Lecture-5; MPH-5161

Topic: Food Adulteration

What is food adulteration?

◆Food adulteration can be defined as the contamination or adulteration of food or food materials by adding harmful substances to it.

♦Food adulteration takes place when intentionally or unintentionally substances that degrade the quality of food are added to it.

•one of the man-made hazards is the adulteration of food. When food is contaminated with external sources or when its natural composition or quality is changed, it is adulterated.

•Food adulteration has serious effects on our health.

•Despite various measures taken by the government, spreading awareness about the hazards of food adulteration is a prevalent practice in many countries.

•Various methods of food adulteration is deployed by the food industries using various chemical and synthetic substances.

•Despite various actions and penalties, the practice of adding adulterant is quite common in developing countries.



Some common examples of food adulteration include:

- Usage of high doses of preservatives like formalin to make the food item look colorful and attractive
- Using chemical like carbide to rapidly ripen fruits and vegetables

• Replacing oil with petrol or diesel to fry food items to make them crispier

Other examples of adulteration include:

- Milk could be found adulterated by adding water or by removing the cream or by adding artificial coloring agents like caramel, coal tar colors and preservatives like formaldehyde, boric acids etc.
- Meat & Eggs could be found adulterated by adding preservatives like potassium nitrate, boric & other acids etc. Coloring matter like Aniline red and cochineal-carmine is usually added colors.
- In Vegetable, **malachite green** is used for bright glowing green color which may be carcinogenic for humans.
- Starch being added to give rich texture to paneer & condensed milk and could cause stomach disorders.
- Pepper oil is added to ice cream which could cause Kidney, lung, and heart diseases.
- Coffee Powder is adulterated through Tamarind seeds. Chicory powder being used as coloring agent & to add weight.
- Injectable dyes in watermelon, peas, capsicum, brinjal, papaya seeds.
- Sudan dyes which are meant to be used for coloring plastics and synthetic materials, are rather being used as coloring agents in food like red chili and other products. Sudan dyes have been identified as carcinogenic for human and can lead to severe health hazards.

What do we mean by Adulterants?

The substances that lower the quality of food, when added to it, are called adulterants.

Addition of these adulterants reduces the value of **nutrients** in food and also contaminates the food, which is not fit for consumption.

The adulterant may be present in any form and in any quantity.

Adulterants are mostly harmful. Some adulterants are also identified as carcinogenic or lethal when exposed to them for a longer period. Different types of adulterants are used to adulterate different types of food.

These adulterants can be available in all food products which we consume daily, including dairy products, cereals, pulses, grains, meat, vegetables, fruits, oils, beverages, etc.



Table. Below is a list of a few adulterants added to the food products along with their harmful effects.

| Food Products | Adulterant | Harmful Effects |
|-------------------------------|---|---|
| Milk and Curd | Water and starch powder. | Stomach disorders. |
| Ghee, Cheese and Butter | Mashed potatoes, Vanaspati and starch powder. | Gastro-intestinal disturbances and other stomach disorders. |
| Grains | Dust, Pebbles, Stones, Straw, weed seeds, damaged grain, etc. | Liver disorders, Toxicity in the body, etc. |
| Pulses | Dyes, chemical and Lead Chromate. | Stomach disorders. |
| Coffee powder | Chicory, tamarind seeds powder. | Diarrhoea. |
| Теа | Artificial colouring agents. | Liver disorders. |
| Sugar | Chalk powder, Washing soda, Urea, etc. | Stomach disorders and kidney failure. |

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| Pepper | Dried papaya seeds and blackberries. | Severe allergic reactions including stomach and skin irritations. |
| Mustard seeds | Argemone seeds. | Abdominal contractions, sluggishness and increased excretion. |
| Edible Oils | Mineral oil, Karanja oil, castor oil and artificial colours. | Gallbladder cancer, allergies, paralysis, cardiac arrest, and increased LDL cholesterol. |
| Turmeric Powder | Pesticide residues, sawdust, chalk dust, industrial dyes, metanil yellow dye arsenic, lead metal etc. | Cancer and Stomach disorders. |
| Chilli and Coriander powder | Redbrick powder, Rhodamine B dye, Red lead, dung powder, soluble salts, water-soluble synthetic colours and other common salts. | Metal toxicity, Cancer, lead poisoning, tumour, variations in blood pressure and other stomach related disorders. |
| Cinnamon sticks | Cassia bark. | Liver Damage, Low Blood Sugar, Mouth Sores and increased risk of cancer. |
| Cumin seeds | Coloured grass seeds, sawdust and charcoal dust | Stomach disorders. |
| Jam, Juice and Candies | Non-permitted dyes including metanil yellow and other artificial food dyes. | These dyes are highly carcinogenic that have the potential to cause different types of cancer. |
| Jaggery | Washing soda, chalk powder | Vomiting and other Stomach disorders |
| Honey | Molasses, dextrose, sugar and corn syrups | Stomach disorders |
| Fruits and Vegetables | Chemical dyes, Malachite green, calcium carbide, copper sulphate and oxytocin saccharin wax. | Stomach disorders, vomiting, and dyes used are highly carcinogenic. |
| Tomato sauces | Pumpkin pulp, non-edible artificial colors and flavors. | Gastritis and inflammation of vital organs. |

| Ice Cream | Pepper oil, ethyl acetate, butyraldehyde, nitrate, washing powder. | Dreadful diseases that affect organs including lungs, kidneys, and heart. |
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When is Food Considered Adulterated?

There are some conditions that are required to conclude whether a food is adulterated or not. These points are summarized below.

- A substance that degrades the quality of food or turns it hazardous is added to it.
- Cheaper or low-quality substances are used as a substitute for whole or a few ingredients.
- A constituent of food is partly or wholly taken out, reducing the quality of food.
- It's made presentable with harmful substances. or its color is changed to make it look better.
- Anything that depreciates the quality of food is added to or abstracted from it.

Why is Food Adulteration done?

For many years, food adulteration is done by food manufacturers and industries for various reasons.

1.Food adulteration is practiced as a part of a business strategy to gain more profit by cheaper means. Example, adding water to milk to increase its quantity and gain more profit from less volume of milk.

2.It is also done to make the food presentable and as an imitation of some other food which is more in demand.

3. Food adulteration is many times done by those who do not have a proper understanding of its hazards. Due to a lack of awareness and proper knowledge, it is still widely practiced.

4.Adulteration increases the weight of the food, helps gain more profit, and increases sales in cheaper ways.

5. The increasing rate of the population also plays a major role in food adulteration.

6. The inefficiency of government initiatives to control it.

Types of Food Adulteration

There are four different types of food adulteration.

- Intentional Adulteration: When substances that look similar to the constituents of the food are added to it, to increase its weight and gain more profit. Examplemixing of stones, marbles, sand, mud, chalk powder in various foods and contaminated water in drinks/juices etc.
- **Incidental Adulteration:** Incidental adulteration occurs due to negligence while handling food. Like residues of pesticides in grains, larvae growth, presence of droppings of rodents, etc.
- **Metallic Adulteration:** The addition of metallic materials into food like lead or mercury is metallic adulteration. It may happen accidentally or even intentionally.
- **Packaging Hazard:** The packing materials in which the food is packed may also interfere and mix with the constituents of the food, leading to packaging hazards.

Methods of Food Adulteration

Various food adulteration methods are as follows: -

- **Mixing:** Mixing of sand, dust, clay, mud, and stones with food particles.
- **Substituting:** Some healthy constituents are replaced by cheaper and lowquality ones, which alter the nutritional values of the food and may even impose a health hazard.
- Using Decomposed Food: This method indicates mixing decomposed food with healthy ones. Food that even conceals damage or inferiority of any manner is also considered to be adulterated. Also, the deliberate mixing of healthy food with questionable quality food leads to the final product being adulterated.
- Additions of Toxic Substances: Food adulteration also involves the mixing of food with toxic substances to gain higher profit and increase sales. For example, addition of color, dyes, or harmful unpermitted preservatives.
- **Misbranding:** Altering the manufacturing dates, expiry dates, list of ingredients or misleading ingredient derivatives, and so on.
- Artificial Ripening: Adding chemicals to the fruits and vegetables which speed up the process of ripening in them, is also considered food adulteration. For example, mango is ripened with carbide for meeting the commercial demand against supply.

Effects of Food Adulteration on Human Health

Food adulteration has a great impact on our health. Be it any kind of adulteration, prolonged consumption of this type of food is very harmful to the body. Consuming such food increases the toxicity in the body. As the nutritional value of the adulterated food goes down, such food is no longer nutritive for the body. The addition of chemical adulterants and colors many times proves to be fatal. as they pose an onset of health risks and also carcinogens. Some adulterated food may also affect our internal organs directly leading to heart, kidney, liver, and many more organ disorders and failure.

Some health hazards associated with specific food adulteration incudes;

- Mineral oil if added to edible oil and fats can cause cancers.
- Lead chromate when added to turmeric powder and spices can cause anemia, paralysis, brain damage and abortions.
- Lead containing water use in natural and processed food can lead to lead poisoning, foot drop, insomnia, constipation, anemia, and mental retardation.
- Cobalt containing water use in drinking water and liquors and can cause cardiac damage also copper, tin, and zinc can cause colic, vomiting and diarrhea.
- Mercury in mercury fungicide treated grains, or mercury-contaminated fish can cause brain damage, paralysis, and death.
- Non-permitted color or permitted food color like metal yellow, beyond the safe limit in colored food can cause allergies, hyperactivity, liver damage, infertility, anemia, cancer and birth defects.



How to Detect Food Adulteration

Food adulteration has many harmful effects on our health. Prolonged consumption of adulterated food may even prove to be lethal. Therefore, it is important to detect if the food is adulterated. Various home methods can be used to do this. **For example-**

Detection of Common adulterants in food:

1. Detection from Milk:

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.

- Common Types of Adulterants in milk
- Neutralizers
- Starch
- Formalin
- Glucose
- Cane sugar
- > Urea
- Water

Detection of Neutralizers in Milk



- Take 5 ml of milk in a test tube & add 5 ml alcohol followed by 4-5 drops of rosalic acid.
- If the color of milk changes to pinkish red, then it is inferred that the milk is adulterated with sodium carbonate / sodium bicarbonate and hence unfit for human consumption.

Detection of Formalin in Milk

- Take 10 ml of milk in test tube
- Add 5 ml of conc. sulphuric acid on the sides of the test tube with out shaking.
- If a violet or blue ring appears at the intersection of the two layers, then it shows the presence of formalin.



Test for Detection of Urea

- i. Five ml of milk is mixed well with 5 ml Para dimethyl amino benzaldehyde (16%). If the solution turns yellow in color, then the given sample of milk is added with urea.
- ii. Take 5 ml of milk in a test tube Add 0.2 ml of urease (20 mg / ml). Shake well at room temperature Then add 0.1 ml of bromothymol blue solution (0.5%) Appearance of blue color after 10-15 min indicates the adulteration milk with urea

Test: Detection of detergent in milk

- Take 5 to 10ml of sample with an equal amount of water.
- Shake the contents thoroughly.
- If milk is adulterated with detergent, it forms dense lather.
- Pure milk will form very thin foam layer due to agitation.



Detection from sweeting agent like Sugar

o i. Chalk powder:

- Dissolve 10 gm of sample in a glass of water, allow settling, Chalk will settle down at the bottom.
- o ii. Urea:
- o On dissolving in water it gives a smell of ammonia.

Test: Detection of sugar solution in honey

- Take a transparent glass of water.
- Add a drop of honey to the glass.
- Pure honey will not disperse in water.
- If the drop of honey disperses in water, it indicates the presence of added sugar



<u>Test: Detection of malachite green in green vegetables like bitter ground, green chili and others.</u>

- Take a cotton piece soaked in water or vegetable oil. (Conduct the test separately).
- Rub the outer green surface of a small part of green vegetable/chili.
- If the cotton turns green, then it is adulterated with malachite green.



Similarly, we can check Rhodamine-B adulterate sweet potato.



Test: Detection of artificial/water soluble synthetic colors in chili powder

- Sprinkle chili powder on the surface of water taken in a glass tumbler.
- The artificial colorants will immediately start descending in color streaks.



Test: Detection of iron filings in tea leaves

- Take small quantity of tea leaves in a glass plate.
- Move the magnet through the tea leaves.
- Pure tea leaves will not show any iron filings on the magnet.
- If adulterated, then iron filings will be seen on the magnet.



Test: Detection of clay in coffee powder

- Add ¹/₂ teaspoon of coffee powder in a transparent glass of water.
- Stir for a minute and keep it aside for 5 minutes. Observe the glass at the bottom.
- Pure coffee powder will not leave any clay particles at the bottom.
- If coffee powder is adulterated, clay particles will settle at the bottom.



How can Adulteration be Prevented?

Every year, the 7th of April is celebrated as the *World Health Day* globally and as per the reports, WHO aims to bring a general awareness about the adulterations of food products, motivate and inspire everybody to have a healthy, balanced diet.

Here are certain safety tips to avoid Adulteration

- 1. Avoid dark colored, junk and other processed foods.
- 2. Make sure to clean and store all the grains, pulses and other food products.
- 3. Wash fruits and vegetables thoroughly in running water before they are used.
- 4. Check if the seal is valid or not, before buying food products like milk, oil and other pouches.
- 5. Always make sure to check and buy products having an FSSAI-validated label, along with the license number, list of ingredients, manufactured date, and its expiration.
- 6. On the industry level, food adulteration can only be checked with strict and stringent laws and government interventions and checks.

MITIGATION MEASURES FOR ADDRESSING FOOD ADULTERATION:

- There must be proper surveillance of the implementation food laws.
- There should be monitoring of the activities with periodical records of hazards regarding food adulteration.
- There should be periodical training programs for Senior Officer/Inspector/Analysts for food safety
- There should be consumer awareness programs organized by holding exhibitions/seminars/training programs and publishing pamphlets.
- There should be strict actions regarding the punishment for those who are involved in food adulteration.
- There should be help and support from International INGOs for implementation of food laws.