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A HANDBOOK ON

FOOD ADULTERATION

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Dedicated to my daughters

Inika and Ketika

PREFACE

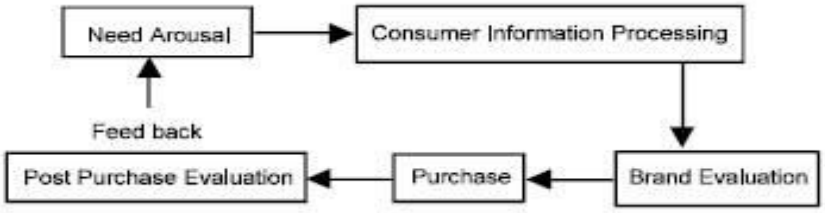
The goal of this book is to educate everyone on the foods they consume on a regular basis. Our diet has a significant impact on our health, yet I've noticed that nowadays hardly a single food product is really clean. It poses a significant threat to our health. Even those from higher and lower social classes are unaware of this. To prevent food from being tampered with, the Indian government has established a number of laws and regulations regarding the kind of food that should be produced. Despite making a very large profit from it, the food industry continues to pay little attention to this issue.

Food adulteration is the purposeful reduction in the quality of the food by the addition or replacement of unauthorised alternative components, the removal of beneficial elements, or both. Usually, this is done to lower the cost or increase the supply of a particular food item. To demonstrate this, we analysed a variety of food samples and discovered that every single one of them had chemicals and adulterants, not one of which was pure. In this book, we've attempted to outline many techniques for spotting food adulterants that are often found in markets or even our own homes. Finally, I want to encourage everyone to regularly test the foods they eat since this quick procedure may prevent long-term health issues.

Dr Mukta Jain

1.1 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. { And reduce manufacturing costs or for some other deceptive or malicious purpose}. Adulterants may also be accidentally or unknowingly introduced into substances. The addition of adulterants is called adulteration.[1][2]



Model of Buying Behavior [1]

The first approach consists of determining the ratio between some chemical constituents and assumes these ratios are a constant component of the particular food. From this point of view, it seems to make sense that any addition of any substance into foods will modify the value of these ratios or will highlight an anomaly in its chemical composition. This approach is frequently associated with a large set of analyses and the use of chemo metrics. In this area, many pattern classification procedures (such as PCA, LDA, HCA, SIMCA, PLS, CVA, and ANN) can be applied to the dataset to compare similarities or differences of sample data with original data. Theoretically, after a multivariate analysis taking into account many analytical factors, adulterated samples form singular groups that can be easily distinguishable from authentic samples.[3]

An alternative approach to this problem could be to search for a specific marker in the product, which could be a chemical constituent (complexes, molecules, nucleic acids) or morphological component (plant cells), that proves either the adulteration or authenticity of the food. The thermal behavior is followed over hanging temperature and/or time. O carry out these analytical controls, many techniques are seed usable. This review focuses on the following: microscopic analysis; HPLC; GC, GC-MS, GC-FTIR; Visible ectrophotometry; AAS/AES, ICP-AES, ICP-MS; IRMS, GC-IRMS, GC-C-IRMS;
DSC; and IR and mid-IR, NMR.[1][4]

Despite of improvement in production, processing and packaging, more poisons seem to be entering our food chain. For example Indian spices or 'measles' add taste and flavor to food and also help in digestion. Some spices like turmeric have an antiseptic effect on the body. But what is most important is the quality of these ingredients. Every consumer wants to get maximum quantity of a commodity for as low a price as possible. This attitude of the consumer being coupled with the intention of the traders to increase the margin of profit, where the quality of the commodity gets reduced through addition of a baser substance and removal of vital elements also commonly known as food adulteration.[1] [5]

1.2 Definition of Adulterated Food

Under the Prevention of Food Adulterant Act, an Adulterant is any material which is employed for the purposes of adulteration. Any article of food is adulterated if:

1. If any inferior or cheaper substance has been substituted wholly or in part,
2. If any constituent of the article has been wholly or in part abstracted,
3. If the article has been prepared, packed or kept under in sanitary conditions,
4. If the article is obtained from diseased animal,
5. If the article contains any poisonous ingredient,
6. If the article contains any prohibited or excessive preservatives,
7. If the neither quality nor purity of the article falls below prescribed standard.[6]

Adulterated food is dangerous because it may be toxic and can affect health and it could deprive nutrients essential for proper growth and development. But shortages and increasing prices some of the common adulterated foods are milk and milk products, attar, edible oils, cereals, condiments (whole and ground), pulses, coffee, tea, confectionary, baking powder, nonalcoholic beverages, vinegar, bean and curry powder.[7]

1.3. Why Food Adulteration?

Let us be clear that food adulteration in India under the law includes both willful adulteration of food and "substandard" foods which do not conform to the prescribed food standards but are not done intentionally. Taking an overall view of all types of food adulteration, three major underlying causes could be identified. The more important reason is the basic dishonesty of the food traders and an urge to make quick and easy money. There are significant numbers of cases of food adulteration committed by small traders due to their ignorance about the standards they are expected to maintain.[8][9]

1.4 What You Can Do?

Food Adulteration occurs in rural as well as urban areas. So the first option is to buy branded and ISI-marked products. Even if these branded items cost a little extra, it is worth paying the extra amount to safe guard your health.[10]

If you have purchased any branded item and doubt its quality, you can at least approach the company concerned. Always remember to preserve your grocery bills so that the company can take necessary steps regarding the complaint. If you find that any food is adulterated, then do not keep silent. Complain to Prevention of Food Adulteration Department in your city/town/district and report to the newspapers and make more and more. People aware to take joint action.[11]

1.5 Literature of food adulteration in India

Historically, the usage of adulterants has been common in societies with few legal controls on food quality and poor/nonexistent monitoring by authorities; sometimes this usage has even extended to exceedingly dangerous chemicals and poisons. In the United Kingdom during the Victorian era, adulterants were quite common; for example, cheeses were sometimes colored with lead. Similar adulteration issues

were seen in industry in the Unite States, until the passage of the Pure Food and Drug Act of 1906. More recently, adulterant use in the People's Republic of China has inspired much public attention.[12]

Adulterant usage was first investigated in 1820 by the German chemist Frederick Acumen, who identified many toxic metal colorings in food and drink. The physician Arthur Hill Hassall later conducted extensive studies in the early 1850s, which were published in The Lancet and led to the 1860 Food Adulteration Act and subsequent further legislation.[13]

At the turn of the 20th century, industrialization in the United States saw and upraise in adulteration and this inspired some protest. Accounts of adulteration led the New York Evening Post to parody:- Mary had a little lamb, And when she saw it sicken, She shipped it off to Packing town, And now it's labeled chicken.

Methods of food analysis have been developed in order to obtain information about the composition of foods for nutritional and dietetic purposes, to aid in the standardization of production and manufacture of products, and for regulatory purposes to protect the people against deleterious, harmful or adulterated foods. This book was written to give a "systematic coverage to the salient facts of the chemical analysis of foods and food products. "There is first a discussion of general methods and physicochemical methods of analysis, followed by chapters on coloring matters, preservatives and metals in foods. There follow separate chapters on various classes of foods, including milk and cream, milk products, oils and fats, sugar foods and carbohydrates, gums, cereals, starch and other polysaccharides, jams, jellies and fruit, spices, flavors and condiments, nonalcoholic beverages and allied products, alcoholic beverages, meat, meat products, fish and eggs, vitamins and inorganic determinations.[14]

1.6 Recognized adulteration in food

"The bread I eat in London is a deleterious paste, mixed up with chalk, alum and bone ashes, insipid to the taste and destructive to the constitution. The good people are not ignorant of this adulteration; but they prefer it to wholesome bread, because it is whiter than the meal of corn [wheat]. Thus they sacrifice their taste and their health. To a most absurd gratification of a misjudged eye; and the miller or the baker is obliged to poison them and their families, in order to live by his profession. "Tobias Smelled, The Expedition of Humphrey Clinker (1771). A history of food poisoning and adulteration is found in the textbook, Death in the Pot: The Impact of Food Poisoning on History.[10][11]

1.7 Food Inspection and Grading

The government has a Food Inspection and Grading Service that routinely analyses the properties of food products to ensure that they meet the appropriate laws and regulations. Hence, both government agencies and food manufacturers need analytical techniques to provide the appropriate information about food properties. The most important criteria for this type of test are often the accuracy of the measurements and the use of an official method. The government has recently carried out a survey of many of the official analytical techniques developed to analyze foods, and has specified which techniques must be used to analyze certain food components for labeling purposes. Techniques have been chosen which provide accurate and reliable results, but which are relatively simple and inexpensive to perform.[12]

1.8 Notable incidents of adulteration

- In 1987, Beech-Nut paid $2.2 million in fines for violating the Federal Food, Drug, and Cosmetic Act by selling artificially flavored sugar water as apple juice.[13]

- In 1997, Con Agra Foods pled guilty to federal criminal charges that one of its units illegally sprayed water on stored grain to increase its weight and value.[14]
- In 2007, samples of wheat gluten mixed with melamine, presumably to produce artificially inflated results from common tests for protein content, were discovered in many U.S. pet food brands, as well as in human food supply. The adulterated gluten was found to have come from China, and U.S. authorities concluded that its origin was the Xuzhou Annoying Biologic Technology Development Company, a Xuzhou, China-based company. [15]

- In 2008, significant portions of China's milk supply were found to have been contaminated with melamine. Infant formula produced from melamine-tainted milk killed at least six children and were believed to have harmed thousands of others.[16][17]

- In 2012, a study in India conducted by the Food Safety Standards Authority of India (FSSAI) across 33 states found that milk in India is adulterated with detergent, fat and even urea, as well diluted with water. Of the 1791 random samples from 33 states, just 31.5% of the samples tested (565) conformed to the FSSAI standards while the rest 1226 (68.4%) failed the test.[18]

1.9 Criteria for selection of food

Selection of wholesome and non-adulterated food is essential for daily life to make sure that such foods do not cause any health hazard, However, visual examination of the food before purchase makes sure to ensure absence of insects, visual fungus, foreign matters, etc. Therefore, due care taken by the consumer at the time of purchase of food after thoroughly examining can be of great help. Secondly, label declaration on packed food is very important for knowing the ingredients and nutritional value. It also helps in checking the freshness of the food and the period of best before use. Such types of food may cause various diseases. Consumption of cut fruits being sold in unhygienic conditions should be avoided. It is always better to buy certified food from reputed shop.[19]

1.10 Food Adulteration in India

Samples that were seized from Chennai have been disposed off at dumping zones since they did not even have basic information like address of manufacturers, manufacturing and expiry date and batch number. It is the duty of civic bodies to keep a check on the sale of unhygienic roadside eateries but my question is what is the common man doing to deal with this problem.[20] People do not even check the manufacturing and expiry date before buying or consuming any product or even medicines. For our own safety is it not our duty also to at least check these basic things. Or are we going to wake up only when some health problem arises due to consumption of such substandard food products. Roadside foods, ice-creams, candies, cold drinks are very tempting, especially in this scorching heat. The masses

should be educated about the need for precautionary measures in water and food consumption during summer because contaminated water and food is the major reason for acute diarrheas diseases**.**

Coming back to dangers of food adulteration very few know how dangerous it can be. I will elaborate it with few examples. The Delhi Health Department seized samples of turmeric power, black pepper and masoor dal. Let us have a look at these-

Turmeric- it is usually adulterated with yellow aniline dyes/non-permitted coloring agents like metanil yellow/tapioca starch. The first two adulterants are carcinogenic and tapioca starch can cause stomach disorders.

Dal- it is usually adulterated with kasseri dal which can cause cancer.

Black pepper- papaya seeds are the commonly used adulterant which can lead to stomach and liver problems.

These are very few examples which prove how dangerous food adulteration can be. Therefore we should notify the civic health bodies if we come across any such practices in the market.[1][21]

1.11 Types of adulteration

There are three types of adulteration namely:

1. ***Intentional adulterants:*** Intentional adulterants are sand, marble chips, stone, mud, chalk powder, water, mineral oil and coal tar dyes. This adulteration cause harmful effects on the body.

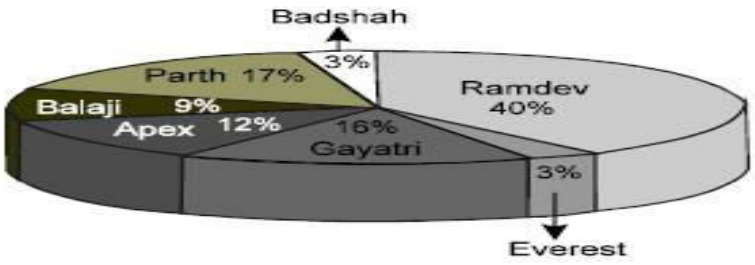
2. ***Metallic contamination:*** Metallic contaminations include arsenic from pesticides, lead from water, and mercury from effluents of chemical industries, tin from cans etc.

3. ***Incidental adulterants:*** Incidental adulterants are pesticide residues, tin from can droppings of rodents, larvae in foods. Metallic contamination with arsenic lead, mercury can also occur incidentally. Pests such as rodents and insects intrude into the food at high degree and produce filth in the form of excreta, bodily secretions and spoilage through micro organisms. The most common incidental adulterants are pesticides, D.D.T and marathon residues present on the plant product. The maximum permissible residue allowed for D.D.T, marathon is 3 ppm when ingested.[22]

1.12 Adulterant Food Articles Effects on Health

- Mineral oil Oils and black pepper Diarrhea, vomiting, cancer.
- Methyl / alcohol Alcoholic liquors Blurred vision, blindness, death.
- Lead chromate Turmeric and powder mixed spices Anemia, brain damage.
- Kesari dal Pulses and besan Paralysis of legs.
- Dung Coriander powder Tetanus.

- Iron filling Suji, tea leaves Possibility of tetanus.
- Argemone oil Oils and fats Epidemic dropsy, glaucoma, blindness, cardiac arrest.
- Pesticide Residue All of foods Acute or chronic, poisoning, with damage to nerves and vital organs types.
- Metanil Yellow Turmeric, mixed spices, saffron, Tambours, cancer, testicular degeneration in males. Dehusked pulses, rice, golden beverages.
- Lead Tap water, some processing foods Lead poisoning, causing foot drop, anemia, and brain damage.[23][24]



Preference of brand or selected spices [15]

1.13 Economic Adulteration

A food is adulterated if it omits a valuable constituent or substitutes another substance, in whole or in part, for a valuable constituent (for instance, olive oil diluted with tea tree oil); conceals damage or inferiority in any manner (such as fresh fruit with food coloring on its surface to conceal defects); or any substance has been added to it or packed with it to increase its bulk or weight, reduce its quality or strength, or make it appear bigger or of greater value than it is (for example, scallops to which water has been added to make them heavier).[1][25]

1.14 Problems due to adulteration

- Food adulteration, apart from cheating the consumers, often results in disorders or diseases. Some of the foods commonly adulterated in India and problems are as follows. Pulses like masoor, black gram and channa are mixed with kesari dhal. Consumption of kesari dhal for a long time produces lathyrism which results in paralysis of the lower limbs. Roasted tamarind and date seeds are ground and adulterated with coffee powder. Edible oils and fats are adulterated with cheap edible and no edible oils. Argemone seeds resemble mustard and are used to mix with mustard seeds. Argemone oil itself extracted from the seeds, is used to adulterate oil such as coconut, sesame and groundnut.[26]
- Argemone oil is poisonous and its use results in dropsy in human beings. Fats and oils are also adulterated with petroleum products causing gastro intestinal disturbances. The most frequently used food adulterant in India is colouring matter. Colour is used in many foods such as milk products, confectionery, soft drinks, alcoholic beverages, tea and spices. Colours are also added to foods such as egg preparations, bakery products, fruit products and others. More than 70 percent of the colour containing marketed samples of

foods is found to contain no permitted colourants like lead chromate and coal tar dyes. Use of foods containing non permitted colourants results in various health hazards.[27]

15. Microbiological Contamination and Adulteration

The fact that a food is contaminated with pathogens (harmful microorganisms such as bacteria, viruses, or protozoa) may, or may not, render it adulterated. Generally, for ready to eat foods, the presence of pathogens will render the food adulterated. For example, the presence of Salmonella on fresh fruits or vegetables or in ready to eat meat or poultry products (such as luncheon meats) will render those products adulterated.[28]

For meat and poultry products, which are regulated by USDA, the rules are more complicated. Ready-to-eat meat and poultry products contaminated with pathogens such as Salmonella or Listeria monocytogenes, are adulterated. (Note that hotdogs are considered ready-to-eat products.) For raw meat or poultry products, the presence of pathogens will not always render a product adulterated (because raw meat and poultry products are intended to be cooked and proper cooking should kill pathogens).[29]

1.16 Poisonous or Deleterious Substances

Generally, if a food contains a poisonous or deleterious substance that may render it injurious to health, it is adulterated. For example, apple cider contaminated with E. coli O157:H7 and Brie cheese contaminated with Listeria monocytogenes are adulterated. There are two exceptions to this general rule. First, if the poisonous substance is inherent or naturally occurring and its quantity in the food does not ordinarily render it injurious to health, the food will not be considered adulterated. Thus, a food that contains a natural toxinat very low levels that would not ordinarily be harmful (for instance, small amounts of amygdalin in apricot kernels) is not adulterated.[1][30]

Second, if the poisonous or deleterious substance is unavoidable and is within an established tolerance, regulatory limit, or action level, the food will not be deemed to be adulterated. Tolerances and regulatory limits are thresholds above which a food will be considered adulterated. They are not binding on FDA. FDA has established numerous action levels (for example, one part per million methyl mercury in fish), which are set forth in its booklet Action Levels for Poisonous or Deleterious Substances in Human Food and Animal Feed.[1][31]

1.17 Filth and Foreign Matter

Filth and extraneous material include any objectionable substances in foods, such as foreign matter (for example, glass, metal, plastic, wood, stones, sand, cigarette butts), undesirable parts of the raw plant material (such as stems, pits in pitted olives, pieces of shell in canned oysters), and filth (namely, mold, rot, insect and rodent parts, excreta, decomposition). Under a strict reading of the FD&C Act, any amount of filth in a food would render it adulterated. FDA regulations, however, authorize the agency to issue Defect Action Levels (DALs) for natural, unavoidable defects that at low levels do not pose a human health hazard. In most cases, DALs are food-specific and defect-specific. For example, the DAL for insect fragments in peanut butter is an average of thirty or more insect fragments per 100 grams. In the case of

hard or sharp foreign objects, the DAL, which is based on the size of the object and the likelihood it will pose a risk of choking or injury, applies to all foods.[1][32]

1.18 Enforcement Actions against Adulterated Food

If a food is adulterated, FDA and FSIS have a broad array of enforcement tools. These include seizing and condemning the product, detaining imported product, enjoining persons from manufacturing or distributing the product, or requesting a recall of the product. Enforcement action is usually preceded by a Warning Letter from FDA to the manufacturer or distributor of the adulterated product. In the case of an adulterated meat or poultry product, FSIS has certain additional powers. FSIS may suspend or withdraw federal inspection of an official establishment. Without federal inspection, an establishment may not produce or process meat or poultry products, and therefore must cease operations. With the exception of infant formula, neither FDA nor FSIS has the authority to require a company to recall an adulterated food product. However, the ability to generate negative publicity gives them considerable powers of persuasion.[33]

1.19 Prevention of Food Adulteration Programme

- The Ministry of Health and Family Welfare is responsible for ensuring safe food to the consumers. Keeping this in view, a legislation called "Prevention of Food Adulteration Act, 1954" was enacted. The objective envisaged in this legislation was to ensure pure and wholesome food to the consumers and also to prevent fraud or deception. The Act has been amended thrice in 1964, 1976 and in 1986 with the objective of plugging the loopholes and making the punishments more stringent and empowering Consumers and Voluntary
  Organisations to play a more effective role in its implementation.[34]

- The laws regulating the quality of food have been in force in the country since 1899. Until 1954, several States formulated their own food laws. But there was a considerable variance in the rules and specifications of the food, which interfered with inter-provincial trade. The Central Advisory Board appointed by the Government of India in 1937 and the Food Adulteration Committee appointed in 1943, reviewed the subject of Food Adulteration and recommended for Central legislation. The Constitution of India provided the powers to Central Government for making such legislation as the subjects of Food and Drugs Adulteration are included in the concurrent list. The
  Government of India, therefore, enacted a Central Legislation called the Prevention of Food adulteration Act (PFA) in the year 1954 which came into effect from 15 June, 1955. The Act repealed all laws, existing at that time in States concerning food adulteration.[34]

In India, a three-tier system is in vogue for ensuring food quality and food safety. They are:

1. Government of India; 2. State / UT Governments;

3. Local Bodies.

The Prevention of Food Adulteration Act is a Central legislation. Rules and Standards framed under the Act are uniformly applicable throughout the country. Besides, framing of rules and standards, the following activities are undertaken by the Ministry of Health and Family Welfare.

- Keeping close liaison with State/local bodies for uniform implementation of food laws.
- Monitoring of activities of the States by collecting periodical reports on working of food laws, getting the reports of food poisoning cases and visiting the States from time to time.
- Arranging periodical training programme for Senior Officer/Analysts.
- Creating consumer awareness about the programme by holding exhibitions/seminars/ training programmes and publishing pamphlet'.
- Approving labels of Infant Milk Substitute and Infant food, so as to safeguard the health of infants.
- Coordinating with international bodies like ISO/FAO/WHO and Codex.
- Carrying out survey-cum-monitoring activities on food contaminants like colours.

Holding activities connected with National Monitoring Agency vested with powers to decide policy issues on food irradiation. The Ministry of Health and Family Welfare constituted a National Codex Committee (NCC) and an Assistant Director General (PFA) has been working as Liaison Officer for NCC. The NCC has further constituted 24 Shadow Committees corresponding to various Codex commodities committees for preparation and finalization of India's stand. India has been regularly attending the various sessions of the Codex Alimentarius Commission and various Codex Commodity Committees to put forward her views and defend these views.[35]

1.20 The Food Safety and Standards Act, 2006

With the coming into effect of the Food Safety and Standards Act, 2006 (FSSA) enacted by Parliament in August 2006, the Prevention of Food Adulteration Act, 1954 stands repealed from the date on which Food Safety and Standards Act comes into force on such date as the Central Government may, by notification in the Gazette. Notwithstanding the repeal of the enactment and Orders specified in the Second Schedule, the standards, safety requirements and other provisions of the Act and the rules and regulations made there under and Orders listed in that Schedule shall continue to be in force and operate till new standards are specified under this Act or rules and regulations made there under. Provided that anything done or any action taken under the enactment and Orders under repeal shall be deemed to have been done or taken under the corresponding provisions of this Act and shall continue in force accordingly unless and until superseded by anything done or by any action taken under this Act.[36]

1.21 Identifying Food Adulteration and Misbranding: Consumer Rights Protection

Adulteration of food items can harm consumer health, and hence is a serious offence. Instances of food adulteration and misbranding are common in both rural and urban areas, and the need for curbing them is urgent. Several instances of adulteration of food items like milk and ghee with detergents and other harmful chemicals have been witnessed in the country. Spices such as turmeric, coriander and red chilly are also adulterated with stone powder, horse dung and chemicals. Manufacturers, in an attempt to make quick profits, are unmindful of the health of the public and resort to such mean techniques. Although there are

stringent laws for consumer rights protection and for punishing culprits, Indian consumers are unaware of the laws and their provisions. Besides, consumers must also be vigilant about identifying adulterated food and HINGTON wrong branding of articles by unscrupulous manufacturers.[37]

EXPERIMENT

1. **Glass Wares Required:-**
   Test Tube, Boiling test tube, Beaker, Slides

2. **Food Samples required:-**

   Mustard Oil, Edible Oil, Ghee, Honey, Milk, Soda lemonade, Coffee powder , Tea Leaves, Jiggery, Asafoetida, Turmeric Powder, Pulses, Bajra, Wheat flour, Dry red chilli, Coriander powder, Pulses samples.

3. **Chemical Required**: -

   Conc. HCl, Conc. Nitric Acid. silver nitrate, carbon tetrachloride, chloroform, paraffin, H_2SO_4, distilled water

Procedure and Observation for detection the Adulteration in the food Items

Table A: - Detection of Mustard Oil

Name of food articles	**Adulterant**	**Diseases/ health affects**	**Simple method for detection of common adulterants affects**	**Remarks**
1) Mustard Oil[38]	Castor oil	Causes vomiting gastro enteritis (diarrohea) convulsions oedema	Take 1 ml of oil in a clean dry test tube. Add 10 ml of acidified petroleum ether. Shake vigorously for 2 minutes. Add 1 drop of Ammonium Molybdate reagent. The formation of turbidity indicates presence of Castor oil in the sample.	Sample A + + + Sample B + + Sample C +
	Cotton seed oil	Causes vomiting, gastro enterits(diarrohea)	Take 3 ml of the sample in a test tube. Add in it 2 ml of amyl alcohol, 1 ml of carbon disulphide and a little amount of sulphur. Plug the mouth of the test tube and heat the tube on the flame of a spirit lamp for 3 minutes. A red colouration indicates the presence of cotton seed oil in mustard oil.	Sample A + Sample B - - Sample C -
	Argemone oil	Epidemic dropsy, glaucoma,heart trouble, debilitating diseases like beri-beri	Add 5 ml, conc. HNO3 to 5 ml. sample. Shake carefully. Allow to separate yellow, orange yellow, crimson colour in the lower acid layer indicates adulteration.	Sample A - Sample B + + Sample C - -
	Mineral oil	Liver trouble and possibility of cancer	Take a little amount (3 ml) of the sample in a test tube. Add 20 drops of alcoholic potash. Heat the tube on the flame of a spirit lamp for 3 minutes to effect decolourization of the mixture. Add 10 drops of distilled water and shake the tube. Examine the tube to trace turbidity. Continue the operation of adding water up to 15 ml and the examination of the tube for appearance of turbidity. The appearance of turbidity indicates the presence of mineral oil in mustard oil.	Sample A + + Sample B + Sample C -

Table B:- Detection Of Edible Oil

Name Of Food Articles	Adulterant	Disease/Health Affects	Simple Method For Detection Of Common Adulterants	Remarks
2) Edible Oil[38]	Prohibited Colour	The consumer may be deprived of the desired nutritional value of food	Take a little amount(20 drops) of the sample in each of the four test tubes. Prepare 3 different solutions, mixing up 1 part of distilled water, 3 parts of distilled water and 4 parts of distilled water. Add 2 ml of each solution in 3 test tubes and 2 ml of hydrochloric acid in the fourth test tube. Shake each tube to mix up the contents thoroughly. A rosy colouration in the mixture of any tube indicates the presence of prohibited colour in edible oil.	Sample A ++ Sample B +++ Sample C +
	Cyanide	Heart trouble, debilitating diseases	Take 3 ml of the sample in a test tube. Add 10 drops of alcoholic potash and heat the tube on the flame on a spirit lamp. Add a little amount of ferrous sulphate and ferric chloride to the test tube and shake it mix up thoroughly. Add 3 ml of hydrochloric acid. A blue colouration indicates	Sample A – Sample B – Sample C –
	Mobil Oil/ Lube oil	Epidemic Dropsy, Glaucoma	Take 20 drops of the sample in a test tube. Add 10 drops of alcoholic potash. Heat the tube on the flame of a spirit lamp to decolourize the mixture. Add 10 drops of dichloroquinol chloride. Heat the tube again. The appearance of blue colour indicates the presence of a compound of triorthocrysyle phosphate (TOCP) which contributes to the incidence of paralysis. Traces of this compound in edible oil to an admixture of edible oil with Mobil oil.	Sample A + Sample B - - Sample C –
	Rancidity	The consumer may be deprived of the desired nutritional value of food	Take 3 ml of the sample in a test tube. Add in it 3 ml of hydrochloric acid. Plug the mouth of the test tube. Shake the tube to mix it up. Add 3 ml of 0.1% phloroglucinol value food solution in ether. Shake the tube vigorously for 2 minutes and keep it aside. Examine for half an hour. A red or pink colouration in the acid layer indicates that the oil sample is rancid.	Sample A ++ Sample B + Sample C -

Table C :- Detection Of Ghee

Name of food articles	Adulterant	Disease/ Health affects	Simple method for detection of common adulterants	Remarks
3.) Ghee[38]	Mashed Potato Sweet Potato, etc.	Consumer deprived desired value food	may Boil 5 ml. Of the sample in a test tube. Cool and a drop of from the iodine solution. Blue colour indicates presence of nutritional Starch. Colour disappears on boiling & reappears on cooling.	Sample A + + Sample B + + + Sample C +

	Vanaspati	Consumer deprived desired value food	may Take 5 ml. Of the sample in a test tube. Add 5 ml. Of from the Hydrochloric acid and 0.4 ml of 2% furfural solution or nutritional sugar crystals. Insert the glass stopper and shake for 2 minutes. Development of a pink or red colour indicates presence of Vanaspati in Ghee.	Sample A + + Sample B + + + Sample C + +
	Rancid (old ghee)	Consumer deprived desired value food	may Take one teaspoon of melted sample and 5 ml. Of HCl in a from the stoppered glass tube. Shake vigorously for 30 seconds. nutritional Add 5 ml. Of 0.1% of ether solution of Phloroglucinol. Restopper & shake for 30 seconds and allow to stand for 10 minutes. pink or red colour	Sample A + + + Sample B + + Sample C + + +
	Synthetic Colouring Matter	Consumer deprived desired value food	may Pour 2 gms. Of filtered fat dissolved in ether. Divide into 2 from the portions. Add 1 ml. Of HCl to one tube. Add 1 ml. Of 10% nutritional NaOH. Shake well and allow to stand. Pink colour in acidic solution or yellow colour in alkaline solution indicates added colouring matter.	Sample A + + Sample B + Sample C -

Table D: - Detection of Honey

Name of food articles	Adulterant	Disease/ Health affects	Simple method for detection of common adulterants	Remarks
4.) Honey[39]	Invert sugar/jaggery	Leprosy, Diabetes	Fiehe's Test: Add 5 ml. Of solvent ether to 5 ml. Of honey. Shake well and decant the ether layer in a Petri dish. Evaporate completely by blowing the ether layer. Add 2 to 3 ml. Of resorcinol (1 gm. Of resorcinol resublimed in 5 ml. Of conc. HCl.) Appearance of cherry red colour indicates presence of sugar/jaggery.	Sample A + + Sample B + + + Sample C + +
	Metanil Yellow Colour	Degeneration of testis in male	Aniline Chloride Test: Take 5 ml. Of honey in a porcelain dish. Add Aniline Chloride solution (3 ml of Aniline and 7 ml. Of 1:3 HCl) and stir well. Orange red colour indicates presence of sugar.	Sample A + + Sample B + Sample C – Insert line

Table E: - Detection of Milk

Name of food articles	Adulterant	Disease/ Health affects	Disease/Health affects	Simple method for detection of common adulterants	Remarks
5.) Milk[40]	Sugar	It causes cancer causes behaviors, like irritating behaviors		Take a little amount (3 ml) of the sample in a test tube. Add in it 2 ml of hydrochloric acid or muratic acid. Heat the tube after adding a bit (50 mg) of resorcinol. A red colouration indicates the use of sugar in milk. The detection may be made by a different test. Take a small amount (5 ml) of the sample in a test tube. Add a little amount (1 mg) of invertase enzyme. After 5 minutes, dip a strip of diastix in it. Lift the strip after half a minute. A change in colour from blue to green indicates the use of sugar in milk.	Sample A + Sample B - - Sample C -
	Glucose	It causes cancer . causes behaviors, irritating behaviors		Take a little amount (5 ml) of the sample in a test tube like Dip a strip of diastix in it for half a minute. A change in colouration from blue to green indicates the presence of glucose in milk.	Sample A + + + Sample B + + Sample C + + +

	Cereal starch	Diarrhea, gas formation	Take 3 ml of the sample in a test tube. Add a drop of 1% aqueous solution of iodine. A blue or deep blue colouration indicates the use of cereal starch in milk.	Sample A + + Sample B + Sample C -
	Urea	Urea on boiling may convert into biuret which causes fall in blood pressure produces stone irritating	Take 5 ml of the sample in a test tube. Add a little amount of soyabean or arhar powder. Shake the tube to mix up the contents thoroughly. After 5 minutes, dip a red litmus paper in it. Lift the paper after 30 seconds. A change in colour from red to blue indicates the use of urea in	Sample A - Sample B - - Sample C -
	Boric acid		Take 3 ml of the sample in a test tube. Add 20 drops of hydrochloric acid and shake the tube to mix up the contents thoroughly. Dip a yellow paper strip and lift the same after a minute. A change in colour from yellow to red followed by a change from red to green by addition of drop of ammonia solution indicates the presence of boric acid in milk.	Sample A - - Sample B - Sample C -
	Dalda	Deprived from the desired nutritional value food	Take a little amount (3 ml) of the sample in a test tube. nutritional A Add 10 drops of hydrochloric acid or muratic acid. Mix up a little amount (one-fourth of a tea-spoon) of sugar. Examine the mixture after 5 minutes. A red colouration indicates the use of dalda in milk.	Sample A + + Sample B - Sample C +

Table F: - Detection of Soda lemonade

Name of food articles	Adulterant	Disease/Health affects	Simple method for detection of common adulterants	Remarks
6.) Soda lemonade[41]	Soda lemonade		Pour 2 drops of the sample on a metanil yellow paper strip. A violet colouration indicates the presence of mineral acid in aerated water. colour impression gets retained after drying the paper.	Sample A + + + Sample B + + Sample C + +

Table G: - Detection of Coffee powder

7.) Coffee powder[41]	Cereal starch	deprived desired value food	Take a small quantity of the sample in a test ube and add 3 nutritional ml of distilled vater in it. Light a spirit lamp and heat the ontents to colourize. Add 33 ml of a solution f potassium permanganate and HCl (1:1) to ecolourize. The formation of blue colour in ixture by addition of a drop of 1% aqueous olution of iodine indicated adulteration with starch.	Sample A + + Sample B + + + Sample C + +
	Powder scorched persimmon stones	deprived desired value food	Take a small quantity (1 tea-spoon) of the sample and nutritional spread it on a moistened blotting paper. it, with much care, 3 ml of 2% aqueous solution of sodium carbonate. A red colouration indicates the presence of scorched persimmon stones in coffee powder.	Sample A + Sample B - - Sample C -

Table H: - Detection of Tea Leaves

Name of food articles	Adulterant	Disease/ health affects	Simple method for detection of common adulterants	Remarks
8.) Tea Leaves[41]	Iron Flakes	Damage to elementary canal	Spread a small quantity (2 tea-spoons) of the sample on a piece of paper. Draw a magnet over it. Iron flakes, if present, cling to the magnet. The same test may be carried out to trace iron flakes from tea half-dust and iron filings from tea dust	Sample A - - - Sample B - - Sample C -
	Coal Tar Dye	Cancer and diseases	Scatter 1 tea-spoon of the sample on a moistened white blotting paper. After 5 minutes, remove the sample and examine the paper. A revelation of coloured spots indicates the use of the dye.	Sample A + Sample B - Sample C -

Table I: - Detection of Jiggery

9.) Jiggery[42]	Sodium bicarbonate		Take a little amount (one-fourth of a tea-spoon) of the sample in a test tube. Add 3 ml of muratic acid. The presence of sodium carbonate or sodium bicarbonate effects effervescence.	Sample A Sample B Sample C
	Metanil yellow colour	Consumer deprived desired value food	may Take a little amount (one-fourth of a tea-spoon) of the from the sample in a test tube. Add 3 ml of alcohol and shake the nutritional tube vigorously to mix up the contents. Pour 10 drops of hydrochloric acid in it. A pink colouration indicates the presence of MYC.	Sample A + + Sample B + Sample C -

Table J: - Detection of Asafoetida

Name of food Articles	Adulterant	Disease/ health affects	Simple method for detection of common adulterants	Remarks
10.)Asafoetid a (Heeng) [43]	Soap stone, other earthy matter	Damage to the elementary canal and kidney stone	Shake a little quantity of powdered sample with water. Soap stone or other earthy matter will settle at the bottom.	Sample A + + + Sample B + + Sample C + + +
	Chalk	Stomach disorder, cancer	Shake sample with Carbon tetrachloride (CCl_4). Asafoetida will settle down. Decant the top layer and add dil.HCl to the residue. Effervescence shows presence of chalk.	Sample A + Sample B - Sample C -
	Resin colour	cancer	Take a little amount of small parts of the sample in test tube. Add 3 ml of distilled water and shake the tube gently. Pure asafoetida dissolves in water very quickly and produces a milky white colour, but in case of adulteration with a chemical colour the mixture turns to be coloured.	Sample A + Sample B + Sample C -

Table k: - Detection of Gram powder

Name of food articles	Adulterant	Disease/Health affects	Simple method for detection of common adulterants	Remarks
11.) Gram powder[43]	Kesari powder		Take a half of a tea-spoon of the sample in a test tube with 3 ml of distilled water. Add 3 ml of muratic acid. Immerse the tube in warm water. Check the tube after 15 minutes. A violet colouration indicates the presence of Kesari powder in Gram powder.	Sample A + + + Sample B + + Sample C +
	Metanil yellow colour	Consumer deprived desired value food	may Take a half of a tea-spoon of the sample in a test tube. Add from the 3 ml of alcohol. Shake the tube to mix up the contents nutritional thoroughly. Add 10 drops of HCl in it. A pink colouration indicates adulteration of gram powder with metanil yellow.	Sample A + Sample B + + + Sample C + +

Table L: - Detection of Bajra

Name of food articles	Adulterant	Disease/ health affects	Simple method for detection of common adulterants	Remarks
12.) Bajra[44]	Ergot inf Bajra	Consumer may deprived from water desired nutritional value food	Swollen and black Ergot infested grains will turn light in the weight and will float also in water	Sample A - Sample B + + Sample C +
	Metanil Yellow	Stomach disorder, Degeneration of testis in male/cancer	Add few drops of conc. HCl to sample. Instant appearance of violet colour, which disappears on dilution with water, indicates pure turmeric. If colour persists Metanil yellow is present.	Sample A + + + Sample B + + + Sample C + +
13.) Dry turmeric root[43]	Metanil Yellow	Stomach disorder, Degeneration of testis in male/cancer	Take a piece of dry turmeric root and rub the outer surface with a piece of cotton soaked in liquid paraffin. A yellow colouration of cotton indicates adulteration of turmeric root with metanil yellow colour	Sample A - - Sample B - Sample C +

Table M: - Detection of Pulses

14.) Pulses[44]	Metanil Yellow	Consumer may deprived from the desired value food nutritional	Add conc.HCl to a small quantity of dal in a little amount of water. Immediate development of pink colour indicates the presence of metanil yellow and similar colour dyes.	Sample A + + Sample B + Sample C -
	Lead Chromate	Lathyrism	Shake 5 gm. Of pulse with 5 ml. Of water and add a few drops of HCl. Pink colour indicates Lead Chromate.	Sample A - Sample B + Sample C - -

Table N: - Detection of Turmeric Powder

15.) Turmeric Powder[43]	Starch of maize wheat, tapioca, rice	Deprived from the is desired nutritional value of food	A microscopic study reveals that only pure t turmeric is yellow coloured, big in size and has an angular structure. While foreign/added starches are colourless and small in size as compared to pure turmeric starch.	Sample A + + Sample B - Sample C + + +
	Lead Chromate	Anaemia Abortion, paralysis, brain deprived from the desired nutritional	Ash the sample Dissolve it in 1:7 Sulphuric acid (H_2SO_4) and filter. Add 1 or 2 drops of 0.1% dipenylcarbazide. A pink damage colour indicates presence of Lead Chromate.	Sample A - - Sample B - Sample C -

Table O: - Detection of Wheat flour

16.) Wheat flour[45]	Excessive sand & dirt	Stomach disorder lever damage and cancer	Shake a little quantity of sample with about 10 ml. Of Carbon tetra chloride and allow to stand. Grit and sandy matter will collect at the bottom.	Sample A + + + Sample B + Sample C + +
	Excessive bran	Stomach disorder lever damage and cancer	Sprinkle on water surface. Bran will float on the surface.	Sample A + + Sample B + + + Sample C +
	Chalk powder	Stomach disorder lever damage and cancer	Shake sample with dil.HCl Effervescence indicates chalk.	Sample A + Sample B - Sample C +

Table P: - Detection of Dry red chilli

Name food articles	Adulterant	Disease/ Health Affects	Simple method for detection of common adulterants	Remarks
17.) Dry red chilli[46]	Rhoda mine B colour	Stomach disorder lever damage	Take a red chili from the sample and rub the outer surface with a piece of cotton soaked in liquid paraffin. The sample is adulterated if the cotton becomes red.	Sample A + + + Sample B + + Sample C +
	Brick powder grit, sand, dirt, filth, etc.	Lever damage, cancer	Pour the sample in a beaker containing a mixture of chloroform and carbon tetrachloride. Brick powder and grit will settle at the bottom.	Sample A + Sample B + Sample C -

Table Q: - Detection of Coriander powder

18.) Coriander powder[46]	Dung powder		Soak in water. Dung will float and can be easily detected by its foul smell.	Sample A + Sample B - Sample C +
	Common salt		To 5 ml. Of sample add a few drops of silver nitrate. White precipitate indicates adulteration.	Sample A + Sample B + Sample C -

Table R: - Detection of Black Pepper

Name of food articles	Adulterant	Disease/Health affects	Simple method for detection of common adulterants	Remarks
19.) Black Pepper[45]	Papaya seeds/light berries, etc.	Stomach disorder lever damage and cancer	Pour the seeds in a beaker containing Carbon tetra-chloride. Black papaya seeds float on the top while the pure black pepper seeds settle down.	Sample A + + + + Sample B + + Sample C -

Table S: - Detection of Badi Elaichi seeds

20.) Badi Elaichi seeds[47]	Choti Elaichi seeds	Consumer may deprived from the desired nutritional value food	Separate out the seeds by physical examination. The seeds of Badi Elaichi have nearly plain surface without wrinkles or streaks while seeds of cardamom have pitted or wrinkled ends	Sample A + + Sample B – Sample C +

Table T: - Detection of Cumin seeds

21.) Cumin Seeds(Black Jeera)[47]	Grass seeds coloured with charcoal dust	Consumer may deprived from the desired nutritional value food	Rub the cumin seeds on palms. If palms turn black adulteration in indicated.	Sample A + + Sample B + Sample C + + +

Table U: - Detection of Parched rice

Name of food articles	Adulterant	Disease/Health affects	Simple method for detection of common adulterants	Remarks
22.) Parched rice[47]	Urea		Take 30 pieces of parched rice in a test tube. Add 5 ml of distilled water. Shake the tube to mix up the contents thoroughly. After 5 minutes, filter water contents and add to it a little amount (a half of a tea-spoon) of powder of arhar or soyabean. Wait for5 minutes and then dip a red litmus paper in the mixture. Lift the paper after 30 seconds and examine it. A blue colouration indicates the urea in rice.	Sample A + Sample B - Sample C - -

Discussion

The study deal with knowledge and awareness of women (homemaker) about food adulteration. That is why investigator found it necessary to generate awareness among the homemakers about the existing food adulteration practices of the retailers and manufacturers and equip them with simple household test for detecting adulteration. Normally this type of awareness is required as follows

1.) Background information

The result revealed that from the selected sample size one-third of respondents were less than or equal to thirty years of age, while half of the respondents were between 31 to 50 years of age group, 28% of respondents were educated up to higher secondary. In the present study majority of the respondents i.e., 70% were homemakers, while self employed and professionals were very less i.e., almost 2% each. Major decisions for

purchasing food: The result disclosed that, in 45% of families, the home maker took the major decisions for purchasing food for their families, where as 16.67% of families were dependent on the decisions made by the husband, one forth of the families under study took the decisions jointly (husband and wife) and in only very few families, decisions were taken up by their in laws. Buying practices of the homemakers: The present study was carried out on sixty respondents. The buying practices includes the type of packaging used while purchasing, brand choice, shop choice and purchase frequency of the selected items undertaken for study.

2.) Consumer awareness

Regarding consumer awareness the result depicted that majority, that is, two third of the respondents were moderately aware about their rights and responsibilities related to food quality and food adulteration. The aggregate mean item score regarding consumer rights and responsibilities was found to be 1.687 which shows a shift towards high awareness (Table 2). The aggregate mean item score was found to be 1.543 regarding food adulterations which show on an average the respondents were moderately aware regarding adulteration of food.

3.) Food adulteration problem faced

The result depicted that little less than half of the respondents have sometimes or other faced problem of adulterated food, one-fifth of the respondents have never come across adulterated food or may be they were not aware about adulterated food.

4.) Preference of brand

When the distribution of the respondents with respect to their use of brands while purchasing spices was done, the result showed that 40% respondents used Ramdev brand, where as one sixth of the respondents used Gaytri and Parth brand. Very few of them used Everest, Balaji and Badshah brand of food items selected for the present stud

5.) Shop used

The result revealed that the most popular type of shop used by the respondents under study for of the above test, null hypothesis was accepted or spices and flour was a general kiryana store where as only 5% of the respondents purchased spices from small scale industries

6.) Purchase frequency

With respect to purchase frequency, the facts discovered through survey revealed that half of the respondents purchased singoda flour, moriya flour and bajara flour on monthly basis. More then half of the respondents purchased whole wheat and rice yearly, while very few respondents purchased flours and spices weekly or fortnightly **Conclusion:-**

Form the present study it could be concluded that low income group respondents were least educated, had low awareness about their rights and responsibilities and food adulteration. So this group needs to be armed with lot of information and training on the issues of food adulteration and ways to raise their voice when felt cheated. They had limited income, so they could not reach the standard items of their choice. On seeing such condition of consumer, our government has made sincere efforts to curb the fraudulent practices by enactment of various laws. It is highly unlikely that more legislation or increasing fines and jail terms alone will help reduce adulteration, particularly given the corruption that exists in the enforcement area and the low conviction rate. Greater consumer vigilance and action alone can help improve the situation. But such efforts are not fruitful

unless consumers themselves are aware of their rights and responsibilities. Under these circumstances, consumer literacy is the need of the hour with special attention to low income groups who suffer the most.

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