International Agricultural Science & Technology Fellows Program of USDA's Foreign Agricultural Service (USA) under Indo-US Agricultural Knowledge Initiative in 2007-08; the Best Teacher Award during 16th Convocation of NDRI in 2018. Dr. Sharma is a Fellow of the National Academy of Agricultural Sciences and National Academy of Dairy Science.



Food Laws

Mr. Prasanta Baidik

Mr. Prasanta Baidik is currently the Technical Officer and Executive Assistant (Sampling And Inspection Role) at Food Safety & Standards Authority of India (East). He did his B.Tech in Food Technology and Bio-chemical Engineering from Jadavpur University.

Dr. Prasenjit Batabyal

Dr. Prasenjit Batabyal is presently, working as a Technical Officer with Food Safety & Standards Authority of India (FSSAI). He completed his Ph.D from Calcutta university in Environmental Microbiology in 2015 and has published 13 research papers in internationally reputed journals.

Adulteration in Tea

Dr. T.C. Chaudhuri

Dr. T.C. Chaudhuri superannuated as Director Research from the Tea Board of India after holding the position for over 20 years. He also worked as Honorary Advisor in the Board and was founder Secretary of the National Tea Research Foundation. Dr Chaudhuri was also associated as International Coordinator in the Working Group on Pesticide residue at the Inter Governmental Group on Tea at FAO, Rome for over 12 years, and Coordinator of India Chapter of International Organic Tea Project by the Common Fund for Commodities, Amsterdam. He has guided over hundred research projects leading to 50 Ph.D's in the field of tea and allied subject areas. He has published over 100 research and scientific papers and articles ranging from breeding, cultivation, agro-aspects, standard setting and R&D works. He has also published two books, besides many technical bulletins.

ORAL PRESENTATION

FSNM/ORAL/1

A Study to Detect Common Adulterants in Milk and Chenna Based Sweets in Kolkata

Jincy Abraham[1] & Neha Kanodia[2]
[1]Assistant Professor, Department of Food Science & Nutrition Management, J.D. Birla Institute, Kolkata
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[2] Ex-M.Sc. Student, Department of Food Science & Nutrition Management, J.D. Birla Institute, Kolkata

Abstract

Adulteration is the process by which the quality of food is reduced through the addition of an inferior substance. The nature of food adulteration and contamination may vary from place to place or there could be newer adulterants, as a result of changing environmental factors, like non-seasonal rains or improved production/cultivation practices. A national survey in India has revealed that almost 70% of the milk sold and consumed in India is adulterated by contaminants such as detergent and skim milk powder, but impure water is the highest contaminant. The demand for sweets and ghee increases during festival season and there is a shortage of milk during this time which further leads to increased adulteration. The study was conducted to detect adulterants in branded, non-branded milk and chenna based sweets in kolkata. Results showed that branded milk including tetra packs were adulterated with sugar, urea and formalin. All the chenna based sweets were adulterated with starch and artificial colours.

Keywords: Awareness, Detection, Food Adulteration, Milk, Sweets.

Introduction

Food as a basic need for all people must be wholesome and safe. Food adulteration is a major public hazard which affects the quality of life of people. It consists of large number of practices e.g.:-mixing, substitution, concealing the quality, putting of decomposed food for sale, misbranding or giving false labels and addition of toxicants. Its harmful effects include stomach disorder giddiness and joint pain, diarrhoea, etc. There are three types of adulteration namely:

- Intentional adulterants: It includes sand, marble chips, stone, etc.
- Metallic contamination: It includes arsenic from pesticides, lead from water, and mercury from effluents of chemical industries, etc.
- Incidental adulterants: This includes tin from can droppings of rodents, larvae in foods, pesticides, D.D.T and marathon residues present on the plant product, etc.

A national survey in India has revealed that almost 70% of the milk sold and consumed in India is adulterated by detergent, skim milk powder and impure water. According to a survey by FSSAI in 2012, 68% milk samples were found to be adulterated in which 31 % were from rural areas. In the urban areas, 68.9 % milk was found to be adulterated with water, detergent, urea and skim milk powder.
Shortage of milk during festival time leads to increased adulteration. Milk based sweets are often found to be adulterated with bloating paper, starch and aluminium.

To protect general public against the defective practices adopted by the trader, Prevention of Food Adulteration Act 1954 (PFA Act 1954) was enacted by Indian parliament which specifies microbial standards for pasteurised milk, milk powder, skimmed milk powder, etc. The Food Safety and Standards Authority of India (FSSAI) under Food Safety and Standards Act, 2006, has been created for laying down science based standards for articles of food and to regulate their manufacture, storage, distribution, sale and import to ensure availability of safe and wholesome food for human consumption. A Central Food Laboratory established under the act is located at Kolkata, Andhra Pradesh, Uttar Pradesh, Jammu and Kashmir, Karnataka, Kerala and Tamil Nadu for the purpose of reporting on suspected food products.
It is equally important for the consumer to know the common adulterants and their effect on health. Label declaration on packed food is very important for knowing the ingredients, nutritional value, and freshness of the food and the period of best before use. It is always better to buy certified food from reputed shop.

Methodology
Milk samples (open and branded) were collected from outlets and milk vendors from four different places i.e., North Kolkata, South Kolkata, East Kolkata and West Kolkata. For milk, analysis was done to check for water, starch, urea, formalin, sugar and acidity.
Chenna based sweets were collected from different sweet outlets from North, South, East and West Kolkata. For cheena sandesh, analysis was done to check for starch, metanil yellow, vanaspati and artificial colouring.

Results & Discussions
The flowing are the findings of the study:

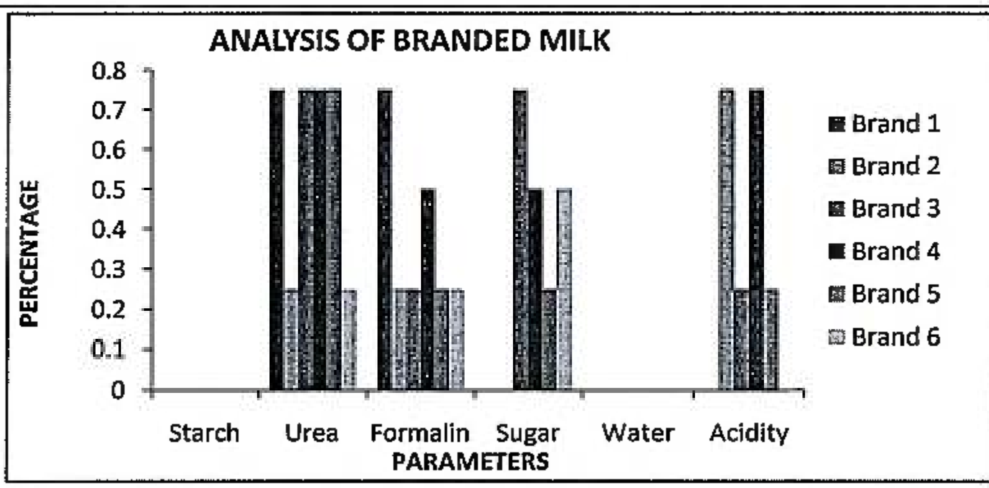

Figure 1: Percentage of adulterants in branded milk.

None of the branded milk samples were adulterated with starch or excess water. It was seen that the tetra packs of branded milk (brands 5 and 6) were found to be adulterated. Brands1, 3, 4 and 5 contained 75% of urea. Brand1 showed the highest percentage of formalin (75%). The highest percentage (75%) of sugar was recorded in brand 3. Brands 2 and 4 showed highest percentage of acidity (75%).

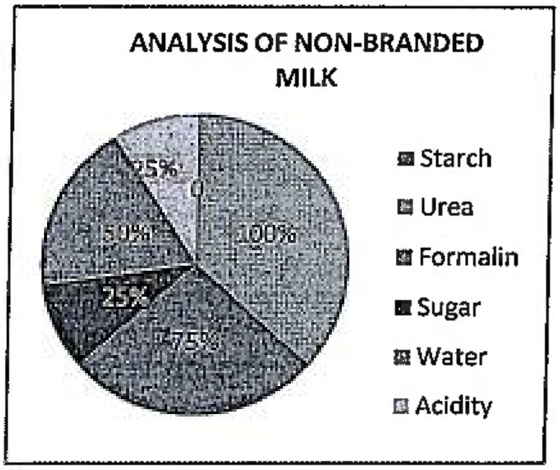

Figure 2: Percentage of adulterants in non-branded milk.

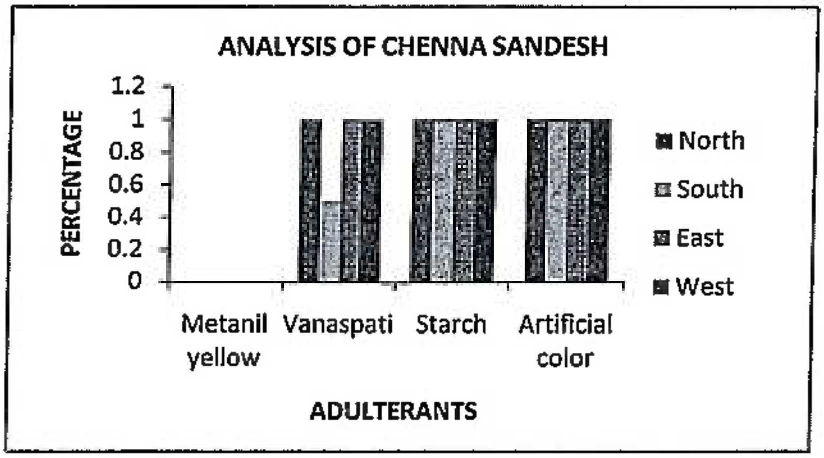

Figure 3: Percentage of adulterants in chenna sandesh.

Starch was absent in both forms of milk samples. Non-branded milk samples contained maximum amount of urea (100%) as compared to branded milk samples. Formalin was present more in non-branded milks than branded milks. Water was found in non-branded milks unlike in branded milks. Acidity found to be less in non-branded milk samples.

A study was conducted in Gandhinagar and Ahmadabad, Gujarat. Qualitative analyses were carried out on 50 milk samples. The extent of adulteration varied significantly with least percentage for Glucose (30%), Sodium chloride (46%), Sucrose (50%) and highest for ammonium sulphates (96%) & Urea (100 %).

In all the chenna sandesh samples, metanil yellow was not found. Sandesh samples from North, East and West Kolkata were 100% adulterated with vanaspati whereas 50% of sandesh were adulterated with vanaspati in South Kolkata. Since vanaspati is cheaper than ghee, so it is used by the shop keepers. All the chenna sandesh samples were adulterated with starch and artificially coloured pista.

Conclusion

The study was focussed to detect the presence of common adulterants in milk and chenna based sweets. 24 branded milk samples and 4 non-branded milk samples were collected from North, South, East and West Kolkata. From the same places, 16 chenna based sandesh were collected from outlets selling sweets.

While doing the chemical analysis for milk it was found that none of the branded milk samples contained starch or excess of water. The tetra packs of branded milk (brands 5 and 6) were also found to be adulterated. This is of high concern since people pay more money for tetra pack because of its high quality and safety. On an average comparison with branded and non-branded milk samples, it was found that non-branded milk samples contained maximum amount of urea (100%) as compared to branded milk samples, formalin was present more in non-branded milks than branded milks. Water was found only in non-branded milks whereas branded milk samples contained more acidity than non-branded milk samples.

On analysing the chenna sandesh it was observed that none of the sweet samples were adulterated with metanil yellow, while all the samples gave a positive result for presence of starch and colour. Some of the samples were also adulterated with vanaspathi while samples collected from South Kolkata had less of vanaspathi.

Since milk is consumed by majority of population, including sensitive groups like children & the elderly, therefore steps should be taken to curb its adulteration as it is the most adulterated food in India. It is also advisable to buy sweets from reputed outlets where the chance of adulteration is less. Adulteration is a menace prevalent in our society that slowly consumes the human life. Creating awareness & being more vigilant will help solve this problem. Consumers should start reacting to such cases so that the people involved in such a life threatening malpractices like that of food adulteration can be put behind bars.

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FSNM/ORAL/2

A Comparative Analysis of Adulteration in Local and Packaged Tea

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Abstract

Food adulteration is a process of deliberate contamination of food material with low quality, cheap and non-edible or toxic substances. Tea is one of the most preferred beverages worldwide. But, it is being adulterated both intentionally as well as unintentionally with certain harmful chemicals like artificial colour, azo dyes, coal tar dye and many more to make more profit by retailer or seller. The present study was done to access the consumer knowledge on tea adulteration and to perform comparative analysis of adulteration between packaged tea and local tea. 150 housewives residing in Kolkata were selected and a survey was performed using a Knowledge, Attitude and Practice (KAP) questionnaire. Furthermore, different tea samples were collected from different areas of Kolkata to detect common adulterants. The survey results displayed the present knowledge of people on food adulteration as well as tea adulteration and their practice and attitude towards the same. Furthermore, the result of the tea analysis indicated that low cost tea contained more adulterants as compared to high cost tea and also local tea contained more adulterants than packaged tea. The present study attempts to increase the general awareness of the population at large about adulteration of tea in addition to the simple techniques available to detect the same which will help to prevent tea adulteration.

Keywords: Adulteration, consumer awareness, KAP, tea.

Introduction

An adulterant is a chemical substance which should not be contained within other substances (e.g. food, beverages, and fuels) for legal or other reasons [1]. The term adulteration is applied for the deterioration of different food items either by mixing them with cheap and inferior substances or by extracting any valuable ingredients.[2] Adulteration is either intentional by either removing substances to food or altering the existing natural properties of food knowingly. Unintentional adulteration is usually includes ignorance's, carelessness or lack of facilities for maintaining food quality. Incidental contamination during the period of growth, harvesting, storage, processing, transport and distribution of foods are also considered [3]. Consumption of adulterated food can cause severe health problems in the human body which include digestive system disorders, stomach infections, liver disorders, cancer of stomach, disorders of blood, lung cancer, epidemic dropsy, glaucoma, cardiac arrest, lathyrism, diarrhoea, carcinogenesis, stomach disorders, food poisoning etc.[4]

Tea is regarded as one of the most consumed and preferred aromatic beverages in the world. It is an ancient beverage steeped in history and loved by many. Tea has been shown to provide energy and alertness in the morning and a range of health benefits have been associated with drinking tea [6]. There are four types of tea, according to the method of processing which include black tea, green tea, oolong tea and herbal tea

[5,6]. The most preferred tea among these are black tea because of its availability, reasonable price and a number of health benefits. In present times, food adulteration is a major problem worldwide as it severely affects human health and is associated with food safety. One of the most commonly used adulterant in tea is colour. Tea leaves which were damaged during manufacturing process or are of inferior quality are being treated with various colouring agents to improve their appearance and price [7]. According to earlier reports, tea has been found to be adulterated with azo dyes such as sunset yellow, tartrazine, carmosine, brilliant blue and indigo carmine.[8] Other adulterants include starch, sand, china clay, french chalk, iron fillings, chicory, lather flakes, caffeine, used tea leaves and many more [9].

Today tea adulteration is a common practice in the market since tea is the most commonly consumed beverage in the world. The present study was done to check the knowledge, practice, attitude of the general population toward the adulteration of tea and to chemically analyze tea samples for presence of adulterants from different regions of Kolkata.

Methodology

Selection of place: The survey was conducted in Kolkata. For the survey, 150 housewives (25-50 yrs old) belonging to middle income group residing in different parts of the city were randomly selected from different areas of Kolkata.

Construction of questionnaire: The questionnaire was prepared using KAP format which is generally used to determine population knowledge, attitude and practice of that particular area.

Collection of raw materials: Black tea samples were used for the study. Two types of tea i.e. local tea and packaged tea of both high price and low price categories were collected. Tea Samples were collected from different tea dealers from four areas of Kolkata including East Kolkata, North Kolkata, South Kolkata and Central Kolkata. All the samples were procured, sealed in zip lock pouches and stored in card board boxes. The samples were protected from light and air till the completion of study. Tea samples were coded as shown in Table (table 1).

Table 1: Codes of different tea samples

Area of Kolkata	Price	Code
East Kolkata	Low	E1
East Kolkata	High	E2
North Kolkata	Low	N1
North Kolkata	High	N2
South Kolkata	Low	S1
South Kolkata	High	S2
Central Kolkata	Low	C1
Central Kolkata	High	C2

Test for Detection of Artificial Colour:

The tea was spread on the surface of clean glass containing water. Changes in the colour of water indicated that the tea sample was dyed with water soluble colours.

Test for Detection of Coal Tar Dye:
Tea samples were taken in a test tube and 5 ml of concentrated Hydrochloric acid was added to it. Appearance of pink or crimson colour indicated the presence of coal tar dye in tea samples.

Test for Detection Iron Fillings:
Tea samples were placed in plates and a magnet was held near the plates. If iron filling were present then tea samples were attached to the magnet thereby confirming the presence of the above.

Test for Sand:
Tea samples were taken in test tubes. Then 7ml of water was added and mixed well. Formation of any sedimentation indicated presence of sand in tea samples.

Test for Cereal Starch:
Small quantity of tea sample was taken in a test tubes and distilled water was added to it. The contents were heated to produce colour. Potassium permanganate solution and diluted Hydrochloric acid (1:1) were added to it to decolorize the mixture. Then 1% aqueous solution of iodine was added. Presence of blue colour indicated adulteration of tea samples with cereal starch.

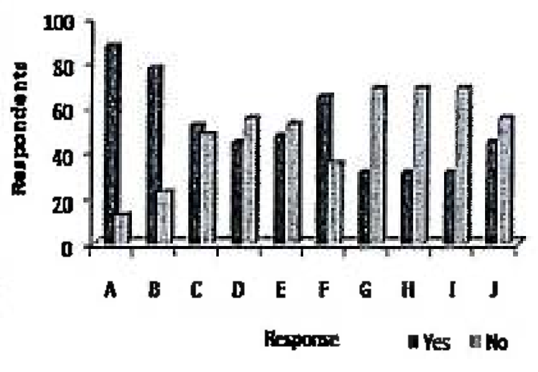
Test for Detection of Catechu:
Tea samples were taken in a test tube and 5ml water was added to it and followed by few drops of lead acetate solution. The solution was thereafter filtered followed by addition of few drops of silver nitrate. Appearance of grayish cloudiness indicated the presence of catechu.

Test for Azo Colour:
Tea samples were treated with a strong alcohol and the solution was evaporated to dryness. Then it was treated with water. Appearance of characteristic dye colour (red or yellow or orange) indicated adulteration with azo dye.

Test for Chicory:
The samples were boiled in a test tube with 2 drops of concentrated Hydrochloric acid. 15 drops of potassium ferrocyanide solution was added and liquid was again boiled till the appearance of dark green colour. The liquid becomes brown and murky, if chicory is present in tea samples, otherwise a precipitate settles at the bottom, leaving a supernatant solution of light yellow colour [10].

Results & Discussion
Result of Survey Analysis: The KAP questionnaire contained group of questions to analyze general population's knowledge, attitude and practice about tea. Overall results (Figure no.1) gave a brief idea about a person's practice related to tea consumption. Result (A) showed that 87.33% people were aware about the incidence of food adulteration whereas 12.66% did not know the phrase "food adulteration". 77.33% people had information about harmful effect of food adulteration whereas 22.66% people were uninformed about their adverse effect (B). Many of people fool themselves into believing that the food they eat is healthy and safe by buying food

products manufactured by reputed companies and brands. According to some individuals, most of the times they believe the food is safe due to perfect packaging, labeling, etc. However, some said they could not identify adulterated food from the original one. Moreover, 52% people had idea about adulteration of tea and 48% people did not have idea about tea adulteration (C). 47.33% people knew about the type of adulterant can be present in tea whereas 52.66% people did not know about it (E). It was seen that some individual were aware of the type of tea adulteration and had found adulterants like pieces of wood, sand, used tea leaves and most commonly coloured tea leaves. It was observed in the survey that 44.66% people were aware of the information that adulterant can be present in both local tea and packaged tea, whereas 55.33% people had no idea regarding this matter (D). Result also indicates that 64.66% people agreed that their tea purchase was affected by price and 35.33% person did not agree with the same (F). The overall result indicated that 68.66% people did not prefer to report in consumer forum by creating awareness among common people and didn't want to put a step forward towards to prevent adulteration whereas 31.33%people preferred to do so (G,H,I). After analyzing all the results collected from the survey, it was revealed that most people were generally ignorant and reluctant in spreading awareness about the common adulteration practices. The result also indicates that 44.66% population had found adulterant in tea, whereas 55.33% population did not find tea adulteration (J). After analyzing all the results, it was concluded that most of the individuals did not have knowledge about food adulteration and as well as its consequences. They were unaware of the fact that food is being adulterated and this consumption would lead to serious health injury. In Kolkata, most of the people preferred packaged tea for their convenience. Some people knew about tea adulteration as they had found adulterants like artificial colour, sand, iron fillings etc. But despite of these people are not enthusiastic enough to create awareness among common people about food adulteration.

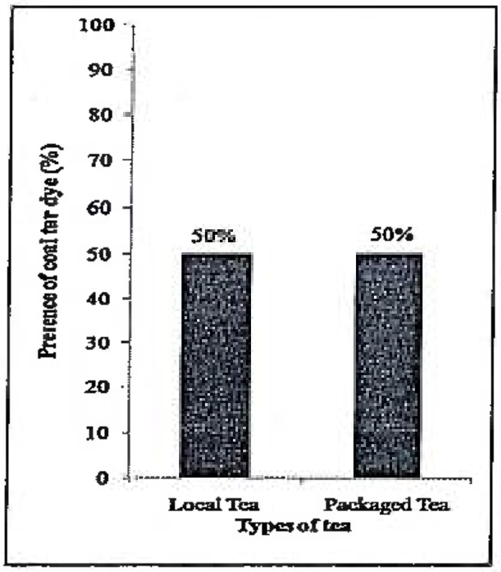


A	Food adulteration
B	Harmful effects of food adulteration
C	Tea adulteration
D	Adulteration in packaged and local tea
E	Types of adulterants in tea
F	Cost effecting tea purchase
G	Reporting in consumer forum about adulteration
H	Creating awareness regarding adulteration
I	Steps taken to eliminate adulteration
J	Testing adulterants in tea

Figure 1: Graphical representation (%) of survey result

Presence of Coal Tar Dye: Brand B and F among packaged tea and S1, E1, E2 and N1 local tea samples were found to be adulterated with coal tar dye. Therefore, 50% of local tea as well as 50% of packaged tea samples displayed coal tar dye adulteration (Figure 2). Coal tar is a brown-black coloured thick liquid generated during incomplete burning of coal. Addition of coal tar dye to tea gives it a dark black colour hence improving its overall appearance for the consumers. Consumption of coal tar dye leads to cancer.

A



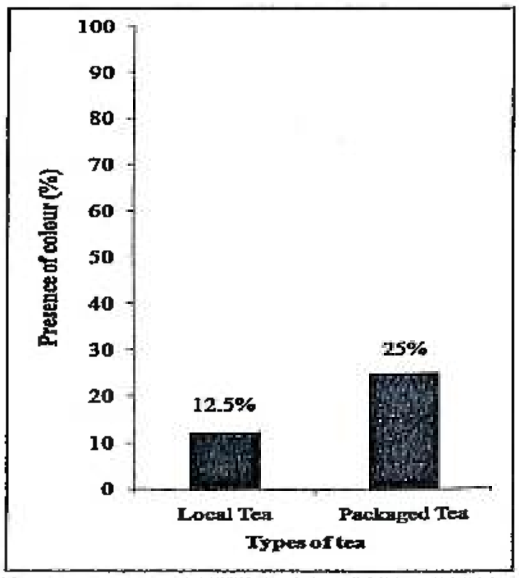
B

Tea samples (code)	Result
Sample- A	Negative
Sample- B	Positive
Sample- D	Negative
Sample- F	Positive
Sample- E1	Positive
Sample-E2	Positive
Sample-N1	Positive
Sample- N2	Negative
Sample- S1	Positive
Sample- S2	Negative
Sample-C1	Negative
Sample- C2	Negative

Figure 2: Presence of coal tar dye

Presence of Artificial Colour: The results of chemical analysis displayed that Brand F amongst packaged tea samples and local tea coded as N1 was adulterated with artificial colour. The overall results showed that 12.5% of local tea and 25% of packaged tea samples were indeed adulterated with artificial colour (Figure 3). Generally, tea leaves can be conceivably adulterated with artificial colour for various reasons which include attracting customers towards the product, increasing profits, and sometimes to sell low cost tea dyed with colour at a higher price.

A



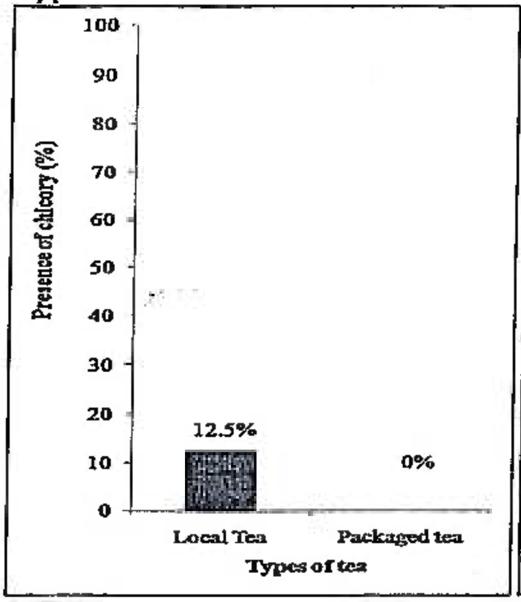
B

Tea samples (code)	Result
Sample- A	Negative
Sample- B	Negative
Sample- D	Negative
Sample- F	Positive
Sample- E1	Negative
Sample-E2	Negative
Sample-N1	Positive
Sample- N2	Negative
Sample- S1	Negative
Sample- S2	Negative
Sample-C1	Negative
Sample- C2	Negative

Figure 3: Presence of artificial color

Presence of Chicory: It was observed that that only C1 was adulterated with chicory (Figure 4). One of the common adulterants of tea is prepared from the root of chicory plant, *Cychorium intybus*. Chicory root gives a pleasant aroma when it is added to tea. However, it acts like a sedative on the central nervous system and could impair reaction time in some individuals.

A



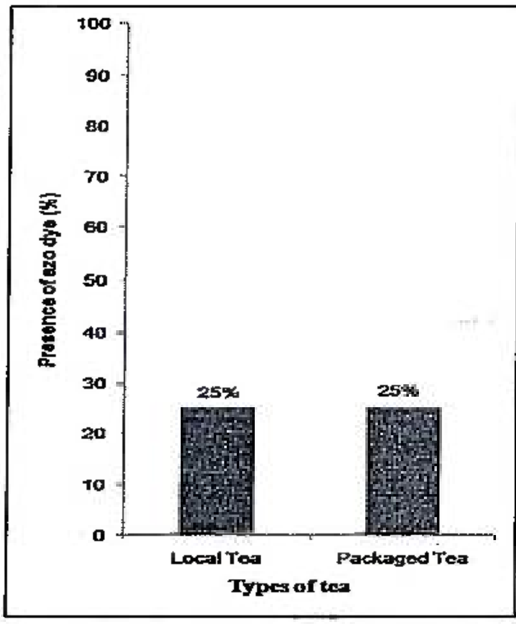
B

Tea samples (code)	Result
Sample- A	Negative
Sample- B	Negative
Sample- D	Negative
Sample- F	Negative
Sample- E1	Negative
Sample-E2	Negative
Sample-N1	Negative
Sample- N2	Negative
Sample- S1	Negative
Sample- S2	Negative
Sample-C1	Positive
Sample- C2	Negative

Figure 4: Presence of chicory

Presence of Azo colours: Chemical analysis of tea samples showed that brand D and samples E2 and N1 displayed the presence of azo colours. Therefore, 25% of both packaged tea as well as local tea samples were found to be adulterated with azo dye (Figure 5). Azo dyes are synthetic colours more stable than most of the natural food dyes. Adulteration with azo dye imparts a strong flavour and colour.

A



B

Tea samples (code)	Result
Sample- A	Negative
Sample- B	Negative
Sample- D	Positive
Sample- F	Negative
Sample- E1	Negative
Sample-E2	Positive
Sample-N1	Positive
Sample- N2	Negative
Sample- S1	Negative
Sample- S2	Negative
Sample-C1	Negative
Sample- C2	Negative

Figure 5: Presence of azo colors

Presence of Iron Fillings, Catechu, Sand and Cereal Starch: The test for iron filings, catechu, sand and cereal starch gave a negative result for all the samples (Table 2). Iron filings are intentionally added to increase the weight of the total product enabling the retailer to make greater profits. Unintentionally, iron fillings can be added during the manufacturing process of tea. These lead to serious health injury like chocking, bleeding etc. Catechu is often mixed with tea to make it more appealing and attractive. Moreover, sand and cereal starches might be intentionally added to tea to increase the weight of the total product. Sometimes, it could also be added unintentionally during processing, packaging, transportation or sale.

Table 2: Presence of adulterants in tea samples

Adulterants	N1	N2	S1	S2	C1	C2	E1	E2	A	B	D	F
Artificial colour	P	A	A	A	A	A	A	A	A	A	A	P
Iron filling	A	A	A	A	A	A	A	A	A	A	A	A
Coal tar dye	P	A	P	A	A	A	P	P	A	P	A	P
Sand	A	A	A	A	A	A	A	A	A	A	A	A
Cereal starch	A	A	A	A	A	A	A	A	A	A	A	A
Azo dye	P	A	A	A	A	A	P	A	A	A	P	A
Catechu	A	A	A	A	A	A	A	A	A	A	A	A
Chicory	A	A	A	A	P	A	A	A	A	A	A	A
A: Absent, P: Present												

Comparison between packaged tea and local tea: From the chemical analysis of all the tea samples, it was revealed that tea samples were mainly adulterated with different colouring materials which include water soluble artificial colour, coal tar dye, azo dye and chicory. Overall analysis indicated that 50% of the local tea varieties were adulterated compared to 37.5% for the packaged tea samples (Figure 6).

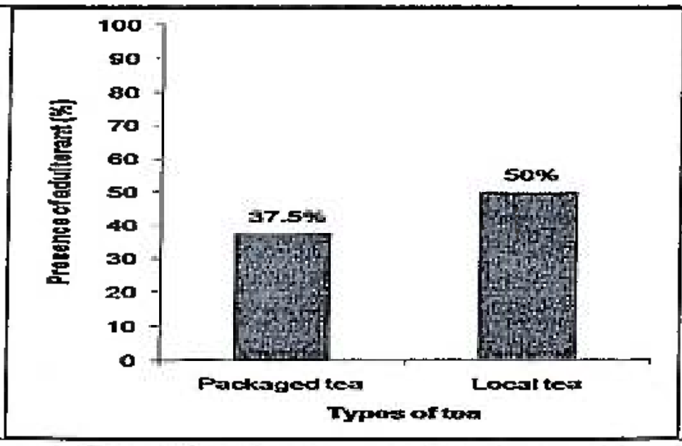


Figure 6: Comparison between packaged tea and local tea

It was observed that low cost tea displayed increased adulteration compared to high cost tea. Analysis of data revealed that 50% of low priced tea samples showed presence of one or more adulterants compared to only 25% for high priced tea samples (Figure 7).

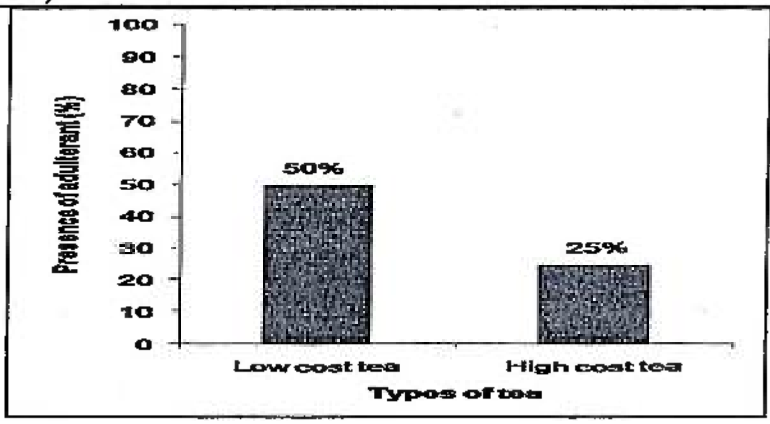


Figure 7: Comparison between high cost tea and low cost tea

Conclusion

After the study, it was concluded that most of the individuals did not have knowledge about food adulteration and as well as its consequences. They were unaware of the fact that food is being adulterated and this consumption could lead to serious health injury. In Kolkata, most of the people preferred tea as a drink and some of them preferred it twice or thrice a day. Adulterants like artificial colour, sand, iron fillings were found in the tea samples. Most of the people preferred packaged tea, which was less adulterated compared to local tea as it was observed in chemical analysis that local tea contained more adulterants. In chemical analysis, it was seen that tea contained mainly colours as an adulterant to give an attractive look. From the result it was seen that low priced tea contained more adulterants as compared to high priced tea. However, despite of these it was seen that people were not enthusiastic enough to create awareness among common people as well as take steps to prevent adulteration of food. The practice of adulteration can be prevented only when the population at large takes a step forward. Moreover, people also need to be more conscious about the quality of product that is been served. Regular and routine analysis of different tea samples would help in generating awareness about tea adulteration.

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The less known Facts About Arecanut and its Associated Products' Adulteration

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Abstract
Betel quid chewing is an ancient, socially, ceremonially and culturally accepted practice in India and other countries. One of the ingredients of betel quid is arecanut. Arecanut is the most common masticating product among humans all over the world. It is actually seed or endosperm of the Oriental palm (Areca catechu L) of the Palmae family. Arecanut is grown widely in South and South Asian countries. In India, arecanut and betel leaf are considered sacred and no ceremonial function is incomplete without them. It is used traditionally to treat several ailments such as hypertension, allergy, ulcer, migraine and has antioxidant, anti-inflammatory and analgesic properties. Epidemiological and laboratory studies have shown positive and negative effects associated with arecanut chewing. Studies have also shown that several samples of arecanut and its chewing product like pan masala available in the market were contaminated with cancer causing fungus, Aflatoxins. Nearly 37.5% of the samples in India were found infested with such fungus which may potentially contribute to the carcinogenic effects on human oral tissue. Heavy metals, pesticides are the other sources that make arecanut 'substandard' and 'adulterated'. But in spite of this, researchers have blamed arecanut for all the ill-effects. So, there is an urgent need to evaluate and detect the actual harmful substance responsible for the ill-effects of arecanut and strict action may be taken on the manufacture and sale of such products for the benefit of areca farmers and chewers of the same.

Keywords*:* adulteration, arecanut, aflatoxins

Introduction

Arecanut is the oldest and common masticator used along with other ingredients among humans all over the world. It is widely distributed in South and South East Asia especially India, China, Bangladesh, Indonesia, Myanmar, Thailand, Malaysia, Vietnam, Philippines. Arecanut is actually the seed or endosperm of the oriental palm *Areca catechu L* of the Palmae family. Arecanut is often misnamed as 'betel nut' as this nut is commonly used for chewing along with the leaf or inflorescence of *Piper betle*, a tropical shade-loving perennial evergreen vine of the Piperaceae family. Arecanut has an important place in the ancient system of Indian medicine such as Ayurveda, Unani and Homeopathy. The World Health Organization (WHO) has enlisted 25 different beneficial effects of *Areca catechu* on mankind. Arecanut is traditionally used to treat several ailments as it has laxative, digestive, antiulcer, carminative, anti-diarrhoeal, anti-helmintic, anti-malarial, anti-hypertension, diuretic, pro-healing, anti-bacterial, hypoglycaemic, anti-heartburn properties. In India, two to three ayurvedic preparations containing arecanut are advocated by doctors for the management of diabetes. The seven alkaloids present in arecanut (arecoline, arecaidine, guvacine, guvacoline, isoguvacine, arecolidine and homoarecoline) possess drug-like properties. The chemical constituents of arecanut (both green and ripe) include 17-26% polysaccharides, 11-30% polyphenols, 8-15% fibres, 8-15% fats, 6-9% proteins, 1-2.5% ash, and 0.11-0.24% alkaloids. Arecanut also contains Vitamin B6 (286.9mg) and Vitamin C (416.2 mg). The fatty acid composition includes lauric acid (19.5%), myristic acid (46.2%), palmitic acid (12.7%), oleic acid (6.2%), linoleic acid (5.4%), hexadecenoic acid (7.2%) and minor proportions of stearic acid, decanoic acid and monoethylenic acid. In China, around 30 medicines are prepared using arecanut as one of the ingredients for the treatment of several gastrointestinal disorders and parasitic diseases of man. [1]

Different Chewing Forms of Arecanut

Arecanut or betel nut is generally chewed along with other ingredients in four different forms: one wet type called 'betel quid' and three other types are dry forms called 'pan masala', 'gutka' and 'sweet supari'. The constituents of betel quid differ in various countries. It generally contains ingredients such as the leaf of *P. betle*, slaked lime, catechu (*Acacia catechu*), certain spices, artificial sweeteners such as saccharin and essences in different proportions. In countries such as Taiwan, Papua New Guinea, etc., instead of the leaf of *P. betle* its inflorescence, fruits or stem are used in making the quid. The betel quid is either chewed as such or chewed with the addition of a piece of tobacco (*Nicotiana tabacum*) as per individual preference. Pan masala is a packaged form of chewing product containing arecanut, lime, catechu, condiments and certain flavoring agents and artificial sweeteners. Generally pan masala does not contain tobacco. When tobacco is mixed with pan masala it is called as gutka, zarda or khaini. Sweet supari is another form of packaged arecanut which is processed and flavoured. All the dry forms of these chewing products are manufactured industrially and available in market in small (four to five gram) sachets in different brand names. Though the chewing habit varies among people in different regions, the betel quid or its commercial preparations are kept chewing inside the mouth for about 15 min to an hour and repeated five to six times a day. In most of the cases the chewed substance is spit out and rarely consumed. [5]

Adulterations in Arecanut with 'aflatoxin' producing fungus Aflatoxins are fungal toxins inducing acute toxicity, carcinogenicity and several other adverse effects on human health. The fungi responsible for the production of aflatoxins are mainly *Aspergillus flavus* and *A. parasiticus*. Four types of aflatoxins, B1, B2, G1 and G2 commonly infest food items. Among them aflatoxin B1 is considered to be the most potent one accounting for nearly 70% of the total aflatoxin content in food. Children are affected most by aflatoxin ingestion leading to stunted growth, liver damage and even liver cancer. Adults are also at risk but have a higher tolerance limit. It was reported that arecanuts, with high moisture content and if not processed and dried properly or harvested prematurely and allowed to dry in heaps are invariably attacked by such fungi. The central core portion (pith) of arecanut, which is soft and sweet is mostly preferred as the site of infection and the infection by these fungi gives a dark patchy appearance to the inside core [49]. Contamination of arecanut with such cancer causing fungi is reported in several countries. Continuous consumption of such aflatoxin contaminated food, even if they are in small doses can lead to many human health problems [5]

Infestation of *Aspergillus flavus* was commonly reported in Indian arecanuts. It was found in stored and marketed indigenous as well as imported arecanuts to this country. This fungus was also reported to be the predominant one among several other fungal species identified in arecanut samples found in the markets of Lucknow and Gulbarga cities of India. Seven species of *Aspergillus*, including *A. flavus* and *A. niger* were isolated from the arecanut samples in Lucknow market and the concentration of aflatoxin B1 was found to be 51.09 µg/kg, much higher than the tolerance limit fixed by WHO. *A. flavus* and *A. niger* were also isolated from the arecanut samples from Gulbarga. The concentration of aflatoxin in such arecanut samples of Gulbarga were not given in the report. In another study conducted on the infestation of aflatoxin in arecanut in India it was noticed that out of 32 arecanut samples, 12 (37.5%) were found to be contaminated with aflatoxins with an average aflatoxin B1 content as high as 94µg/kg (range: 18-208) and average total aflatoxin (B1+B2+G1+G2) content of 137µg/kg (range 18-293).[2]

Aflatoxin contamination in arecanut was also noticed in several other countries. Both aflatoxin B1 and G1 were recovered from the arecanut samples in Malaysia. In a study on the prevalence of aflatoxin B1 (the most potent among the aflatoxins group) in 278 arecanut samples imported to Pakistan from other countries during 2010-2011 (India-21 samples, Indonesia-51. Sri lanka-34 and Thailand-172 samples), all samples (100.0%) of arecanuts of Indian origin showed aflatoxin B1 contamination ranging from 11.7-267.0 µg/kg with a mean of 92.5µg/kg. The figures for Indonesia, Sri Lanka and Thailand were 80.4%, 73.5% and 30.2% with aflatoxin B1 ranging from 3.3 – 39.2 (mean 11.6), 6.5 - 103.4 (mean 35.0) and 3.3 – 77.0µg/kg (mean 6.65µg/kg), respectively. A rapid cross-sectional study conducted at Bangladesh on the extent of aflatoxin contamination in several human food items and poultry feed revealed the presence of aflatoxin at 30.6ng/g level in the samples of their arecanuts[61]. In Nepal, it was reported that as many as 25% of arecanut samples were found to be contaminated with aflatoxin B1 or B2. They further presumed that intake of aflatoxin contaminated food might be an important unrecognized risk factor to public health which could have long-term health implications if not attended properly. In South Africa it was noticed that nearly 40 to 60 % of dried arecanut samples (sliced or whole) imported were found to be contaminated with *A. flavus*, and the concentration of aflatoxin B1 in such arecanuts was found to be in excess of the commonly accepted food limit. Based on the arecanut consumption data it was also calculated that chewers of un-boiled dried arecanuts in South Africa may consume a total aflatoxin (B1+B2+G1+G2) content of 3.6-1080 ng per 24h. They also presumed that in countries such as India and Taiwan where the people mostly chew similar type of arecanut, the concentration of aflatoxins consumed may even go up and potentially contribute to the reported carcinogenic effects of different chewing products of arecanut on human oral tissue. In spite of such widespread presence of aflatoxin in arecanut, the health researchers did not take care of this aspect seriously, but simply blamed arecanut for all the ill effects. [3]

Adulteration in Pan Masala

Though the label in pan masala sachets gives an impression that they contain arecanut along with certain other condiments and flavouring agents, most of the brands neither revealed all the contents nor mentioned the actual quantity of each ingredient in them.

There was no proper quality control on these products either in several countries. In such circumstances, there is every possibility that substandard / spurious / adulterated materials which are dangerous to human being might have been incorporated for some reason or the other in different brands. The chemical composition of the food material is primarily responsible for its biochemical activity and related health implication. Presence of polycyclic aromatic hydrocarbons (PAH) and certain toxic metals such as lead, cadmium and nickel were already reported in all the five common pan masala brands tested in Ahmadabad, India. Though the actual levels of these compounds in the products tested were not given in this report, in another laboratory study on the chemical composition of several common brands of pan masala, it was found that most of them were adulterated with PAH, certain insecticides such as DDT and BHC isomers, in addition to toxic metals such as copper, zinc and magnesium (all these are known to possess carcinogenic, tumorigenic, teratogenic and mutagenic potentials), in higher concentrations than permissible limits. High concentrations of toxic metals such as lead, arsenic, cadmium and copper, much above the permissible limits prescribed by the WHO, were also detected in several Indian brands of tobacco blended pan masala. Several dangerous volatile aldehydes, such as formaldehyde, acrolein, crotonaldehyde, propionaldehyde and isobutyraldehyde have also been detected in the studies conducted on the chemical analysis of pan masala. [5]

The adulteration in pan masala was so common that certain brands of these products which claimed that they were 'tobacco free' contained up to 13.28g of nicotine (a known carcinogen) per 100g of the content. It was also reported that certain other brands of pan masala contained 'menthol', an organic compound mainly used against colds and throat irritation as topical application, in more concentration than the acceptable limit for food stuffs fixed by the Food Adulteration Act of India. Though this act fixed the maximum level of menthol in pan masala at 0.1% (1.0mg/g), it was noticed that as many as 75% of samples of branded pan masala contained 1.1-6.5mg of menthol per gram of the product and in non branded pan masala up to 92% of the samples contained 1.1-6.5mg of menthol per gram of the product. There were reports to show that chronic intake of menthol was injurious to human health. Most of the pan masala and pan flavourings found in Indian market were reported to contain artificial sweetener, saccharin, a known urinary bladder carcinogen, in several folds higher than the maximum levels permitted by the Prevention of Food Adulteration (PFA) Act of India. Hence, it is highly necessary for the concerned Government Departments to make regular and surprise chemical analysis of different brands of pan masala available in the market and curb such illegal activities for the benefit of mankind. The researchers should also consider all these factors before labeling only one constituent of pan masala as carcinogenic or dangerous. In spite of such dangerous reports on the widespread contamination and adulteration of arecanut and its chewing products, it is strange that most of the research papers which reported the harmful effects of chewing arecanut products did not either analyzed the actual contents of the chewing products they dealt with, or took note of the harmful effects of other ingredients or the contaminations and adulterations found on such ingredients, but simply tagged arecanut for all the adverse consequences developed by chewing these products. [4]

Besides all of these, arecanut can be adulterated physically. For instance, arecanut may be replaced with pebbles, stones. They are coloured with artificial dye, given a desired shape and are flavoured artificially. The main aim behind this is to increase its availability and profit to other places. People are also blindly consuming these artificially-made arecanut and affecting the oral tissues and food pipe also and death may occur also if measures are not taken early. Also, unhygienic conditions maintained during preserving arecanut can lead to detrimental effects. [1][5]

Preventive Measures

Fully ripe Arecanuts after preserving are used throughout the year. Fresh fruits are preserved in thick layers of mud. Fresh fruits are stored by steeping in water, resulting in discolouration of outer husk and foul smell due to bacterial attack but the inner core is well preserved. Use of a solution containing sodium benzoate (0.1 %) and potassium meta-bisulphate (0.2%) acidified to a pH of 3.5-4.0 with hydrochloric acid for steeping ripe nuts after initial heat blanching is suggested to eliminate the foul smell and improve the quality of nuts.[4]

Conclusion

The data from the analyses shows that most of the arecanuts and its products available in the market are contaminated and adulterated with toxic chemicals like polycyclic aromatic hydrocarbons and dangerous insecticides such as DDT and BHC isomers in addition to toxic metals. 'Tobacco free' pan masala brands were even contained nicotine, methanol and saccharin in very high concentrations than the maximum levels permitted by the Prevention of Food Adulteration (PFA) Act of India. Moreover, studies have blamed arecanut for all the ill-effects. So, there is an urgent need to evaluate and detect the actual harmful substance responsible for the ill-effects of arecanut and strict action may be taken on the manufacture and sale of such products for the benefit of areca farmers and chewers of the same.

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Detection Techniques of Adulterants in Spices

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Abstract
Food adulteration is a process in which the food quality of food is lowered by the addition of other ingredients or by extracting its food value up to a certain extent. This is done either by carelessness or for the factory's profit or sometimes it may happens due an accident. Spices in our country is one of the main ingredient in our food material. Food adulterant can be easily mixed with these spices but on the other hand, it is not that much easy to detect. In my research project I have tried to detect these adulterants not only by common techniques but also have tried to study the Novel Techniques of detection so that it can be tested more precisely. Near infrared hyper spectral imaging (NIR HSI) in conjunction with multivariate image analysis was evaluated for the detection of millet and buckwheat flour in ground black pepper. Additionally, mid-infrared (MIR) spectroscopy was used for the quantification of millet and buckwheat flour in ground black pepper. These techniques were applied as they allow non-destructive, invasive and rapid analysis. My poster is partially based on review paper of near infrared hyper spectral imaging and few laboratory works on common techniques.

Keywords: Near infrared hyper spectral imaging, detection, food adulteration, adulterant

Introduction

Adulteration in a broad and legal sense is the debasement of any article. Adulteration of food mean substandard foods, which fails to comply with the definition of safe food by the Food and Agriculture Organization (FAO) and World Health Organization(WHO).Food adulteration (e.g. spice adulteration) can be categorised into two separate groups namely, incidental and intentional adulteration (Anon., 2009). Incidental adulteration occurs when foreign substances are added to a food due to ignorance, negligence or improper facilities. The problem of adulteration persists at every level of food from preparation to consumption. This can occur during harvesting of spice during the processing of spices, or by intentional addition during processing.

Adulterants

An adulterant is a chemical substance that should not be contained within other substances (for examples food and beverages) for legal or other reasons. The addition of adulterant is called adulteration. This are a kind of additive added in the food samples to increase profit. Most of the adulterants are harmful or less in nutrition.

Adulterants Found in Spices and Spices Source

Here are some common adulterants that are use to adulterate spices –Turmeric is adultered with Metanil yellow. Mustard seeds are adultered with Argemone seeds. Salt and Sugar is adultered with chalk powder. Red chilli powder is adultered with brick powder. Cumin seeds is adultered with grass seeds which is coloured with charcoal. Cinnamon may sometimes be contaminated with Cassia bark. The quality of Iodized salt is lowered by adding Common salt.

Detrimental Effects of Adulterants in Spices (Global Occurrence/ Statistics)

Monosodium Glutamate in Maggi Noodles was tested at the U.P. Food Safety and Drug Administration lab at Gorakhpur, U.P. and then at the Central FoodLab, Kolkata in June 2015. It was found to be containing lead at 17.2 partsper million (ppp). Under Food Safety and Standard Regulations, 2011, the permissible levels lead range from 0.2 ppm in milk substitutes and babyfoods, to 10ppm in categories like baking powder, tea, onion powder (Dehydrated) and Masalas used to add flavour.

China said Monday that it had detained 22 people suspected of operating an underground network that intentionally adulterated milk with an industrial chemical, melamine. The contamination has led to the nation's worst food safety crisis in decades.

In March 2001, Europe began discovering Sudan dyes in spices. A February 2017 search of Europe's Rapid Alert System for Food and Feed (RASFF) for "unauthorised colour" and "sudan" in the "herbs and spices" food category resulted in 429 notifications.

Need for Suitable Detection Techniques of Adulterants in Spices

To avoid detrimentalhealth hazards detection techniques are needed.

Common Detection Techniques for Adulterants in Spices

Types of Detection Techniques

- Mustard seeds have a smooth surface. When pressed, inside it is yellow in colour. Argemone seeds have grainy, rough surface and are black in colour. When pressed, inside it is white in colour.
- Brick powder can be tested in red chilli powder when brick powder will settle down faster in water. The artificial dyes will immediately start descending in color streaks.
- Metanil yellow in turmeric powder-Add few drops of HCL and water inturmeric powder. If violet colour is formed then metanil yellow is present.Add few drops of HCL and water in turmeric powder. Immediate separation of yellow colour indicate presence of dyes.
- In alcohol papaya seeds will float but the black pepper will settle down. Grass seed in cumin seed -Rub them on your palm. If palm trees turn black adulteration is indicated.

Advantages of these Techniques and their Limitations

These techniques have many advantages such as, the cost of these methods is comparatively low, less sophisticated and capable to detect without much complications. These methods are comparatively less time consuming.

Limitations include: the techniques are qualitative not quantative. Thus many of the safe limits remain unknown and may cause health hazard. When the intensity of adulteration is low, common techniques might not be able to detect the adulterant present. Statistical Analysis are not possible.

Techniques Novel Detection

This are basically modern techniques used for detection of adulteration of spices not only quantitatively but also qualitatively. Accurate data and statistical analysis can be reported. These are more sophisticated way of determining adulterant level in food especially spices

Novel Techniques for adulterants in Spices: Detection Limits and their Limitations

- **NIR spectroscopy:**

  Vibrational spectroscopic techniques, including NIR spectroscopy, are based on interactionsbetween electromagnetic radiation and vibrational modes of covalently bound molecules(Herschel, 1800; Osborne *et al.*, 1993; Pasquini, 2003; Reich, 2005; Walsh & Kawano,2009). The spectral range 700 to 2500 nm (14 300 to 4000 cm-1) is examined when workingwith NIR spectroscopy. In this region overtone and combination vibrational modes impartchemical and physical information (Osborne *et al.*, 1993; Walsh & Kawano, 2009).Overtones occur when a molecule is vibrationally excited from the ground state to the15second or higher vibrational energy level. A combination is created when two or morevibrational modes are excited simultaneously. The vibrations observed in the NIR region involve primarily C-H, O-H, N-H and S-H bonds (Pasquini, 2003). The observed peaks in a NIR spectrum are usually broad and overlapping.

- **NIR hyper spectral imaging**

  NIR hyper spectral imaging (NIR HSI) is applied in various scientific fields and is known by names including chemical or spectroscopic imaging, NIR imaging and spectral imaging (McClure, 2003; Garini *et al.*, 2006; Gowen *et al.*, 2007). NIR hyper spectral imaging integrates conventional imaging and NIR spectroscopy to attain spatially resolved spectral information from an object (Reich, 2005; Burger, 2006; Gowen *et al.*, 2007; Wang & Paliwal, 2007). Hyper spectral imaging was originally developed for remote sensing applications andhas found its way to the spectroscopist laboratory environment through fusion with NIR spectroscopy (McClure, 2003; Gowen *et al.*, 2007).

  Chemometrics is used to mathematically reduce the dimensionality of spectral data obtained from both conventional NIR spectroscopic and NIR hyper spectral imaging (NIR HSI) experiments (Tatzer *et al.*, 2005). This statistical discipline allows for better understanding of chemical constituent behaviour through exploration and classification of mathematically reduced data(Beebe *et al.*, 1998). Sample spectra collected in the NIR region contain both physical andchemical information (Ozaki *et al.*, 2007). Extraction of this information from NIR spectra iscomplicated by multicollinearity and multiple sources of spectral noise originating from lightscattering and instrument defects. Multi-collinearity is when different variables (e.g. wavelengths) correlate within a specific data set (Næs *et al.*, 2002). Extraction of chemical and physicalin formation from spectral data sets is possible through the application of spectral chemometric and pre-processing techniques.

NIR-HSI Technique for Adulterant Detection in Spices

Principles of NIR-HSI

NIR hyper spectral imaging (NIR HSI) is applied in various scientific fields and is known by names including chemical or spectroscopic imaging, NIR imaging and spectral imaging. NIR hyper spectral imaging integrates conventional imaging and NIR spectroscopy to attain spatially resolved spectral information from an object. Hyper spectral imaging was originally developed for remote sensing applications and has found its way to the spectroscopist laboratory environment through fusion with NIR spectroscopy .NIR HSI poses various advantages when compared to conventional analytical methods. These include no physical contact and it enables non-destructive measurements from a sample. NIR hyper spectral imaging has been applied to wheat, maize, corn and cucumber whereas hyper spectral imaging in the UV/Vis/NIR region has been applied to foodstuffs including apples, cucumbers, citrus fruit, poultry, cherries and maize. NIR HSI has also been applied to animal feed and feed ingredients with great success.

Sample Preparation

Four batches (1, 2, 3 and 4) of whole black pepper, kindly supplied by four manufacturers, millet and buckwheat kernels were milled to approximately 500 µm particle size using a Retsch mill (Retsch model ZM1: sieve with 500 µm hole width, Haan, Germany). All samples were milled to reduce particle size differences, which has been identified as a factor influencing NIR spectra. Ground black pepper was then adulterated with buckwheat or millet flour in evenly spread intervals between 0 and 100% (increments of 5% w/w) forming 19 adulteration levels, one unadulterated black pepper and one pure flour (millet or buckwheat). All ground samples were dried at 74°C for 2 hrs in a vacuum oven (Heraeus model RVT 360, Hanau, Germany) to reduce any variation caused by moisture content, cooled in a desiccator and transferred to clear sepcap vials. The given temperature was chosen to dry the samples effectively without interfering with the chemical integrity of the samples. For the NIR HSI, the sepcap vials containing the adulterated black pepper samples, adulterant (buckwheat or millet flour) as well as unadulterated ground black pepper were packed into four eppendorf tube holders (Eppendorf AG, Hamburg, Germany: 6.5 cm x 21 cm; 80 holes). The vialcontent was transferred to 24 holes of the holder and imaged with a 100 mm lens providing a pixel size of 300 x 300 µm.

Application

Applications of NIR spectroscopy can be found as early as the 1950s. In a review by McClure (2003) it was mentioned that application of this technique appeared dormant until the 1950s and only 91 publications are available on the CNIRS database for the period 1800 to 1950. It was only in 1965 when Karl Norris and David Massie made a breakthrough with their work on the spectral reflectance and transmittance properties of grain, that NIR spectroscopy was seen as a valid analytical tool. NIR spectroscopy has been applied to foods for qualitative and quantitative analyses. The American Association of Cereal Chemists (AACC) International has adopted this technique for measuring protein in barley, oats, rye, triticale and wheat. Wheat flour hardness estimation (AACC, 2009b) and measurements from wheat whole kernels for protein determination (AACC, 2009c) have been approved as official methods of analysis. NIR spectroscopy has also been successfully applied to poultry, fish, red and processed meats for the measurement of moisture, protein and fats (Wehling, 2003). Online application is another area where NIR spectroscopy has proven its capabilities (Benson, 1993). On–line moisture measurement of cereals, flour, milk powders, starch powders and cocoa powders has been performed using NIR spectroscopy.NIR spectroscopy has been used as a method to confirm authenticity for several food commodities . These food products included fruit purées and juices (Rodriguez-Saona et al., 2001; Contal et al., 2002), maple syrup (Paradkar et al., 2002), honey (Downey et al., 2004), echinacea root (Laasonen et al., 2002), milk powder and fishmeal). In the differentiation of wines on the basis of grape variety,) found that NIR spectroscopy yielded correct classification levels of up to 100%.

Application in spices NIR spectroscopy has been employed for the rapid evaluation and quantitative analysis of thyme, oregano and chamomile essential oils (carvacrol, thymol and α-bisabolol) (Schulz et al., 2003). The experiment was performed in reflectance mode and using the spectral range between 1100 and 2500 nm; all volatile oil contents could be successfully predicted (R2>0.97). Standard errors for main essential oil components were within the same range as for the applied GC method.The characterisation of peppercorn, pepper oil and pepper oleoresin, using vibrational spectroscopy methods, has been investigated (Schulz et al., 2005). NIR, attenuated total reflectance (ATR) – infrared (IR) and NIR-FT-Raman spectroscopies were used to identify piperine (a pungent alkaloid within pepper) and pepper oleoresins. Piperine Raman signals was well resolved in the Raman spectra of pepper and related oleoresins. This allowed Raman mapping of the whole green berry and dried peppercorn to determine piperine distribution. NIR measurements were calibrated by GC measurements to create a prediction model for essential oil concentrations in ground black and white pepper. NIR-FT-Raman micro-spectroscopic mapping was employed to investigate the identification of secondary metabolites in medicinal and spice plants (Baranska et al., 2004). The potential of NIR-FT-Raman micro-spectroscopic mapping to identify the microstructure and chemical composition of fennel fruits, curcuma roots and chamomile inflorescence was demonstrated. Through studying microscopic Raman maps the authors could successfully identify anethole, the main essential oil component of fennel fruits. Anethole is distributed through the whole mericarp with the highest concentration at the fruit's top. Spiroethers were identified to be accumulated in the middle part of the flower after studying chamomile inflorescence Raman images. Curcumin distribution could be clearly identified inside the curcuma root whereas the core root contained the highest curcumin concentration. The potential of NIR spectroscopy for analysing red paprika powder naturally contaminated with mycotoxins (aflatoxin B1, ochratoxin A, total aflatoxin) was investigated (Hernández-Hierro et al., 2008). Aflatoxin B1 was the mycotoxin predicted with the greatest accuracy. The occurrence of aflatoxin B1 is indicative of general mycotoxin contamination as it was present in all cases of mycotoxin contamination. NIR spectroscopy has the potential as an alternative to conventional methods for mycotoxin detection. With advances in optics and digital imaging a more advanced technique that incorporates both NIR spectroscopy and imaging has been developed. This technique is called NIR hyper spectral imaging and has shown its potential use in the pharmaceutical industry, defence forces and agricultural industry. In addition mid-infrared (MIR) spectroscopy, focusing on the MIR region (4000 – 400 cm^{-1}) of the electromagnetic spectrum, also poses great advantages for the analysis of adulterated spices. This technique is based on the same vibrational principles then NIR spectroscopy, but is focused on the fundamental vibrations occurring in the MIR region and therefore well resolved peaks can be obtained (Osborne et al., 1993). MIR spectroscopy has been used in authentication studies of oils (Yang & Irudayaraj, 2001), powdered coffee (Downey et al., 1997) and recently for the monitoring of red wine fermentation (Di Egidio et al., 2010). The technique has also been found useful in the determination of structural characteristics of lignocellulosic biomass (Adapa et al., 2009). Comprehensive work on the characterisation of peppercorn, pepper oil and pepper oleoresin has also been performed using MIR spectroscopy in conjunction with other vibrational spectroscopy techniques (Schulz et al., 2005). The identification of various plant substances in the MIR region have also been confirmed (Schulz & Baranska, 2007).

Pros & Cons

The primary advantage to hyper spectral imaging is that, because an entire spectrum is acquired at each point, the operator needs no prior knowledge of the sample, and post-processing allows all available information from the dataset to be mined. Hyperspectral imaging can also take advantage of the spatial relationships among the different spectra in a neighbourhood, allowing more elaborate spectral-spatial models for a more accurate segmentation and classification of the image. NIR HSI poses various advantages when compared to conventional analytical methods. These include no physical contact and it enables non-destructive measurements from a sample (McClure, 2003; Burger, 2006; Gowen *et al.*, 2007). NIR hyper spectral imaging has been applied to wheat, maize, corn and cucumber whereas hyper spectral imaging in the UV/Vis/NIR region has been applied to foodstuffs including apples, cucumbers, citrus fruit, poultry, cherries and maize.

The primary disadvantages are cost and complexity. Fast computers, sensitive detectors, and large data storage capacities are needed for analysing hyper spectral data. Significant data storage capacity is necessary since hyper spectral cubes are large, multidimensional datasets, potentially exceeding hundreds of megabytes. All of these factors greatly increase the cost of acquiring and processing hyper spectral data. Also, one of the hurdles researchers have had to face is finding ways to program hyper spectral satellites to sort through data on their own and transmit only the most important images, as both transmission and storage of that much data could prove difficult and costly.[As a relatively new analytical technique, the full potential of hyper spectral imaging has not yet been realized.

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Non-destructive Methods for the Detection of Food Adulteration: An Overview

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Abstract
Economically motivated food adulteration or food fraud is currently recognized as a global threat to the public health. Many of the methods for detection of food adulteration involve high end technologies, making the whole process difficult and time consuming. Therefore, considerable interest has emerged for non-destructive, rapid techniques so as to achieve highly efficient results with use of minimal analytical technology. This review primarily focuses on the basic concepts of non-destructive detection of food adulteration which collectively represent the available analytical methods and their recent advances. Literature referenced in this review was obtained from bibliographic information in CAB abstracts, AGRICOLA, Google Scholar, Modern Language Association (MLA), American Psychological Association (APA), and Web of Science. Although sophisticated lab techniques are accurate, precise, and reliable, yet they are costly and time consuming. It is essential to develop reliable "quick screening tests". "Nondestructive detection of food adulteration" indicates that the analysis of the sample and the collection of its essential features are made in such a way that the physical and chemical properties of the sample are not altered. This review outlines the practical application of such techniques. Non-destructive analytical methods for the detection of adulterants are becoming increasingly important in the control of food quality and safety.

Keywords: Food Adulteration, Non-Destructive, Quality, Safety.

Introduction

Food Adulteration is performed to achieve more quantity of the food in order to make more profit, following the addition of such chemical substances which should not be present legally or having unwanted status by the recipient. It is astonishing that impostors are at stride ahead of food safety organizations; their escalating technologies protect and allow them to become more refine in their work with each passing moment. As on one side food is adulterated to get additional profit while on the other hand it imposes detrimental aspects to the human health and has become a global threat which is to be eradicated as soon as possible, for that we have to first detect it. Food fraud includes such categories as the substitution of an ingredient with a cheaper alternative, miss description of the real nature of the product or one of its ingredients, incorrect quantitative ingredient declaration, and the utilization of non-acceptable processing practices such as irradiation, heating or freezing (Posudin et al.).

With growing economic as well as quality standards we need to develop or discover such techniques which do not impart any qualitative change into a product while analyzing (Khan et al.). There are various packaging techniques to protect food from external damage, but the question remains that, is the food itself safe? Or is it adulterated with contaminants/adulterants which ultimately pose as a threat to human health? Hence, to address this issue, such techniques need to be developed or studied upon through which time and cost effective rapid analysis of adulteration can be performed.

Adulteration varies among the wide range of food products according to the level of sophistication, economic and health impact, and difficulty of identification. Examples range from tragic, as in the toxic oil syndrome disaster in Spain where thousands were sickened and approximately 300 people died (Terracini B.) , to authentication of the varietal (i.e., cultivar) purity (Pennington et al.) and geographical origin of a product (Jaganathan et al.,). Each can represent a significant case of adulteration.

With regard to food, the term "quality" means the products meet the requirements of an entire complex of criteria, properties and peculiarities, which characterize the product's degree of suitability based on its assessment and consumption. "Food safety" is a condition that ensures food will not cause harm to the consumer when prepared and/or eaten according to its intended use. It entails the handling, preparation, and storage of food in ways that prevent foodborne illnesses. Quality and safety remains a major challenge in the production of high-quality foods (Posudin et al.).

The term "quality evaluation" indicates obtaining meaningful information that can be used in making judgments, both positive and negative, about the degree of excellence of a food. "Nondestructive quality evaluation" indicates the analysis of a sample and the collection of its essential features in such a way that the physical and chemical properties of the sample are not altered.

Nondestructive means no alteration or loss of the product, however, in relatively uniform products very small samples are commonly used that are representative of the bulk of the material (e.g., four 1 ml samples of oil from a 10,000 L tank; volume lost = 0.00004% of the total). These samples may or may not be altered during analysis and even when not altered, the material is seldom reintroduced into the bulk material.

For practical purposes, the analysis can be considered nondestructive, since the samples typically represent only a minute fraction of the total amount of material (e.g., in liquids such as oils, juices, milk or uniform solids such as ground meals). The number of samples required to accurately assess the presence of an adulterant depends upon the uniformity of the distribution of the adulterant and/or the percentage of adulterated product units in the bulk sample (Posudin et al.).

Analysis of Adulteration by Non-DNA Based Techniques

- *Mass Spectrometry (MS)*
  Mass spectrometry is an analytical technique for the separation of ionized atoms and molecules according to their mass-to-charge ratio using electrical and magnetic fields in a vacuum and identifying the composition and structure

of the chemicals. A typical mass-spectrometer contains an ion source that transforms neutral molecules of a sample into ions, a mass analyser that separates ions by their mass and charge in applied electric and magnetic fields, and a detector that provides a qualitative and quantitative estimation of sample compounds. There are two principal types of mass spectrometers: a sector field mass analyser that measures the mass-to-charge ratio of charged particles that are accelerated by an electric field and are separated based on their mass and charge in a magnetic field, and a quadrupole mass analyser that separates the ions according to their mass-to-charge ratio, which is determined by the trajectories of the ions under the influence of an electric field. There are various methods which uses the principle of MS, such as:

- *Gas Chromatography-Mass Spectrometry (GC-MS)*
  This combines gas chromatography and mass spectrometry to identify different substances within a sample. This method is effective in separating compounds into their various individual components and the identification of the specific substances. The GC-MS method combines the capabilities and advantages of both GC and MS analytical approaches. The gas mixture is separated into components by gas chromatograph according to the retention time of each component whereby forming the chromatogram. After entering the mass spectrometer, these components are captured, ionized and detected.

  GC-MS combines high resolution separation of components with very selective and sensitive detection, making it possible to achieve a high level of precision in the identification of unknown chemicals that cannot be achieved using gas chromatography or mass spectrometry separately. GC-MS system with a capillary column is a powerful tool for investigating volatile organic compounds responsible for the aroma of food (Posudin et al.).

  GC-MS is characterized by high sensitivity and a relatively rapid identification of the components in a sample. Nevertheless, it has a high instrumental cost and requires a skilled operator. GC-MS method has been developed for the detection of honey adulteration with high fructose inulin syrups (Ruiz-Matute et al.).

- *Proton Transfer Reaction Mass Spectrometry*
  Proton transfer reaction mass spectrometry (PTR-MS) utilizes chemical ionization that is based on proton-transfer reactions; hydroxonium ions $H3O+$ are used as the reagent ions since the volatile compounds have a higher affinity for these ions.

  This analytical technique has been used for adulteration detection of individual cultivars of extra virgin olive oil through the analysis of volatile organic compounds, when the fraud involves mixing valuable oil with cheaper oils or by mixing the oil of different cultivars (Ruiz-Samblas et al.)

  PTR-MS provides real-time, online quantification of VOCs. The instrument has a high sensitivity (i.e., pptv level), fast response time (~ 1 second) and a compact and robust setup. It is relatively inexpensive and can be fully automated. The shortcoming of the PTR-MS technique is that it characterizes VOCs by way of their mass only which is not sufficiently adequate to identify most volatile compounds (Posudin et al.).

- *Mass Spectrometry with Inductively Coupled Plasma (MS-ICP)*
  This method utilizes inductively coupled plasma as the ion source and a mass spectrometer for separation and detection (Jarvis et al.). It is characterized by high sensitivity and the ability to identify metals and nonmetals, and in some instances at concentrations not exceeding 10– 10 % or one part per 1012 (trillion) parts. The MS-ICP method makes it possible to obtain isotopic information on the elements determined.

The sample is introduced into the central channel in the form of an aerosol that is obtained by spraying a liquid sample. When the aerosol enters the central channel, it evaporates and breaks up into atoms. A significant part of the atoms are ionized due to the high temperature and pass into the mass spectrometer. Here the ions are separated according to their weight against the charge and the detector receives a signal proportional to the relative concentration of the particles (Fig.1).

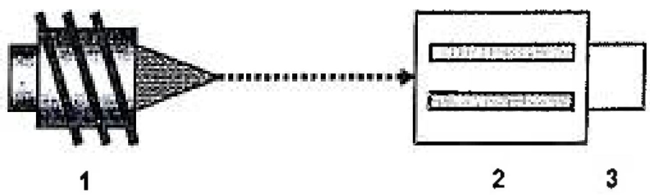

Figure1: Principle of mass spectrometry with inductively coupled plasma (MS-ICP): 1 – source of plasma; 2 – mass-spectrometer; 3 – detector.

Determination of the geographical origin of rice is an example of a practical use. This can prevent possible mislabelling and/or adulteration of rice products. High resolution ICFMS and discriminant analysis was applied to 31 Thai jasmine and 5 foreign (France, India, Italy, Japan and Pakistan) rice samples (Cheajesadagul et al.) and also to ascertain rice (Oryza sativa L.) genotype for determining authenticity and adulteration of food products (Laursen et al.).

The main elemental constituents (H, C, N, O, and S) of bio-organic material have different stable isotopes (^{2}H, ^{1}H; ^{13}C,^{12}C; ^{15}N,^{14}N; ^{18}O,^{17}O,^{16}O; ^{36}S, ^{34}S, ^{33}S, and ^{32}S). Isotopic ratios can be measured precisely and accurately using dedicated analytical techniques such as isotope ratio mass spectrometry (IRMS). Analysis of these ratios shows potential for assessing the authenticity of food of animal origin (Camin et al.).

Capici and others demonstrated that $\delta^{13}C$ and $\delta^{15}N$ isotope values of fat and defatted fraction have different values between each other depending on if a cheese was produced with raw milk or with pasteurized milk thus allowing differentiation between these 2 kinds of product.

Juice adulteration is achieved by either dilution of juice concentrate with water or addition of exogenous sugars (cane, beet sugar or corn syrup). Addition of water to a product can be detected by measuring 18O, the measurement of the 13C/12C ratio, or the deuterium content D/H of sugars isolated from the juice, thus making it possible to distinguish between natural and adulterated juices.

- *High-Performance Liquid Chromatography*
  It involves the application of high pressure (400 bar) and a fine-grained sorbent (a granular material made of solid particles 3-5 micrometers in size). It allows separating a complex mixture of substances quickly and completely (average analysis time is 3 - 30 min) with high resolution.

  HPLC is preferred for analysis of liquid samples; and it can be useful for separation of organic compounds independent of their polarity and volatility (Lehotay et al.). It effectively analyses presence of synthetic dyes in food and detects the fraudulent addition of bergamot juice to lemon juice by identifying flavanones of bergamot fruit.

- *Spectroscopic Techniques*
  These are the most promising methods as they are quick, simple, require small quantities of the food/sample, and are usually non-invasive. Miniaturization of spectrophotometers and the manufacture of portable or hand-held instruments i.e. in-situ measurements have become a reality. There are many portable spectrophotometers on market today. They can measure reflectance or transmittance of food/samples and can be used for direct measurement without sample pre-treatment. Most important spectroscopic methods include:

- *Fluorescence Spectroscopy*
  Fluorescence spectroscopy utilizes fluorescence emission and excitation spectra of electromagnetic radiation for qualitative and quantitative analysis of the structure and properties of a sample. It is an active process, which is why it is characterized by a high sensitivity. In addition, this technique is very rapid, low-cost and provides non-destructive interaction with the sample.

  Extra virgin olive oil is the most expensive and highest-quality cooking oil. As a consequence, manufacturers often replace part of this oil with cheaper oils, such as olive–pomace oil for economic benefit. Fluorescence spectroscopy has been utilized for the detection of adulteration of extra virgin olive oil with olive-pomace oil at a level of 5% (Guimet et al.).

- *Fourier Transform Infrared Spectroscopy*
  FTIR method works on the principal of interaction of electromagnetic radiations with the molecules of specific food with defined energy. This

analytical technique is based on the measurements of the temporal coherence of a radiative source, using time-domain measurements of the electromagnetic radiation or other types of radiation. The sensitivity of FTIR ranges from very low parts per million (ppm) to high percent (%) levels.

This method was successfully applied for adulteration detection in pure pomegranate juice concentrate in which grape juice was added (Vardin et al.) and determining the presence of industrial grade glycerol in four brands of red wine at a detection limit of 1% (Dixit et al.).

- *Nuclear Magnetic Resonance Spectroscopy*
  Nuclear magnetic resonance spectroscopy (NMR spectroscopy) is a spectroscopic technique that is based on the analysis of the magnetic properties of atomic nuclei that possess spin. The advantages of NMR spectroscopy are the ability to qualitatively and quantitatively detect very fine structural components.

  The adulteration of virgin olive oil with a wide range of seed oils was detected at level as low as 5% by means of application of NMR spectroscopy and with multivariate statistical analysis, which was performed on 13 compositional parameters derived from the spectra (Vigli et al.).

- *Raman Spectroscopy*
  Raman spectroscopy (RS), gives spectral information on fundamental vibrations of functional groups in a molecule. It is based on the inelastic scattering of incident radiation through its interaction with vibrating molecules (Bumbrah et al.).

  If a sample has Raman active substances, a small amount of radiation is scattered at different wavelengths due to interactions between the incident electromagnetic waves and the vibrational energy levels of the Raman active molecules in the sample.

  Zhang et al., used Surface Active Raman Scattering (SERS) to detect melamine in liquid milk with minimal sample preparation. The limit of detection by this method was 0.01 μg ml−1 for melamine standard samples and 0.5 μg ml−1 of melamine in liquid milk. The test results for SERS were very precise and as good as those obtained by liquid chromatography/tandem mass spectrometry. The method was simple, fast (only requires about 3 min), cost effective and sensitive for the detection of melamine in liquid milk samples. Therefore, it is more suitable for the field detection of melamine in liquid milk.

Sensor Technologies

- *Optic Sensors: Electronic Noses and Tongues*
  Electronic noses (e-noses) and electronic tongues (e-tongues) crudely mimic the human smell and taste sensors (gas and liquid sensors) and their

communication with the human brain. The e-nose often consists of non-selective sensors that interact with volatile molecules that result in a physical or chemical change that sends a signal to a computer which makes a classification based on a calibration and training process leading to pattern recognition. The e-tongue uses a range of sensors that respond to salts, acids, sugars, bitter compounds, *etc.* and sends signals to a computer for interpretation (Baldwin et al.). Fresh cherry tomato juice adulterated with different amounts of the juice from overripe tomatoes was assessed using e-Nose and e-Tongue measurements, the simultaneous utilization of both instruments indicated a better performance than when used individually (Chen et al.).

- *Nano Biosensors*
  Nano materials-based bio-sensing holds great potential in designing highly sensitive and selective detection strategies necessary for food safety analysis. Several metal ions can specifically identified by amino acid because of the functional side chain (such as cysteine). Based on the graphene-enhanced electrochemical signal, the recognition of heavy metal ions (Cd^{2+} and Pb^{2+}) can be characterized via the change of electrochemical signal.

- *Analysis of Adulteration by DNA Based Techniques*
  Utilization of DNA can be done as an effective tool to detect the adulteration and GMO content in various food products like oil, honey, beverages, baked products, animal feed, fried products, adulteration of milk and milk products. New generation DNA based adulteration detection methods either complement the existing physical, sensory, or biochemical analytical methods or as a stand-alone tool due to its cost effectiveness, high sensitivity and reliability. Two commonly used methods are:

- *DNA Bar Coding*
  DNA barcoding is a relatively simple technique that is based on the sequence variation in short nucleotide regions called barcodes that enables species identification and commodity authentication. Efficiency of DNA barcoding in seafood traceability has resulted in its adoption as a method for authentication of fish based commercial products by the US Food and Drug Administration (Yancy et al.).

- *DNA Extraction*
  Extracted DNA can be used as a biomaterial for detecting adulterants. An investigation on adulteration of goat's milk with cow's milk in Taiwan, targeting the specific bovine mitochondrial DNA showed a 25% of adulteration in goat's milk and 50% of debasement in goat's milk powder (Cheng et al.).

Conclusions

Globalization has resulted in increased global trade accompanied by a rise in the unscrupulous practices of adulteration to attain economic gain resulting in eroding the perceived biological value and quality of the product besides corroding public faith. Food quality control is an essential prerequisite to safeguard the consumer's interests and health. It is evident in this review, that cutting-edge, rapid non destructive methods of detecting food adulterants are the need of the hour. The character and nature of the product and the adulterant, as well as the distribution of the adulteration among and within samples, are critical in selecting the most appropriate and effective analytical method. While the spectroscopic methods have proved to achieve robust results time and again, the emerging biosensing and DNA based technologies seems promising.

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FSNM/ORAL/6

Consumer Awareness about Food Adulteration

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Abstract

"Prevention is better than cure", one of the most common and popular proverbs where prevention means to avoid, and cure means to correct anything that is troublesome or detrimental. Many of us do not stick to the power of prevention until trouble knocks us. No man is perfect but with the help of prevention, one can avoid many disasters, complexities, confusion and destruction. This brings us to the present scenario where food adulteration is a major threat to our society and can pose a serious risk to health. Food is the basic necessity of life but at the end of the day, many of us are not sure of what we eat. Adulteration of food is an age old problem. It consist of a large number of practices e.g. mixing, substitution, concealing the quantity, putting up decomposed foods for sale, misbranding or giving false labels and addition of toxicants. It is the consumers who are defrauded the most by traders, who not only raise prices but also adulterate the foods commonly purchased by the consumers. Food is adulterated to increase the quantity and make more profit. Examples include - milk is mixed with water and vanaspati is used as an adulterant for ghee and many others. As adulteration is rampant everywhere, consumer should be aware of the adulterators and adulterants and should take steps to safeguard themselves against those food items which we consume almost every day. This study intends to create awareness among consumers regarding food adulteration by educating them regarding the ill effects of adulterants in edibles.

Keywords: Adulteration, awareness, consumer forum, quality assurance

Introduction

Ever since the dawn of mankind, food and water have been prime to all existence on our planet. Food equates to nourishment which in turn enables people to thrive, fight diseases and lead a healthy life. However, in the recent past the nourishment that we have taken for granted from food has been dwindling rather drastically. In the quest for making a quick buck, the 'providers' are compromising on the quality of food delivered by contaminating them with adulterants. This has led to widespread health issues and the need to spread awareness amongst consumers has never been greater. Consumer is the largest economic group and central point of all marketing activities. Consumers play a vital role in the development of a nation. According to Mahatma Gandhi, "A consumer is the most important visitor on our premises. He is not dependent on us, we are on him. He is not an interruption to our work; he is the purpose of it. We are not doing a favour to a consumer by giving him an opportunity. He is doing us a favour by giving us opportunity to serve him." But unfortunately various ways of cheating a consumer has become the common practice of greedy sellers and manufacturers to make unreasonable profits and without heed to confer consumer rights and interests. Thus, with the rise in the income of people, the quality, the quantity and the sophistication of the consumer goods has also increased. The market is literally overflowing with the new products based on intricate technology. It is very difficult for the consumer to select one food item because of misleading advertisements, improper media emphasis and food adulteration. As a result of these malpractices, the ultimate victim is a consumer, who innocently takes adulterated foods and suffers. Therefore, a consumer's best defence is knowledge of his/her rights as a consumer and of the remedies which exist to resolve these problems when they occur. "Knowledge and awareness about adulterated foods, laws and its rights related to adulterated food is crucial in a society where technology heightens opportunities for perpetrators of fraud deception and misrepresentation" (Garman and Jonest, 1992). Adulteration of food stuffs is commonly practiced in India by the trade. When the price of the food production is higher than the price which the consumer is prepared to pay, seller is compelled to supply a food product of inferior quality. Thus adulteration occurs. They mix low quality, cheap, non-edible substances with food and make it adulterated. The cheap, low quality and generally non-edible substances which are purposely mixed with food items to earn profit are called Adulterants. Food adulteration is a serious crime which is punishable under the law. Consumption of adulterated food can cause serious disorders such as diarrhea, asthma, ulcers, food poisoning, cancer and may even result in death.

Food Adulteration

Adulteration of food is an age old problem. It consist of a large number of practices e.g. Mixing, substitution, concealing the quantity, putting up decomposed foods for sale, misbranding or giving false labels and addition of toxicants. The technical definition of food adulteration according to the Food and Safety Standards Authority of India (FSSAI) is, "The addition or subtraction of any substance to or from food, so that the natural composition and quality of food substance is affected." In India normally the contamination/adulteration in food is done either for financial gain or due to carelessness and lack in proper hygienic condition of processing, storing, transportation and marketing. Adulteration is defined as "the process by which the quality or the nature of a given substance is reduced through:

- The addition of a foreign or an inferior substance e.g. addition of water to milk.
- The removal of vital vitamins, e.g. removal of fat from milk". (Mudambi and Rajgopal, 1985)

Food is adulterated to increase the quantity and make more profit. Food products are said to be adulterated if their quality is adversely affected by adding of any substance which is injurious to health or by subtracting a nutritious substance. Adulteration of food may endanger health if the physiological function of the consumer is affected due to either addition of a deleterious substance or the removed of a vital component. An article of food shall be deemed to be adulterated:

- If any constituent of the article has been wholly or in part abstracted so as to affect injuriously the nature substance or quality thereof.
- If the article has been prepared, packed or kept under insanitary conditions whereby it has become contaminated or injurious to health.
- If the article consists wholly or in part of any filthy, putrid, disgusting, rooter decomposed or diseased animal or vegetable substance or insect infested or otherwise unfit for human consumption.

- If the article is abstained from a diseased animal.
- If the article constrains any poisonous or other ingredient which renders it injurious to health.
- If the article contains any prohibited preservative or permitted preservative in excess of the prescribed limits. It's presence in the food are dangerous for the health of consumer in other word the substance that degrades or lowers the quality of food is an adulterant.

A food item is said to be adulterated if:

- A substance which is added is injurious for human consumption.
- An inferior substance substitutes wholly or partly.
- A valuable ingredient has been abstracted from the food product, wholly or in part.

Various types of adulterants found in the food products are as follows:

- Intentional adulterants: like colouring agents, starch, pepper oil, injectable dyes and others.
- Incidental adulterants: like pesticide residues, larvae in foods, droppings of rodents.
- Metallic contaminants: like lead, arsenic, effluent from chemical industries etc.

Adulteration may be intentional or unintentional. The former is a wilful act on the part of adulterator who intends to increase the margin of profit. On the other hand, adulteration may be incidental contamination, which occurs mainly due to ignorance, negligence or lack of proper facilities. The causes of adulteration may be:

- Availability of too many products in the market
- Poor buying practices of consumers
- Consumer mentality of bargaining
- Consumer psyche
- Availability of adulterants

Every consumer wants to get the maximum quantity of a commodity for as low price as possible. This attitude of the consumers being coupled with the intension of the traders as well as the manufacturer to increase the margin of a profit as high as, the variable market demand permits generates a vicious circle. Where the quantity of the commodity gets reduced through addition of non-permitted foreign matter and/or removal of vital elements, and the process is defined as adulteration. Examples include - milk is mixed with water and vanaspati is used as an adulterant for ghee. Some of the common adulteration practices are - ergot is mixed in cereals, chalk powder in flour, chicory and tamarind seed powder is mixed in coffee powder, papaya seeds in pepper, brick-powder is added to chili powder, metanil yellow is added in turmeric for bright color and wood powder to dhaniya powder, and many others where the list is endless. Research has shown that even fruits, vegetables and cereals, sold in the market, are said to contain high levels of toxic metals like lead, nickel, cadmium, and chromium. Adulteration spares nothing when a spirit of becoming quickly rich, over-rules the moral ground. Even the simple water is not spared. Under the well known brand name-mineral water is reused filling with tube well water and is sold to weary thirsty train passengers. Adulteration is a fatal crime against society.

Amidst all these situations the Indian food processing industry is regulated by several laws which govern the aspects of sanitation, licensing and other necessary permits that needs to run a food business. In order to protect the health of the consumer, the Govt. of India promulgated the "Prevention of Food Adulteration Act" (P.F.A.) in 1954. But there was a need for change due to various reasons which include the changing requirements of our food industry. The act replaced PFA with the FSSA, "Food Safety and Standards Act, 2006", that overrides all other food related laws. The Bureau of Indian standards inspects the various food products manufactured. If the products have the standard quality needed, the certificate in issued. The various certificates of reliability are the F.P.O (Food Products Order) mark, the I.S.I. (Indian Standard Institution) mark and the AGMARK (Agriculture Marketing). In order to test the purity of the various food items, most of the big cities have food testing laboratories. To keep a check, the officials of the health department take samples of common food products from different shops and send them to the food laboratories for analysis. In case an adulterated food in detected, the manufacturer and the shopkeeper who is selling such a product, is prosecuted and punished, according to the law.

Various Methods to Combat Food Adulteration
The best way to avoid this problem is prevention. There are various steps we can take to ensure this and stop the hazards caused by food adulteration.
Spread awareness

Many people are still unaware of the various ways in which food can be adulterated. Reaching out to them and educating them on the dangers of contaminants would be the first step. The Government and social organizations must play a big role in enabling the process of discretion and decision-making, by supplying as much information as possible about quality standards and buying options to the public. Especially now when we are surrounded by technology, intimating people on the do's and don'ts of food adulteration can be much faster and more widespread. A knowledgeable consumer would be in a much better position to assess and avoid consumption of adulterated food. It is also the responsibility of the average consumer on the street to reach out and inform those around him. Various campaigning programmes should be organized so that the people can be approached and explained about the serious problem of food adulteration.

Quality Assurance
The adulteration `industry' operates with complete disregard for human life and flourishes on the lethargy and inefficiency of the authorities who deal with public health and consumer protection. The Government must take steps to ensure that food quality is strictly maintained, starting from the fields where the crops are grown up to the point of sale. Establishing well-equipped food and drug testing analytical laboratories with facilities to test the quality of processed foods, drug formulations, drinking water and other food items is necessary to prevent the distribution of spurious or adulterated or substandard items. Consumers should also take up the baton of responsibility and only invest in quality tested products and immediately report anything suspicious to the authorities.

Constant Vigilance

The root cause of adulteration is the greed for money. In a hurry, one forgets morality and values. Strict implementation of existing laws is needed to curb this malpractice. Timely and appropriate punishment should be given to the culprits. Stringent punishment alone will deter the unscrupulous elements engaged in duping and defrauding the public. People are provided with enough consumer rights. But owing to various reasons, very few take advantages of it. Consumers have to be on guard and should not hesitate to bring cases of adulteration of food or medicines to the notice of the authorities concerned. No one can put a price on a human being's life so it is the responsibility of all to eradicate food adulteration from our society.

Consumer Forums

Adulteration of food items is rampant despite the corrective actions and social awareness. All the steps taken so far to contain this social evil have had little effect. Although there are certain Government mechanisms under various departments for detecting the adulterants, they often fail to take prompt decisions. The Government should therefore strengthen the functioning of the Consumer Protection and Redressal Forum by handing more powers. They should press forward in the enactment of necessary laws since the existing ones are filled with loopholes, which often stand in the way of the consumers' interest. An efficient setup would be to constitute a body consisting of a few representatives of various political parties and social organisations in every district with an eminent and experienced lawyer at the helm. For this, the services of retired judges could also be utilised. This body should be empowered to work independently with the task of identifying the guilty and punishing them. The penalty inflicted upon the offenders should be ideal and tenable and must have the full backing of the Government.

Frequent Raids

Constant inspection and appropriate action must be taken to ensure that good quality food is sold. Raids should be frequent and unplanned so as to catch the perpetrators off guard. They can be categorized into various divisions and the responsibility for each can be taken by the concerned departments. The guilty should be punished and taken penalty for playing with people's life. Their license must be cancelled and moreover, they should prompt the authorities to look into the matter seriously.

Conclusion

Food adulteration is growing rampant by the day. People have been consumed by greed for money so much so that they are now willing to put human lives at risk for it. At this juncture, it is critical that we, as consumers take the right approach towards removing this cancer from our society. While the government has made sincere efforts to curb the fraudulent practices by enacting various laws, the implementation of these laws has been less than what it should be. Combine this with the corruption and low conviction rate and we are looking at a very bleak picture. Greater consumer vigilance and action alone can help improve the situation. We need to have a proper understanding of the adulteration issues and know the differences between natural and aesthetic attributes like texture, appearance and taste. We need to be aware of our rights and responsibilities and raise our voice when we feel cheated. The food on our plate is getting poisoned. The only way we can clean it is by studying what is real and what is fake. Consumer literacy is the need of the hour.

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Detection of Adulteration in Mango Leather using Colorimetric Method

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Abstract

Mangoes were obtained and pureed. Carrot was taken as an adulterant as it is cheaper than mango during its season and mango puree samples were prepared with different percentages of carrot content (0% 2% 5% 10% 50% 66.67% 75%) and TSS content raised to 25° Brix and dried to prepare adulterated mango leathers. They were dried on petri plates with puree load 0.9 g/cm^2 using microwave heating at 100 W power level and 2450 Hz frequency. The total drying time of samples was 6-8 hours and final moisture content of prepared samples was 15-20%. Hunter Lab colorimeter was used to observe the L, 'a', 'b' colour values of the prepared mango leather samples. The L values of the samples were observed to be 29.19-38.92. The 'a' values of the samples were observed to be 10.48-23.93. The 'b' values of the samples were observed to be 18.71-32.655. The L, 'a', 'b' colour values of the samples were used in different mathematical models for colour indices: Total Colour Difference (ΔE), Yellowness Index (YI), Whiteness Index (WI) and Yellow Colour Value. The values of the colour indices were plotted against carrot content (%, w/w) of the samples. Total Colour Difference (ΔE) values increased with increase in carrot content (%, w/w). Yellow Colour Values increased with increase in carrot content (%, w/w) linearly forming a straight line with R^2 =0.9639.

Keywords: Mango leather, adulteration, hunter lab colorimeter, carrot

Introduction

Colour is one of the most important sensory attributes of a food product. An individual's acceptance of a food product starts with the visual appeal of which colour is a parameter along with shape, size and form which are typical to the product [1]. Appearance of a food manifested through its colour strongly influences the consumer about the overall quality of the product [2].

In 1976, the Commission Internationaled 'Eclairge (CIE) introduced a method to measure the colour of food materials. The method was to use 3 dimension: 'L', 'a' and 'b' to quantify the colour of a material. 'L' stands for luminance (colour brightness) and the value of L ranges from 0 to 100, where 0 is luminance for completely black colour and 100 is luminance for completely white colour. 'a' measures green-red colour, positive value is for red colour and negative value is for green colour. 'b' measures blue-yellow colour, positive value is for yellow colour and negative value is for blue colour. The values of both 'a' and 'b' range from -120 to +120. The 'L' 'a' 'b' system of colour measurement has been known to provide consistent colour values [3-5].

The CIE Lab model or 'L', 'a' and 'b' colour model [6] is the most commonly used model in food analysis. As 'L', 'a' and 'b' have homogeneous colour distribution, the guarantee of colour difference and colour segmentation for segmentation process is carried by colour perception through Hunter Lab colorimeter [7-9]. This colour space portrays the colours perceived by human eyes.

Colour in mango and mango products is attributed to rich content of carotenoids. However, during drying of mango using conventional drying techniques, a significant portion of carotenoids is lost due to non-enzymatic browning leading to dark, sometimes unappealing colours. [10] [11]

Mango leather is a popular confectionary popular in India. It is popular mainly for its rich colour and flavour. The bright orange-yellow colour of mango and mango products is attributed to the high content of carotenoids [12].

Carrot is a root vegetable and is known as one of the best sources of carotenes [13]. From the economic point of view, carrots are available at a cheaper rate during its season than mangoes. This fact might be exploited by manufacturers of mango leather by adulterating mango leather with carrot. The result of which is an adulterated product with very close to similar colour values not always differentiable by untrained eyes. This adulteration may lead to a compromise of the sensory properties of mango leather.

In this study, microwave drying technology has been used for preparation of mango leather from mango pulp. Microwave technology uses electromagnetic radiation with frequency range of 300 MHz- 300GHz and wavelength of 1m-1mm. The electromagnetic energy propagates through a medium and increases the temperature of the medium. It has widespread applications in food processing. In domestic microwave ovens, the frequency of electromagnetic waves is 2450 MHz. The certain advantages of microwave drying over conventional drying techniques that the drying time is reduced by 25-90% and drying rate gain a 4-8 fold increment. Apart from this better colour retention has been reported in microwave drying of Parsley, Apple and Grapes [14-23].

The objective of the experiment was to prepare mango leather with different percentages of carrot, observe the colour values of the adulterated mango leathers using Hunter Lab colorimeter and thereafter using some mathematical models to conclude a relation between the adulteration and colour values. To devise a non-destructive analysis method without the use of any chemicals for detecting adulteration in mango leather.

Methodology

Mangoes (*Mangifera indica*) of cultivar 'Langra' were obtained from the Agri-Horticultural society of India and carrots (*Daucuscarrota subsp. Sativus)* of local variety were obtained from local market. The carrots were blanched in water at sub-boiling temperature to mellow them. After washing and sanitization of mangoes and carrots in 50 mg/L active chlorine solution, they were pureed and passed through a 1-mm sieve. Thereafter, the carrot and mango puree were mixed in different proportions (w/w) (Table 1) and then the TSS of the samples were adjusted to 25° Brix by adding cane sugar and spread over petri dishes and dried in microwave oven to get product with final moisture content of 15-18%. The final products had sheet like structure with diameter of 3.5" and thickness of 0.1"

Table 1: Sample Composition

Sample	Mango (%)	Carrot (%)
0 (Control)	100	0
1	98	2
2	95	5
3	90	10
4	50	50
5	33.33	66.67
6	25	75

The products were dried at 100W power level and total time of drying was 6-8 hours. The colour profile analysis has been done by Hunter Lab colour measurement system (Color Flex 45/0, D 65, 10° observer; Hunter Associates Laboratory Inc. Reston, VA, USA). To calibrate the instrument a 3.5 cm white standard plate (L^*= 93.49; a^*= −1.07; b^*= 10.6) has been used. Using the 'L', 'a', 'b' values of the sample the mathematical indices Total colour difference (ΔE), Yellowness Index (YI), Whiteness Index (WI) (Francis and Clydesdale,1975; Bolin and Huxsoll, 1991)and Yellow Colour Value (YCV) (Bravo and Grados, 1998) have been calculated.

(1) $\Delta E = (\Delta L^2+\Delta a^2+\Delta b^2)^{0.5}$

(2) $YI = 142.86\ b/L$

(3) $WI= 100- [(100-L)^2+ a^2 +b^2]^{0.5}$

(4) $YCV= a/b$

Where,

$\Delta L = L_{control}- L_{sample}$

$\Delta a = a_{control} - a_{sample}$ $\Delta b = b_{control} - b_{sample}$

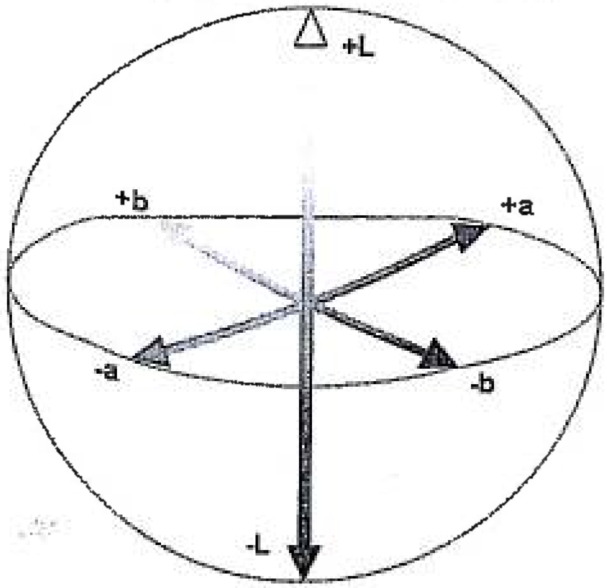

Figure 1: Lab colour wheel

Total colour difference indicates the magnitude of colour difference between stored and control samples. Whiteness indices (WI) are widely measured to yield numbers correlating closely with consumers' preferences for white colours. Yellowness is associated with scorching, soiling, and general product degradation by light, chemical exposure and processing [24]

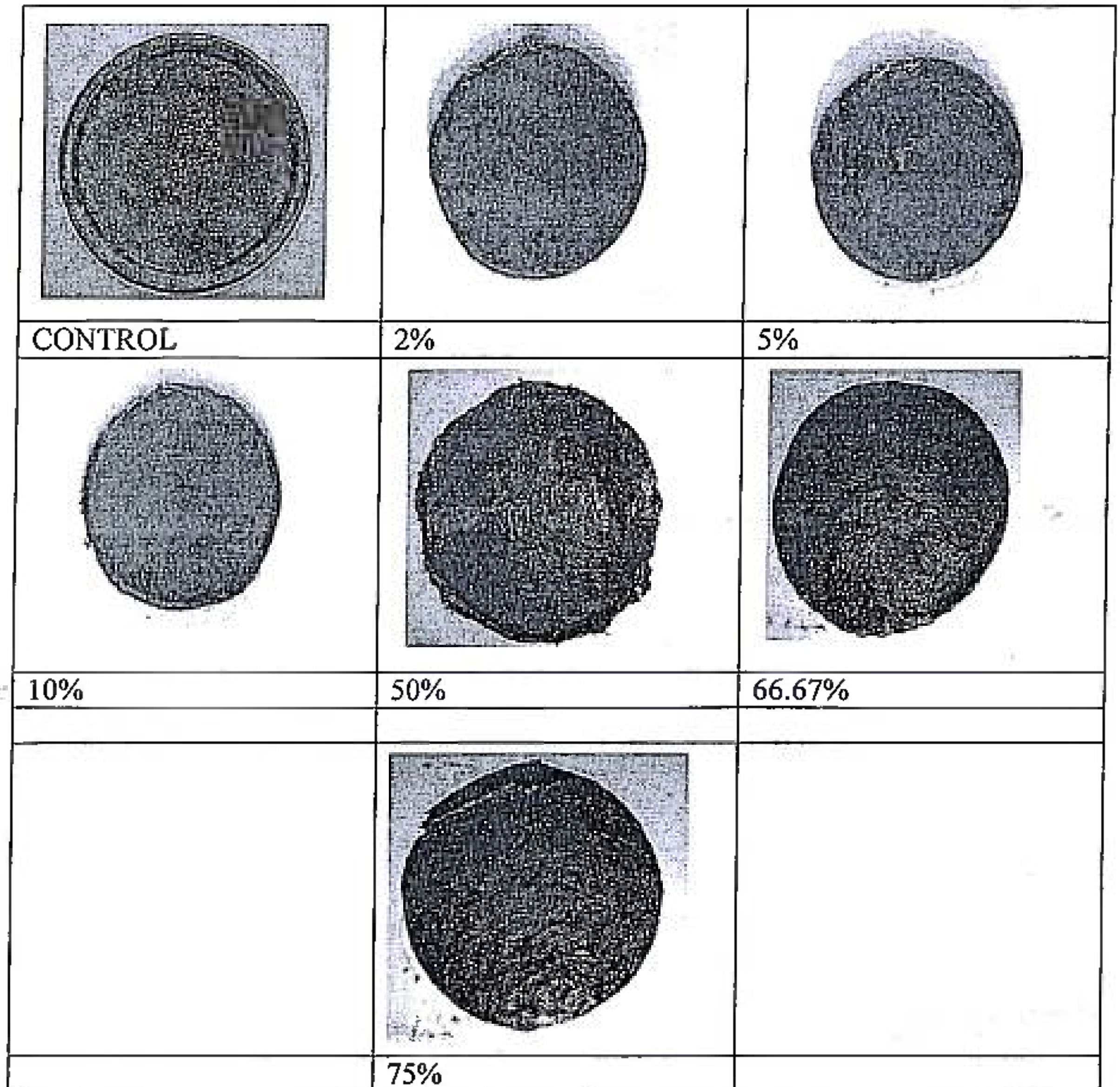

Figure 2: Photographs of the processed samples

Results & Discussion

Table 2: shows the 'L', 'a' and 'b' values of different samples as measured in the Hunter Lab Colorimeter

Sample	L	a	b
Control	29.19	10.48	18.71
1	32.625	16.665	30.97
2	33.175	18.295	32.655
3	33.865	18.375	30.235
4	38.43	23.22	31.13
5	38.33	23.88	31.64
6	38.92	23.93	30.64

The 'L', 'a' and 'b' values observed using Hunter Lab Colorimeter were plotted against concentration of carrot.

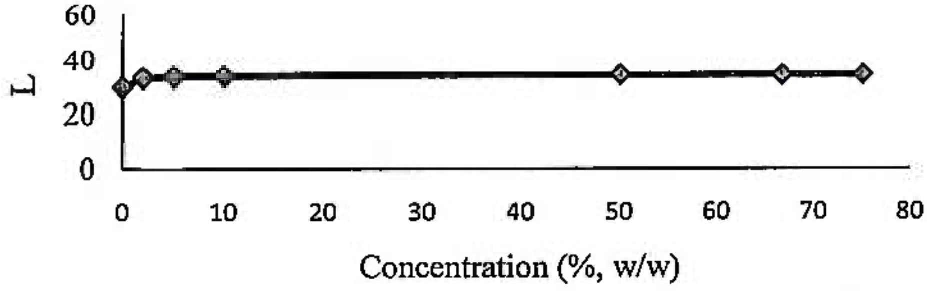

Figure 3: 'L' value vs concentration of carrot in mango

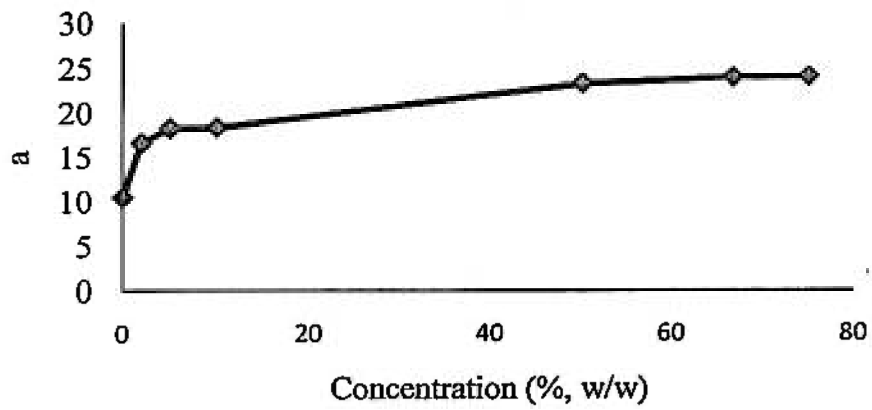

Figure 4: 'a' value vs concentration of carrot in mango

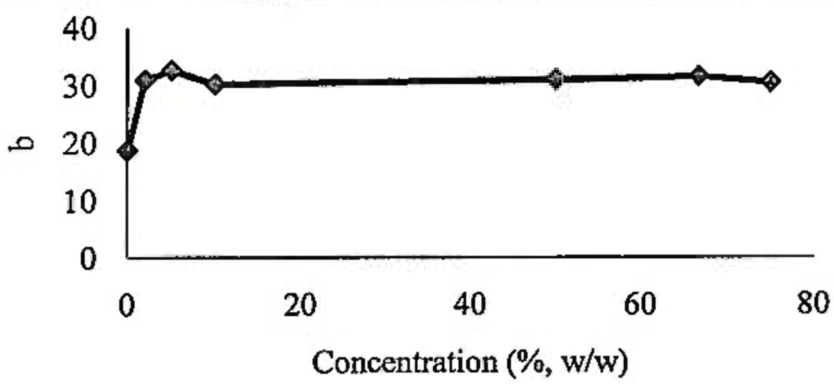

Figure 5: 'b' value vs concentration of carrot in mango

From Figure 3 it can be observed that the L value increases with increase in concentration of carrot in the samples. There was a sharp increase in the L value from

0% to 2% from 29.19 to 32.625 units but after 2% the gradient of increase in L value was negligible as can be seen from the graph.
From Figure 4, similar trend can be observed for 'a' vs concentration i.e. the 'a' value increases with increase in concentration of carrot in the samples, and like in L vs conc. there was a sharp increase in a value with conc. 0% to 2% from 10.48 to 16.665 units and then the increase was gradual showing the product retained the reddish colour with the addition of carrot.

In Figure 5, it can be observed that the 'b' value increases from 0% to 2% concentration but after that it shows a more or less flat line with increasing concentration of carrot. Although, the graph shows that a maximum 'b' value of 32.655 is attained at 10% concentration. It could be attributed to synergistic interaction of carrot and mango colour components which results into a maximum 'b' value at the specific concentration.

The total colour difference (ΔE), whiteness index (WI), yellowness index (YI) and Yellow Colour Value were plotted against concentration of carrot content to analyse the variation of these parameters with carrot content.

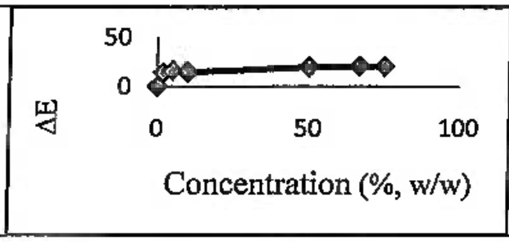

Figure 6: ΔE vs concentration of carrot in mango

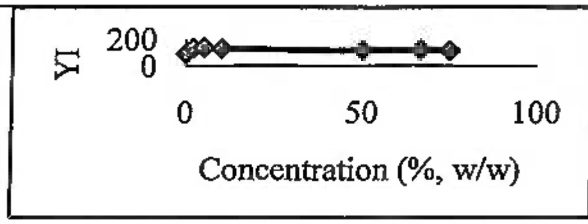

Figure 7: YI vs concentration of carrot in mango

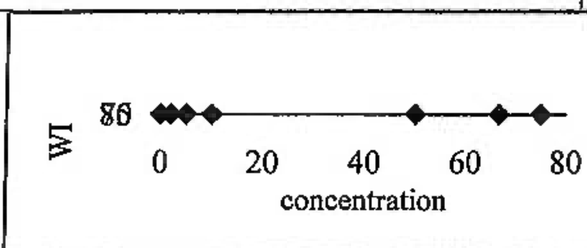

Figure 8: WI vs concentration of carrot in mango

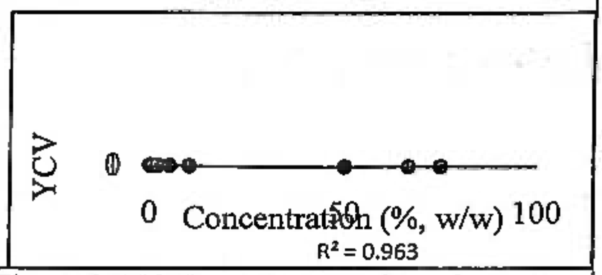

Figure 9: YCV vs concentration of carrot in mango

From Figure 6, we can observe that with only 2% addition of carrot pulp/puree in the mango leather there is a spike in the total colour difference (ΔE) of the product. It can also be observed that the total colour difference is within a range for carrot concentration 2-10 %. However the value increases further with 50% and above concentration of carrot in the mango leather. Also from 50%- 75% the total colour difference is also bound within a range.

In case of total colour difference, for samples with carrot concentration of 2-10% the total colour difference value was in the range of 10-15 units and for higher percentage of carrot in the range of 50-75 % the total colour difference was in the range of 20-22 units. So, a rough estimation could be done about the extent of adulteration.

In Yellowness Index (YI) vs. concentration graph (Figure 7) the YI value increases with concentration up to 5% where it attains a maximum value and then decreases again with increasing concentration. However from 50% to 75% concentration the YI value is bound within a narrow range.

In Figure 8, the Whiteness Index (WI) increases with increasing concentration from 0% to 5% where it attains a maximum value and then decreases with increasing concentration and samples with concentration 50% to 75% attain values lower than WI of 0% sample. Also, there is no visual correlation between WI and concentration that could be deduced from the graph plotted with data obtained.

In case of Yellowness Index (YI), all samples with carrot content had YI value greater than control sample. But from Whiteness Index, no conclusion could be drawn as the WI value increased up to 5% concentration and then decreased to a WI value below control sample.

In Figure 9, Yellow Colour Values (YCV) were plotted against concentration and it can be observed that there is a linear relation between YCV and concentration of carrot in samples.

Among the 4 colour indices that were plotted against concentration, it can be said that only 2 of them showed a correlation with concentration of carrot in the samples: Total Colour Difference (ΔE) and Yellow Colour Value (YCV).

While using the Total Colour Difference (ΔE) only a rough estimation could be done about the percentage of carrot in the sample, a straight line was formed in the YCV vs concentrationplot with R^2 value of 0.9639. The equation of the straight line could be used to back calculate the percentage of carrot in the sample from the 'L', 'a', 'b' colour values.

In this experiment, carrot was taken as the adulterant and mango leather samples were prepared using different percentages of carrot. The mango leathers were processed by microwave technology as a standard processing technology and using the 'L', 'a', 'b' colour values different colour indices (1,2,3,4) were calculated. From the results of the experiment it can be said that some of the colour indices (Total Colour Difference (ΔE) and YCV) could be used as model indices to detect adulteration in mango leather.

Conclusion
This study was an attempt to devise a method to detect the adulteration of mango leather with cheaper substitutes. This is a non-destructive methodwithout the use of chemicals. Carrot was taken as a model adulterant. Mango leather with various percentages of carrot were prepared and the colour values were observed in Hunter Lab colorimeter.Using the colour values different colour indices were calculated and some of them showed correlations to the percentage of added carrot. These indices

could be used as models to detect adulteration in mango leather. The mango leathers were processed by microwave drying technology and using the 'L', 'a', 'b' colour values different colour indices (1,2,3,4) were calculated. From the results of the experiment it can be said that some of the colour indices (Total Colour Difference (ΔE) and YCV) could be used as model indices to detect adulteration in mango leather. This method of analysis can also be carried out for samples dried using other methods such as sun drying, hot air drying, etc.

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FSNM/ORAL/8

Adulteration Of Sports Nutrition Supplement and its Effects on Athletes

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Abstract

Sports Nutrition Supplements are widely used in all over the world. Many of the athletes use dietary supplements for muscle growth, body building, strength and stamina to improve their performance. Adulteration of Sports Nutrition Supplement is a burning problem in sports field. Ingestion of a small amount of prohibited ingredients may result in serious health problem or abnormal doping test. The incidence of adulteration of nutrition supplements can be occurred due to either intentionally addition of prohibited ingredients or accidental. Contamination can occur due to poor manufacturing practice like use of contaminated ingredients or cross contamination during product manufacture. Past few years FDA emphasized on sports nutrition supplements more specifically body building supplements. Presence of steroids or steroid-like substances in body building supplements are associated with potentially serious health risks, including life threatening liver injury. Anabolic steroids and stimulant have been associated with serious reactions such as severe acne, hair loss, altered mood, irritability, increased aggression, and depression. The consumption of dietary supplements rate is very high in athletes but knowledge regarding their use is very limited. Not only athletes, very less percentage of sports medicine physicians had a reliable source of information on dietary supplements. The existing regulation Acts and laws should be corrected and a strong quality assurance system should be developed to reduce the chances of possible exposure to unapproved prohibited contaminants, especially designer steroids and stimulants among athletes

Keywords: Adulteration, athlete, sports nutrition, supplement

Introduction

In the last few years, use of dietary supplements among athletes is notably and extensively increasing in all over the world. The widely used dietary supplements are vitamins, minerals, and other less familiar substances such as herbals, botanicals, amino acids, and enzymes. U.S. Food and Drug Administration defined dietary supplement as a product (other than tobacco) that is intended to supplement the diet and bears or contains one or more of the following dietary ingredients: a vitamin, a mineral, an herb or other botanical, an amino acid, a dietary substance for use by humans to supplement the diet by increasing its total daily intake, or a concentrate, metabolite, constituent, extract, or combination of these ingredients.

In sports, diet is an important factor which helps athletes to maintain strength and stamina for optimum performance. Many athletes and coaches believe that without any dietary supplements a normal diet is not sufficient for optimum performance and mostly they use dietary supplements to improve their diet or to gain a competitive edge. Previously published literature (involving a meta-analysis of 51 published surveys involving 10,274 male and female athletes) found that the prevalence of supplement use was more in athletes, (46%) than in the general population while elite athletes used more supplements than college or high school athletes. Women also showed a greater prevalence of use of supplements than men.

A well balanced diet which contains all the required nutrients is sufficient to meet the energy need among athletes. Diet supplements should not be used as a substitute of normal diet. However, in some cases excess nutrient requirements demand dietary supplements. In addition, high intensity training, psychological stress of competition , frequent travel among athletes can also make them susceptible to viral infections and some supplements can play a role in managing this problem. Vitamin and mineral supplements can also be necessary to reduce the incidence of injury, cramping, etc.

Tendency of use of herbal or botanicals product is increasing as people think they have no other side effect on health. The detection of unidentified substances from herbal supplements is difficult as they are composed of multiple and complex compound. Attractive advertisement of dietary supplements claims that sports nutrition products have multiple benefits such as weight loss, toned physiques, muscle building capacity, increased strength and stamina etc. To meet these expectations sports nutrition supplements companies are often use new ingredients to provide better benefits to their customer.

Basic knowledge regarding federal regulation of dietary supplement is essential for athletes, coaches and training professionals. Dietary supplements health and education act, 1994 handed over the authority to U.S Food and Drug Administration (FDA) to regulate dietary supplement. According to this law dietary supplement should be treated as a food but not as pharmaceutical products. Moreover, dietary supplement manufacturers don't need any approval from FDA before producing or selling their products and not they required to demonstrate clinical efficacy of that particular product. Many dietary supplements contain hidden drugs and unauthorized substances. It is difficult for FDA to identify the presence of any adulterant in dietary supplements until it comes out to the market and spread some negative health effect among customers.

Past few years FDA emphasized on sports nutrition supplements more specifically body building supplements. If any supplement contains undeclared active drug ingredient or impermissible ingredients or new dietary ingredients (NDIs) for which a notification has not been properly field could be considered as adulterated and violation of the Federal Food, Drug and Cosmetic Act.

In recent years FDA has enforced Current Good Manufacturing Practice regulations (CGMP) to all the domestic and foreign industry. CGMP is important to ensure the identity, strength, quality, and purity of drug products by requiring that manufacturers of medications adequately control manufacturing operations. Strong quality management systems, appropriate quality raw materials, robust operating procedures, detection and investigation of product quality deviations, and maintaining reliable testing laboratories are the important component of CGMP.

Previously India has 14 laws that regulated functional food categories including sports nutrition supplements. In 2006, Food Safety and Standards Act (FSSA) was passed and comprises all the previous laws including Prevention of food adulteration act, 1954. This Act includes all the functional food, prebiotics, special dietary uses, health supplements, foods for special medical purposes, nutraceuticals, novel foods, and foods mentioned in traditional Indian systems of medicines. Nutritional labelling requirements, composition of food products, proper claiming of products and inclusion of calorific value of food also controlled by this law.

The incidence of adulteration of sports nutrition supplements can be occurred due to either intentionally addition of prohibited ingredients or accidental. Contamination can occur due to poor manufacturing practice like use of contaminated ingredients or cross contamination during product manufacture. Proper safety measures and quality control is required during the time of product manufacture otherwise presence of any prohibited ingredients could give an abnormal doping test result.

Among all the dietary supplements multivitamins and multi-minerals are safer though there was a case of cross contamination of vitamins tablets with steroids using the same production line. The amount of contamination doesn't have any effect on abnormal doping test. Ingestion of one tainted capsule is able to elevate the urinary level of steroid concentration proposed by WADA. Consumption of 19-norandrostendione, a steroid prohormone, in a little amount (2.5 mcg) can result in elevation of urine metabolites to fail doping test. FDA listed about 781 products as tainted supplement including sexual enhancement (46%), weight loss (39%), muscle building (12%), and other (2%). According to FDA reports most of the high risk dietary substances are Anabolic Androgenic Steroids and stimulant.

Addition or contamination of prohibited substances or newly found ingredients in dietary supplements may cause serious health issues. Bodybuilding supplements containing steroids or steroid-like substances are associated with potentially serious health risks, including life threatening liver injury. In addition to liver injury, anabolic steroids have been associated with serious reactions such as severe acne, hair loss, altered mood, irritability, increased aggression, and depression. They have also been associated with life-threatening reactions such as kidney damage, heart attack, stroke, pulmonary embolism (blood clots in the lungs), and deep vein thrombosis (blood clots that occur in veins deep in the body). These bodybuilding products are promoted as hormone products and/or as alternatives to anabolic steroids for increasing muscle mass and strength. Many of these products make claims about the ability of the active ingredients to enhance or diminish androgen, estrogen, or progestin-like effects in the body, but actually contain anabolic steroids or steroid-like substances, synthetic hormones related to the male hormone testosterone. Researchers found that use of AAS also responsible for "roid rage," an episode of anger and violence.

The consumption of dietary supplements rate is very high in athletes but knowledge regarding their use is very limited. A study among college aged athletes revealed that 86% of the subject was unaware about the adverse effect of supplements. Elite Australian athletes also found to be ignorant regarding Presence active ingredient

(62%), side effects (57%), mechanism of action (54%), or recommended dose (52%) of their supplements. In elite, young German athletes, only 36% were aware of issues with contamination and, surprisingly, only34% of the unaware desired more information. The source of information for athletes regarding dietary supplements is also of poor quality, with the majority of information coming from family members, fellow athletes, friends, coaches, and trainers.

Elite Italian cyclists reported that mostly they received information from the Internet, TV, and radio. Not only athletes, only 51% of sports medicine physicians had a reliable source of information on dietary supplements In a survey of internal medicine residents, 37% were not aware that FDA did not regulate the safety or efficacy of dietary supplements, and 65% were unaware that serious adverse events should be reported to FDA via MedWatch.

Until DSHEA corrects the regulation act, the chances of possible exposure to unapproved prohibited contaminants, especially designer steroids and stimulants will be high for athletes.

Four recommendations should be included in the regulation Act i.e. only allow claims supported by research evidence, require manufacturers to list known adverse effects on labels, require the FDA to analyse the contents of dietary supplements, and restrict definition of dietary ingredients to vitamins and minerals meant to supplement the diet. For botanicals, herbals and other medical products a separate regulatory framework should be established. New and improved testing procedures in doping laboratories have resulted in more cases of adverse findings but may be able to distinguish between inadvertent and intentional doping. WADA recognized 22 new Lab between 2001 -2008 for pharmacological testing of diet supplements. Only detection and identification techniques of new compounds are not sufficient to extract contaminants like performance enhancing drugs from tablets, capsules, powders, gels, bars, beverages, and so on. Legal action against dietary supplement companies has shown some positive results. Athletes are also allowed to take a legal step against any fraud claims by Supplements Company. A German soccer player filed a case against a supplement manufacturer for using a banned substance (non-listed AAS) in his supplement was awarded damages, legal fees, and lost. A dietary supplement is deemed unsafe, it should be mandated to remove from all retail and Internet stores but currently, it is still possible to purchase FDA-banned dietary supplements. Even after testing it is impossible to give 100% assurance that product is completely safe but the chances of adulteration reduced significantly with a quality assurance system in place, supported by GMPs. The only way to avoid complications associated with dietary supplements is to stop using supplements at al.

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POSTER PRESENTATION

FSNM/POST/1

Adulteration of Food - A Deep Rooted Social Evil

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Abstract

Food is essential for nourishment and sustenance of life. Adulteration of food, cheats consumer and can pose serious risk to health in some cases. A common consumer may not have sufficient knowledge about purity and quality of food articles he consumes. A study was done on "Food adulteration and consumer awareness in Dhaka city, 1995-2011" and it was seen that the overall proportion of food samples adulterated decreased during 2001-2005, and 40-54% of daily-consumed food was adulterated during 1995-2011. More than 35 food items were commonly adulterated. Water is the most common adulterant used, which decreases the nutritional value of milk. To the diluted milk, inferior cheaper materials are added such as reconstituted milk powder, urea, cane sugar and even more hazardous chemicals including melamine, formalin, caustic soda and detergents. Of all forms of adulteration the most reprehensible was the use of poisonous coloring matters in the manufacture of jellies and sweets which often contained lead, copper or mercury salts. "The vast majority of food fraud is primarily technical and economical," said John Spink, associate director with the anti-counterfeiting and product protection program at Michigan State University. "However, there are some cases where there can be serious health consequences as illustrated when melamine was added to infant formula and pet food in order to falsify the level of protein content in these products." Food adulteration in India seems to be getting deadlier by the day. The situation is indicative of a deeper malaise in the Indian food regulatory regime.

FSNM/POST/2

Rice: Staple Food or Slow Poison

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Abstract

Rice, also known as *Oryza sativa* is a plant belonging to the family of grasses, *Gramineae*. It is one of the three major food crops of the world and forms the staple diet of about one-third of the world's population. Asia is the leader in rice production accounting for about 90% of the world's production. With this constant increase in the demand of rice over the supply as well as inadequate enforcement of the food laws, there is an increased practice of deliberate substitution or addition of non authentic substances in rice; majorly including stones, dust, pebble, turmeric, metanil yellow, boric acid, urea and synthetic rice over the maximum limits leading to serious health hazards in future, as mentioned by the 'India Today' in their June 2017 report. Not only intentionally, rice can also be contaminated incidentally by the use of pesticides above Maximum Residue Limits leading to itchy eyes, sore throat, chromosome mutations and even cancer, as per the USDA Pesticide Data Program 2014. Fortunately, the harmful adulterants in rice are easily detectable as per the FSSAI protocol.Therefore in order to detect the suitability and safety of rice; a study was performed on ten rice samples of Kolkata. The results showed the presence of adulterants in both organic and conventional rice samples. Analysis of adulteration in rice samples would generate consumer awareness regarding the same which may help them in careful selection of rice samples for consumption.

FSNM/POST/3

Food Adulteration in Cooking Oils of India

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Abstract

Food adulteration is the act of adding or mixing something inferior, harmful and unnecessary substance to food that compromises the product quality. Majority of adulteration in India is intentional and it affects people of all the age groups. Every third eatable in the market is either sub-standard or adulterated. An adulterated food product causes the consumer to be either cheated financially or fall a victim to diseases. Vegetable oils and fats have a big contribution in our diet as cooking or frying oil or in food product formulations. Adulteration has been a major problem in the oil and fat trade. Mixing of good quality oils with cheap, low quality or toxic substances is a common practice among traders to generate greater profits. This may cause epidemic dropsy or hinder the absorption of fat-soluble vitamins. Even today many people in India are unaware about adulteration and its harmful effects. The present research is an attempt to study consumer perception towards adulteration in commonly used cooking oils and to create awareness regarding the same. Publicizing the newly-passed consumer protection law, other existing food adulteration-related laws and different aspects of food adulteration via mass media could play a crucial role in raising consumer awareness.

FSNM/POST/4

How Much Plastic is Theer in Packaged Water?? Micro-plastics Found in Global Bottled Water

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Abstract

Bottled water is usually marketed as the very essence of purity. Packaged water can be a lifeline for many of the 2.1 billion people worldwide with unsafe drinking water.

But according to new research, by Orb Media at Washington D.C shows a single bottle can hold dozens or possibly even thousands of microscopic plastic particles.
The study was supervised by Professor Sherri Mason, a leading microplasic researcher at New York. To test bottled water they infused each bottle with a dye called Nile Red, an emerging method by scientists for the rapid detection of microplasic. The water was then filtered to 1.5microns, which smaller then human RBC. She analyzed bigger particles about 100 microns by Flourier-Transform Infrared Spectroscopy which beams infrared light into an object to read its molecular signature. Polypropylene used in bottle caps, made upto 54% of those larger particles, nylon 16% and PET used in bottle was found to be 16%. The majority of the samples came in plastic bottles. The test showed a greater number of even smaller particles that researchers said are also like plastic. The global average was 314.6 particles per litre. Samples were drawn from 19 locations in 9 countries. Packaged drinking water is the fastest growing beverage market in the world. The result is shocking. Scientists are concerned about the fatal health effect of the microplasic content in packaged water

FSNM/POST/5

Natural Biopolymer Chitosan as Potential Source of Food Preservative for Fruits and Vegetables - A Review

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Abstract
Food preservation is basically done to prevent the growth of microorganisms (such as yeasts, bacteria and fungi), as well as slowing the oxidation of fats that cause rancidity. Food preservation may also include processes that inhibit visual deterioration, such as the enzymatic browning reaction in apples after they are cut during food preparation. Chitosan is a modified, natural biopolymer derived by deacetylation of chitin which can be found in fish shells and also in some microorganisms. Fish shells are nothing but the waste product but it also have some beneficial effects. The antimicrobial activity and film-forming property of chitosan make it a potential source of food preservative or coating material of natural origin which also have food packaging applications. Chitosan is widely used in the preservation of fruits, vegetables (including peaches, pears, Chinese gooseberry, cucumber, pepper, grapes, strawberries, mango, tomatoes, etc.), meat, and eggs. It can prevent fruits and vegetables from getting rotted. Chitosan is a good inhibitor against the growth of a wide variety of yeasts, fungi and bacteria, and also displays gas and aroma barrier properties in dry conditions. According to researches, chitosan with density of 0.02% is enough for the inhibition of bacillus; if the density is 0.005%, the inhibition rate could reach to 90% against *Escherichia coli* and *Salmonella*, while if the density rate comes up to 0.0075%, bacteria could be completely inhibited from growing. It also helps prolong the storage time and shelf life.

FSNM/POST/6

Effect on Food Adulteration on Human Health

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Abstract
Food adulteration is the process in which the quality of food is lowered either by the addition of inferior quality material or by extraction of valuable ingredient. It not only includes the intentional addition or substitution of the substances but biological and chemical contamination during the period of growth, storage, processing, transport and distribution of food products, is also responsible for lowering or degradation of the quality of food products.

The malpractice of adding harmful chemicals in food items is not only impacting on consumers' health but also destroying the nutritional elements from the food product.

The best way to avoid these health problems is prevention .There are many steps we can take to ensure this. We can begin by taking interest in place from where we buy our food ingredients for example, is it from a reputed shop or retailer, we need to check out. We also need to check if these outlets are regularly checked by food inspectors and if the premises are kept clean with no infestation. We need to check if the packaging is intact, as also the expiry date and the source of the product.

It is also necessary to talk regularly to the local community to check if people are falling sick after eating those food ingredient bought from the particular retailer. We should also create awareness in the local community on the ill effect of food adulteration.

FSNM/POST/7

Agriculture & Fishery Activities of Dhapa Area and its Effects on Human Health

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Abstract
The East Kolkata Wetland is a combination of natural and human made area combining ponds, agricultural and garbage disposal and receives pollutants like heavy metal, oil, grease, solid wastes etc. through effluent of different industries. The metals can enter into the crops and fishes through direct consumption of water or organisms, or through uptake processes. These contaminated foods are being consumed by human in a huge quantity on everyday basis. Genetic damage in human health by these metals present in the foods is also being investigated.Although Fishes are major part of the human diet because, it has high protein content, low saturated fat and also contains omega fatty acids known to support good health, but there is a growing concern that metals accumulated in fish muscle tissues may represent a health risk. Metals like arsenic has been associated to various systemic effects like cardiovascular

diseases, skin disorders, and neurotoxicity; nickel compounds has showed an increased risk of lung and nasal cancer in humans, and mercury (Hg) have been implicated as various causes for severe neurological damage to humans. These health concerns become of greater for young children or women. However, consumption of foods may have the probability of contracting cancer over a long lifetime in future.

FSNM/POST/8

Companies Adulterating & Misbranding Food Go Unpunished

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Abstract
The definition of food adulteration according to the Food and Safety Standards Authority of India (FSSAI) is, "The addition or subtraction of any substance to or from food so that the natural composition and quality of food substance is affected."
Food adulteration has been highly rampant in India. India, on a usual basis, witnesses a number of cases of people getting affected by consuming adulterated food products. According to FSSAI, "Some of the most common adulterated foods are milk and milk products, atta, edible oils, cereals, condiments, pulses, coffee, tea, confectionery, baking powder, vinegar, besan and curry powder." The case of food adulteration that took the country by storm was the case of the very loved, Maggi Noodles. Maggi Noodles was found to contain a higher than the permissible level of lead and MSG.
Over the past seven years, about 25% of 53,406 companies against whom prosecution was launched for violating food safety laws were convicted. As many as 72,861 companies were found guilty of misbranding and adulteration during the period of 2015-16. As many as 72,200 samples of foodstuff, such as dal, ghee and sugar, were collected from across India. Of these, 13,571 (about 18%) were found adulterated and substandard. Experts say that the low conviction rate is one of the primary reasons for the rise of adulterated food in market during the past five years. The percentage of adulterated food tested by government has risen from 8% in 2008 to about 18% in 2014 onwards.

FSNM/POST/9

Food as Poison

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Abstract
It goes without saying that science abused results in disaster. Food adulteration, which is big business today, causes slow-poisoning and is, most certainly, a sort of terror that hangs as a black pall over our daily life. We wake up in the morning, brush our teeth, get breakfast and take a cup of tea. Things appear to be alright. Few know that we are being poisoned; fewer still know how. The levels of slow-poisoning are multiple so that the one-sided legal, or even, medical control appears to be an impossibility. What seems to be of effect to some considerable extent is an awareness of the why and the how's of such things that make up the daily-life terror. The belief

is: knowing is being or becoming; in other words, knowledge guarantees caution and is freedom; specific knowledge frees us specifically – freedom, for example, from daily-life terror. The unethical business-motive acts as the polluting agent. From simple fraud to big business is a remarkable way to what goes by the name of financial growth or affluence. Simple fraud allures simple people by the use made of metanil yellow, malachite green, orange red, for instance. Such chemicals are meant for industry, unfortunately and unscrupulously used in food stuff. The result is cruel: carcinogenic. Monosodium Glutamate (MSG) is another case in point – a taste-maker, a flavouring agent for the fast food, turned fatal, especially for the pregnant women, getting in the way of the natural growth of embryo. The poster is about food adulteration and its harmful effects. We need to be rid of them; but the question is: how? There is the law; there is the medicine apparently for relief. But all are impotent because we are not aware. Awareness might function as the most powerful means to the end: Freedom.