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DEPARTMENT OF CHEMISTRY
Topic

“ANALYSIS OF FOOD ADULTERANTS FROM DIFFERENT
DEPARTMENTAL & LOCAL GROCERY STORES BY
QUALITATIVE TECHNIQUES FOR FOOD SAFETY”

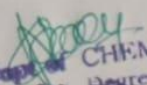
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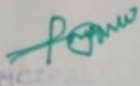
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“ANALYSIS OF FOOD ADULTERANTS FROM DIFFERENT DEPARTMENTAL & LOCAL GROCERY STORES BY QUALITATIVE TECHNIQUES FOR FOOD SAFETY”



STOP ADULTERATION NOW



INTRODUCTION:

Food is any substance, composed of carbohydrates, water, fats and proteins, which can be eaten or drunk by animals, including humans, for nutrition or pleasure.(1) By other words food is one of the basic needs for every living being and very important aspect for life. Many plants or plant parts are eaten as food. There are around 2,000 plant species which are cultivated for food, and many have several distinct cultivars. Almost all foods are of plant or animal origin. Cereal grain is a staple food that provides more food energy worldwide than any other type of crop.(2) Maize, wheat, and rice together account for 87% of all grain production worldwide.(3) Animals are also used as food either directly or indirectly by the products they produce. Meat is an example of a direct product taken from an animal, which comes from either muscle systems or from organs. Food products produced by animals include milk produced by mammary glands, which in many cultures is drunk or processed into dairy products such as cheese or butter. In addition, birds and other animals lay eggs, which are often eaten, and bees produce honey, reduced nectar from flowers, which is a popular sweetener in many cultures.(4) Food can be contaminated by different adulterants. Adulterants are chemical substances which should not be contained within other substances (e.g. food, beverages, fuels for legal or other reasons). The addition of adulterants is called adulteration. (5) It is also a substance which also reduces the vital importance of food and causes some toxic effect to the human body. Adulterants when used in illicit drugs are called cutting agents, while deliberate addition of toxic adulterants to food or other products for human consumption is known as poisoning. (6) Adulteration in food is normally present in its most crude form. Adulterants may be intentionally added to more expensive substances to increase visible quantities and reduce manufacturing costs, or for some other deceptive or malicious purpose. Adulterants may also be accidentally or unknowingly introduced into substances. 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. This ultimately results that the consumer is either cheated or often become victim of diseases. Such types of adulteration are quite common in developing countries or backward countries. Some of the common adulterants are mineral oils, argemone oils, castor oils in edible oils; vanaspathi, mashed potato in ghee; invert sugar or jiggery in honey, kesari dal, lead chromate in pulses etc. which can leads to Epidemic dropsy,

Glaucoma, Cardiac arrest, Lathyrism (crippling spastic paraplegia), Anemia, abortion, paralysis, brain damage, cancer etc.

During the last fifty years there has been a lot of emphasis on the quality and safety of the food products, of the production processes and the relationship between the two [1]. These requirements call for on line detection techniques which have the following advantages: (i) can be assembled in the production line and take place under realistic environment, (ii) early detection of possible failures, (iii) permanent monitoring of the conditions, (iv) assessment of conditions at any desire time [2]. These advantages enable detection of quality changes of raw materials and final product under steady process conditions compared to other non-destructive techniques.

OBJECTIVE:

The Objective of this project is to study some of the common food adulterants present in different food stuffs.

Adulteration in food is normally present in its most crude form; prohibited substances are either added or partly or wholly substituted. 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. This ultimately results that the consumer is either cheated or often become victim of diseases. Such types of adulteration are quite common in developing countries or backward countries. It is equally important for the consumer to know the common adulterants and their effect on health.

The increasing number of food producers and the outstanding amount of import foodstuffs enables the producers to mislead and cheat consumers. To differentiate those who take advantage of legal rules from the ones who commit food adulteration is very difficult. The consciousness of consumers would be crucial. Ignorance and unfair market behavior may endanger consumer health and misleading can lead to poisoning. So we need simple screening, tests for their detection. In the past few decades, adulteration of food has become one of the serious problems. Consumption of adulterated food causes serious diseases like cancer, diarrhea, asthma, ulcers, etc. Majority of fats, oils and butter

are paraffin wax, castor oil and hydrocarbons. Red chilli powder is mixed with brick powder and pepper is mixed with dried papaya seeds. These adulterants can be easily identified by simple chemical tests.

Several agencies have been set up by the Government of India to remove adulterants from food stuffs. Selection of wholesome and non-adulterated food is essential for daily life to make sure that such foods do not cause any health hazard. It is not possible to ensure wholesome food only on visual examination when the toxic contaminants are present in ppm level. 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. The consumer should avoid taking food from an unhygienic place and food being prepared under unhygienic conditions. 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.

SOME ADULTERANTS IN COMMON FOOD:

Majority of adulterants used by the shopkeepers are cheap substitutes easily available. For example, adulterants in fats, oils and butter are paraffin wax, castor oil and hydrocarbons. Red chili powder is mixed with brick powder, turmeric powder is mixed with yellow lead salts and pepper is mixed with dried papaya seeds. Similarly sugar is contaminated with washing soda and other insoluble substances, milk is adulterated with starch, argemone oil is used to adulterate mustard oil, vanaspati ghee is mixed with deshi ghee, beson is mixed with khesaridal etc. These type of adulterants makes a food stuff inferior.

IMPACT OF ADULTERANTS:

Every day we hear and watch live on television sets how the food items are being adulterated and this spurious, unhygienic and harmful food is entering our houses. We have seen how milk and milk products are being made from urea, soap and other harmful chemicals. We all know that vegetables are being given injections to make them grow faster and overnight. The other day we saw how steroids were being injected to chickens to make them into a hen in a very short span of time. We have also come across evidence as to how the fruits are being ripened with the use of harmful chemicals.

Adulteration of food causes several health problems in humans. Some of the health hazards include stomach ache, body ache, anemia, paralysis, and increase in the incidence of tumors, pathological lesions in vital organs, abnormalities of skin and eyes. Hence food adulteration should be given great importance due to its effect in the health significance of the public. The people are suffering from heart disease, kidney failure, skin diseases, asthma and other chronic diseases. The people are hapless victims of this adulteration industry running in full swing and unchecked.

DIFFERENT CHEMICAL TESTS FOR DETECTION OF ADULTERANTS:

Food adulteration has now become a burning problem. The adulterants used are so similar to natural foodstuffs that it becomes very difficult for a common man to detect them.

A few simple tests can be done to detect adulterants found in common foodstuffs.

1. Metanil yellow in pulses:

Shake 5 g of the suspected pulses with 5 ml of water. Add a few drops of hydrochloric acid. A pink colour shows the presence of metanil yellow.

2. Kesari Dal in Channa or Other Dals

Add 5 ml of normal hydrochloric acid to a small quantity of dal in a glass. Keep the glass in simmering water for 15 minutes. Development of pink colour indicates the presence of Kesari dal. By visual detection-shape of dal. The kesari dal is wedge shaped.

3. Water in milk:

Measure the specific gravity with a lactometer. The normal values will fall between 1.030 and

1.034. Milkmen are wise to the test and may dilute the milk only to the right density, so this is only a rough test.

4. Starches in milk:

Add a drop of iodine solution to a small quantity of milk. Milk containing starch turns blue.

Pure milk turns a coffee shade.

5. Vanaspati in pure ghee

Take about one teaspoonful of melted butter with an equal quantity of concentrated hydrochloric acid in a test tube. Add 2 or 3 drops of furfural solution. Shake it well for one minute and let it stand for five minutes. Appearance of pink colour in the lower layer of acid means that vanaspati is present in pure ghee/butter as an adulterant.

6. Argemone Oil in Mustard Oil:

Heat the mixture of oils with a little amount of nitric acid for two to three minutes. A red colour will appear if argemone is present

7. Chalk or any other dust or dirt in sugar:

Dissolve sugar in water, the impurities will settle down at the bottom. Etc.

DETECTION OF STARCH IN MILK:

Milk is a complex mixture and a liquid food, which can easily be adulterated. According to PFA-1954 (prevention of food adulteration act) definition, "Milk is the normal mammary secretion derived from complete milking of healthy milch animal without either addition thereto or extraction there from. There are many methods known for detection of adulteration in milk but the methods discussed below are simple but rapid and sensitive methods to detect adulteration. in Milk contains more than 100 substances that are either in solution, suspension or emulsion in water, the important being casein - the major protein of milk, lactose - milk sugar, whey and mineral salts.[1]

Milk is an almost ideal food. It has high nutritive value. It supplies body building proteins, bone forming minerals and health giving vitamins and furnishes energy giving lactose and milk fat. Besides, supplying certain essential fatty acids.

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. According to National Survey on Milk Adulteration conducted by FSSAI (India) in 2011, water is the most common adulterant followed by detergent in milk. A survey by FSSAI in 2012, 68% milk samples was found to be adulterated in which 31 % were from rural areas. Of these 16.7 % were packet or branded milk and rest were loose milk samples from dairies. In the urban areas, 68.9 % milk was found to be adulterated with water, detergent, urea and skim milk powder. Water is an adulterant in milk which is often always added to increase the volume of milk which in turn decreases the nutritive value of milk which if contaminated poses a health risk especially to infants and children. Detergents are added to emulsify and dissolve the oil in water giving a frothy solution, the characteristic white color of milk. Detergents cause gastro – intestinal complications. Urea is added to milk to provide whiteness, increase the consistency of milk and for leveling the contents of solid-not-fat (SNF) as are present in natural milk. The presence of urea in milk overburdens the kidneys as they have to filter out more urea content from the body.

Hydrogen Peroxide is also added to milk to prolong its freshness, but peroxides damages the gastrointestinal cells which can lead to gastritis and inflammation of the intestine.

Starch, cereal flours or arrowroot are added to make up the density of milk to prevent detection of added water. Starch is also used as an adulterant and if high amounts of starch are added to milk this can cause diarrhoea due to the effects of undigested starch in colon. Its accumulation in the body may prove very fatal for diabetic patients. Carbonates and bicarbonates are added to milk too, this can cause disruption in hormone signaling that regulate development and reproduction. Cane Sugar is added to raise the density to prevent detection of extraneous water.

Sodium chloride (common salt) is added to make up the density (lactometer reading) of watered milk. Like urea, ammonium sulphate is a chemical fertilizer, which is added to milk to raise the density

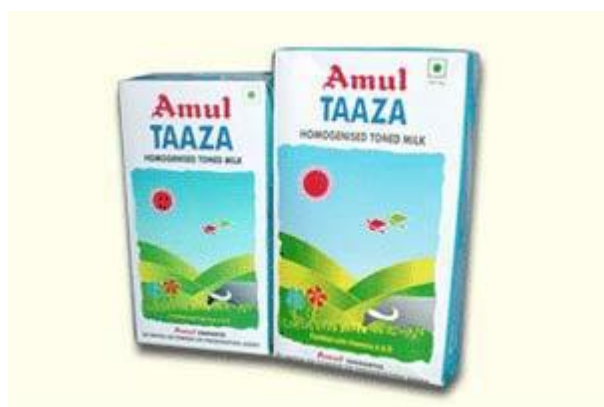
of watered milk. Neutralizers such as caustic soda, caustic potash sodium carbonate, sodium bicarbonate and lime water etc. are commonly added to milk to neutralize the developed acidity in milk. Some of these chemicals (neutralizers) are also ingredients of detergents which are major components of synthetic milk. Sodium and potassium nitrates are oxidizing agents and hence act as preservative. Pond water also contains appreciable quantities of nitrates and such water is usually admixed with milk by rural milk producers or vendors. [28]

Along with water, a very common adulterant of milk is starch. Milk consists of three basic components which are water (about 80%), fat (about 3.5%) and solids containing protein, lactose and mineral matters (about 8.5%). Milk is adulterated with starch to maintain the thickness of fat extracted milk or diluted milk. The presence of starch can be detected by adding iodine solution to milk.

Reagent used: Iodine solution or tincture of iodine.

Procedure: At first 5mL of milk sample is taken in a test tube and is boiled for 3-4 minutes. Then it is cooled and 1-2 drops of iodine solution is added to it and is shaken well.

Detection: Appearance of blue colour indicates the presence of starch in the sample.



Milk Samples

DETECTION OF YELLOW DYE IN TURMERIC POWDER:

Turmeric (haladhi) powder is a popular natural dye used in cooked food. The powder is often adulterated with rice powder, besan, wheat powder etc. which makes the colour of the turmeric pale. To

make the colour bright, often lead chromate, which is a poisonous chemical or coal tar dye is added to turmeric powder.

a) DETECTION OF LEAD CHROMATE:

Reagents: Concentrated HCL and 1% diphenyl carbazide in rectified spirit.

Procedure: 1g of the turmeric powder sample is taken in a test tube and 5ml of concentrated HCL is added to it. The mixture is shaken thoroughly. Now 1ml of 1% diphenyl crbazide reagent is added.

Detection: Appearance of pink to red colour indicates the presence of lead chromate, $PbCrO_4$, in the sample.

b) DETECTION OF COAL TAR DYE:

Reagents: Concentrated HCL and petroleum ether (40-600 C).

Procedure: 5g of the sample is taken in a test tube and 10mL petroleum ether is added to it. The mixture is shaken vigorously and is allowed to stand. 5 mL of conc.HCL is added and is again shaken thoroughly.

Detection: The aqueous acid becomes pink to red in colour if coal tar is present.



TURMERIC POWDER SAMPLES

DETECTION OF VANASPATI (VEGETABLE) GHEE IN DESHI GHEE (MILK PRODUCT):

Deshi ghee, which is a milk product is much costlier than vanaspati ghee. So, deshi ghee is often adulterated with vanaspati ghee. Vanaspati ghee contains sesame oil, which is not present in deshi ghee. Sesame oil reacts with the mixture of conc.HCL and furfural solution to produce rose red colour. This test is known as Baudoium test.

Reagent: Concentrated HCL and 2% solution of furfural in alcohol.

Procedure: 5mL of melted ghee sample is taken in a test tube.5mL of conc. HCL is added to it. Then 2-3 drops of 2% solution of furfural is added in alcohol. The mixture is shaken the mixture and is allowed to stand for about 10 minutes.

Detection: Appearance of rose red colour indicates the presence of vanaspati ghee in the ghee sample.

DETECTION OF ARGEMONE OIL IN MUSTARD OIL:

Argemone oil is a non-edible oil which is often used to adulterate vegetable oil or fat. Argemone oil can be easily detected by FeCl_3 solution test.

Reagent: Concentrated HCl, 10% FeCl_3 solution (dissolve 10g to anhydrous FeCl_3 in 10mL concentrated HCl and dilute to 100 mL with distilled water).

Procedure: In a test tube, 5mL of the mustard oil sample is taken and 2mL of conc. HCl is added to it. Then it is shaken vigorously and is warmed in a little water bath for 5 minutes. It is shaken intermittently during warming. 1mL of 10% FeCl_3 solution is added and is mixed it by rotating the test tube between the palms. The mixture is heated in a boiling water bath for about 10 minutes.

Detection: Reddish brown needle like crystals appear at the junction of the acid and oil, if argemone oil is present.



Oil Sample

DETECTION OF WASHING SODA, CHALK POWDER AND WATER INSOLUBLE SUBSTANCE IN SUGAR:

Chalk powder is a water insoluble substance which is often used as a common adulterant in sugar. Moreover sugar is usually contaminated with washing soda.

a) Detection of various insoluble substances:

Reagent: concentrated H_2SO_4 , alcoholic solution of α -naphthol, dil. HCl.

Procedure: A small amount of sugar is taken in a test tube and is shaken it with little water. Pure sugar dissolves in water but insoluble impurities do not dissolve.

Detection: Insoluble substances appear at the bottom of the test tube if they are present.

b) Detection of chalk powder, washing soda:

Reagent: dil. HCl

Procedure: To a small amount of sugar taken in a test tube, a few drops of dil. HCl is added and observed.

Detection: Brisk effervescence of CO_2 shows the presence of chalk powder or washing soda in the given sample of sugar.



Sugar Sample

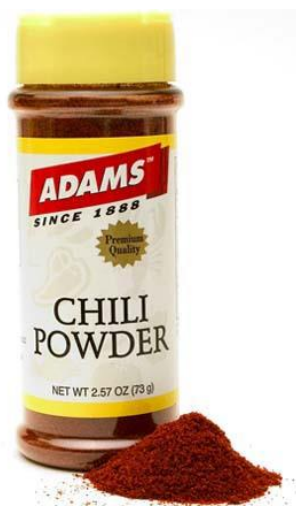
DETECTION OF RED COLOURED LEAD SALTS IN CHILLI POWDER:

Chilli powder often adulterated with red colored lead salts n brick powders.

Reagents: dil. HNO_3 , KI

Procedure: To a sample of chilli powder dil. HNO_3 is added. The solution is filtered and a few drops of potassium iodide solution is added to the filtrate.

Detection: Yellow ppt. indicates the presence of lead salts in chilli powder and insoluble substances indicates the presence of brick powder in the sample.



DETECTION OF KHESARI DAL IN BESON:

Beson powder is usually adulterated with khesari dal which contains butyloxalylalanine amine (BOAA) which causes lethargy and ultimate paralysis in lower limbs of human body on regular consumption. The detection of BOAA in beson powder indicates adulteration of it with khesari dal.

Reagents: dil. HCl

Procedure: To 1g of the beson sample is taken in a test tube and 10 mL of 70% HCl is added to it. The content is boiled for some time.

Detection: Development of pinkish colour indicates adulteration of bason with khesari dal.

Adulteration In Food Stuff And Its Harmful Effects:

FOOD ARTICLE	ADULTERANT	HARMFUL EFFECTS
Bengal Gram dhal & Thoor Dhal	Kesai dhal	lahyrism cancer
Tea	Used tea leaves processed and coloured	Liver Disorder
Coffee Powder	Tamarind seed, date seed powder	Diarrhoea
	Chicory powder	Stomach disorder, Giddiness and joint pain
Milk	Unhygenic water & Starch	Stomach disorder
Khoa	Starch & Less Fat content	Less - nutritive value
Wheat and other food grains (Bajra)	Ergot (a fungus containing poisonous substance)	Poisonous
Sugar	Chalk powder	Stomach - Disorder
Black powder	Papaya Seeds and light berrys	Stomach, liver problems
Mustard powder	Argemone seeds	Epidemic dropsy & Glucoma
Edible oils	Argemone oil	Loss of eyesight, heart diseases, tumour
	Mineral oil	Damage to liver,carcinogenic effects
	Karanja oil	Heart problems, liver damage
	Castor oil	Stomach problem
Asafoetida	Foreign resins galbanum, colophony resin	dysentery
Turmeric powder	Yellow aniline dyes	Carcinogenic
	Non-permitted colourants like metanil yellow	Highly Carcinogenic
	Tapioca starch	Stomach disorder
Chilli powder	Brick powder, saw dust	Stomach problems
	Artificial Colours	Cancer

Sweets, Juices, Jam	Non-permitted coaltar dye, (Metanil Yellow)	Metanil yellow is toxic and carcinogenic
Jaggery	Washing soda, chalk powder	vomiting, diarrhoea
Pulses (Green peas and dhal)	coaltar dye	stomach pain, ulcer
Suapari	colour and saccharin	cancer
Honey	Molasses sugar (sugar plus water)	Stomach disorder
Carbonator water beverages	Aluminium leaves	Stomach Disorder
Cloves	Cloves from which volatile oil has been extracted	cheating waste of money

Prevention:

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 the 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 infestations. 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 in a particular restaurant or food ingredients bought from a particular retailer. We should also create awareness in the local community on the ill effects of food adulteration so that when it happens the public knows when to seek help.

We need to remember that contamination could happen in very small amounts over a period of time and it might be impossible to detect or too late to intervene. So it is prudent that every one of us takes special interest in this subject and educate our families, friends and colleagues about this menace.

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