

## **Food adulteration and its detection**

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### **1. Food adulteration**

Adulteration of food commonly defined as “the addition or deletion of any substance to or from food, so that the natural composition and quality of food substance is affected. Adulteration is either intentional by either removing substances to food or altering the existing natural properties of food knowingly. Unintentional adulteration is usually attributed to ignorance, carelessness or lack of facilities for maintaining food quality.

Food Adulterants are the substances which are added to food items for economic and technical benefits but they reduce the value of nutrients in food and also causes the food contamination leads to unfit for consumption. Food adulterants could be available in dairy products, cereal products, meat & eggs, canned & bottled vegetables, fruits & fruit products fats & oils, beverages etc.

Food is declared adulterated if:

- A substance is added which depreciates or injuriously affects it.
- Cheaper or inferior substances are substituted wholly or in part.
- Any valuable or necessary constituent has been wholly or in part abstracted.
- It is an imitation.
- It is colored or otherwise treated, to improve its appearance or if it contains any added substance injurious to health.
- For whatever reasons its quality is below the Standard

Very often food is adulterated by merchants and traders who are dishonest and want to make a quick profit. But shortages and increasing prices, consumer demands for variety in foods, a lack of awareness, negligence, indifference and lethargy among consumers and inadequate enforcement of food laws and food safety measures also lead to food adulteration.

Some notable incidents of food adulteration are as follows

- In 1987, Beech-Nut paid \$2.2 million as fines for violating the Federal Food, Drug, and Cosmetic Act by selling artificially flavored sugar water as apple juice.
- In 1997, ConAgra Foods pled guilty to federal criminal charges that one of its units illegally sprayed water on stored grain to increase its weight and value.

- 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.
- 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.
- In 2012, a study in India conducted by the FSSAI (Food Safety Standards and Authority of India) across 33 states found that milk in India is adulterated with detergent, fat and even urea, as well diluted with water.

## 2. Types of Adulterants

Majority of adulterants used by the shopkeepers are cheap substitutes easily available. Classification of adulterants based on purpose

- I. **Intentional Adulterants:** Sand, marble chips, stones, mud, other filth, talc, chalk powder, water, mineral oil and harmful colour.
- II. **Incidental adulterants:** Pesticide residues, droppings of rodents, larvae in foods.
- III. **Metallic contaminants:** Arsenic from pesticides, lead from water, effluent from chemical industries, tin from cans.

Secondary classification of adulterants based on effects

**Poisonous or Deleterious Substances:** Generally, if a food contains a poisonous or deleterious substance that may render it injurious to health, it is adulterated. If a food contains a poisonous substance in excess of a tolerance, regulatory limit, or action level, mixing it with "clean" food to reduce the level of contamination is not allowed. The deliberate mixing of adulterated food with good food renders the finished product adulterated.

**Filth and Foreign Matter:** Filth and irrelevant material include any objectionable substances in foods, such as foreign matter (for example, glass, metal, plastic, wood, stones, sand, cigarette butts, etc), 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).

**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 is 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).

**Microbiological Contamination and Adulteration:** The fact that a food is contaminated with pathogens (harmful microorganisms such as bacteria, viruses, or protozoa) 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 will render those products adulterated.

### 3. Some common adulterants and health effects

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.

Let us discuss individual food products adulteration and their side effects

- **Milk**  
Adulterants: Cow/buffalo milk can be adulterated with starch, milk powder and urea  
Health effect: Cancer or acute renal failure
- **Tur dal, Turmeric powder, mixed spices, saffron**  
Adulterants: Metanil yellow, a non-permitted color is a common adulterant in food items like laddu, tur dal and turmeric.  
Health effect: tumor and cancer
- **Ghee**  
Adulterants: Ghee essence is used in vanaspati or cheaper oils and passed off as pure ghee.  
Health effect: Cancer or acute renal failure
- **Sugar and Salt**  
Adulterants: With chalk powder and white sand.  
Health effect: Stomach disorder
- **Tea powder**  
Adulterants : With used tea leaves, dye or artificial colour, iron fillings.  
Health effect: Cancer, tetanus
- **Chilli powder**  
Adulterants : Sudan red, Red brick powder, grit, sand, dirt, non-permitted colors and saw dust.  
Health effect : Stomach disorder, sudan dye is carcinogenic

- **Sweets**  
Adulterants : Metanil yellow  
Health effect :tumor and cancer
- **Mustard seeds and vegetable oil**  
Adulterants : Argemone seeds and argemone oil  
Health effect :Epidemic dropsy
- **Honey**  
Adulterants : Jaggery, Sugar, corn syrup  
Health effect : Obesity, Diabetes , Eyes and nerve damages
- **Few more common adulterants**
  - Asafoetida: Soap stone and other earthy matter is used for adulteration.
  - Cumin seeds: Grass seeds are camouflaged and colored with charcoal dust
  - Turmeric: Lead chromate is used to give turmeric its natural color. It is very harmful. (Causes anemia abortion , paralysis, brain damage)
  - Coriander powder: With dung powder.
  - Fruits: Arsenic sprayed (causes dizziness, chills, cramps, paralysis, death)

#### **4. Need for the detection of food adulteration**

Normally the adulteration in food is done either for financial gain or due to carelessness and lack of 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. 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. Overall, ignorance and unfair market behavior may endanger consumer health and misleading can lead to poisoning. So we need simple screening tests for their detection.

#### **5. Some common food adulteration detection tests**

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.

## **Methods for Detection of common adulterants in milk**

**Food:** Milk

**Adulterant:** Starch

**Method for detection:** Add a few drops of iodine solution. Formation of blue colour indicates the presence of starch.

**Food:** Milk

**Adulterant:** Urea

**Method for detection:** Take a teaspoon of milk in a test tube. Add ½ teaspoon of soybean or Pigeon pea powder. Mix up the contents thoroughly by shaking the test tube. After 5 minutes, dip a red litmus paper in it. Remove the paper after ½ a minute. A change in colour from red to blue indicates the presence of urea in the milk.

**Food:** Milk

**Adulterant:** Vanaspati

**Method for detection:** Take 3 ml of milk in a test tube. Add 10 drops of hydrochloric acid. Mix up one teaspoonful of sugar. After 5 minutes, examine the mixture. The red colouration indicates the presence of vanaspati in the milk.

**Food:** Milk

**Adulterant:** Formalin

**Method for detection:** Take 10 ml of milk in a test tube and add 5 ml of concentrated sulphuric acid from the sides of the wall without shaking. If a violet or blue ring appears at the intersection of two layers then it shows presence of formalin.

**Food:** Milk

**Adulterant:** Detergent

**Method for detection:** Shake 5-10 ml of sample with an equal amount of water, formation of foam indicates the presence of detergent.

**Food:** Milk

**Adulterant:** Synthetic milk

**Method for detection:** Synthetic milk has a bitter after taste, gives a soapy feeling on rubbing between the fingers and turns yellowish on heating.

## **Methods for Detection of common adulterants in milk based products**

**Food:** Sweet Curd

**Adulterant:** Vanaspati

**Method for detection:** Take 1 teaspoon full of curd in a test tube. Add 10 drops of hydrochloric acid. Mix up the contents shaking the test tube gently. After 5 minutes, examine the mixture. The red colouration indicates the presence of vanaspati in the curd.

**Food:** Khoa and its products

**Adulterant:** Starch

**Method for detection:** Boil a small quantity of sample with some water, cool and add a few drops of Iodine solution. Formation of blue colour indicates the presence of starch.

**Food:** Paneer

**Adulterant:** Starch

**Method for detection:** Boil a small quantity of sample with some water, cool and add a few drops of Iodine solution. Formation of blue colour indicates the presence of starch.

### **Methods for Detection of common adulterants in oils and fats**

**Food:** Ghee

**Adulterant:** Vanaspati or Margarine

**Method for detection:** Take about one tea spoon full of melted sample of Ghee with equal quantity of concentrated Hydrochloric acid in a stoppered test tube and add a pinch of sugar. Shake for a minute and let it for five minutes. Appearance of crimson colour confirms the presence of Vanaspati or Margarine.

**Food:** Edible oil

**Adulterant:** Prohibited color

**Method for detection:** Take 5 ml of sample in a test tube and add 5 ml of concentrated hydrochloric acid. Shake gently, let it stand for 5 minutes. Colour will separate in the upper layer of the solution.

**Food:** Coconut oil

**Adulterant:** Any other oil

**Method for detection:** Place a small bottle of oil in refrigerator. Coconut oil solidifies leaving the adulterant as a Separate layer.

### **Methods for Detection of common adulterants in sweetening agents**

**Food:** Sugar

**Adulterant:** Chalk powder

**Method for detection:** Dissolve 10 gm of sugar sample in a glass of water, allow settling, Chalk will settle down at the bottom.

**Food:** Honey

**Adulterant:** Sugar solution (especially water)

**Method for detection:** A cotton wick dipped in pure honey when lighted with a match stick burns and shows the purity of honey. If adulterated, the presence of water will not allow the honey to burn, If it does; it will produce a cracking sound.

**Food:** Jaggery

**Adulterant:** Washing soda

**Method for detection:** Add a few drops of solution hydrochloric acid. Effervesence shows presence of washing soda.

**Food:** Ice-cream and beverages

**Adulterant:** Metanil yellow (a non- permitted coal tar colour)

**Method for detection:** Extract colour with luke-warm water from food articles. Add few drops of concentrated Hydrochloric acid. If magenta red colour develops the presence of metanil yellow is indicated.

### **Methods for Detection of common adulterants in food grains and their products**

**Food:** Wheat, Rice, Maize, Jawar, Bajra, chana, Barley etc.

**Adulterant:** Dust, pebble, stone, straw, weed seeds, damaged grain, weevilled grain, insects, rodent hair and excreta

**Method for detection:** These may be examined visually to see foreign matter, damaged grains, discoloured grains, insect, rodent contamination etc. Damaged / discoloured grains should be as low as possible since they may be affected by fungal toxins, Dhatura seeds etc. In moderately excessive amount can result in risk to health, Discard the damaged undesirable grains before use.

**Food:** Maida/Rice

**Adulterant:** Boric Acid

**Method for detection:** Take a small amount of sample in a test tube, add some water and shake. Add a few drops of HCl. Dip a turmeric paper strip, if it turns red, boric acid is present.

**Food:** Wheat, bajra and other grains

**Adulterant:** Dhatura

**Method for detection:** Dhatura seeds are flat with edges with blackish brown colour which can be separated out by close examination.

**Food:** Besan/gram powder

**Adulterant:** Metanil yellow

**Method for detection:** Take ½ teaspoon of the besan in a test tube. Pour 3 ml of alcohol in the test tube. Mix up the contents thoroughly by shaking the test tube. Add 10 drops of hydrochloric acid. A pink colouration indicates presence of metanil yellow in the gram powder.

**Food:** Pulses

**Adulterant:** Lead chromate

**Method for detection:** Shake 5 gm of pulse with 5 ml of water and add a few drops of HCl. Pink colour indicates Lead Chromate.

**Food:** Black pepper

**Adulterant:** Papaya seeds

**Method for detection:** Papaya seeds can be separated out from pepper as they are shrunken, oval in shape and greenish brown or brownish black in colour.

**Food:** Turmeric powder

**Adulterant:** Colored saw dust

**Method for detection:** Take a tea spoon full of turmeric powder in a test tube. Add a few drops of concentrated Hydrochloric acid. Instant appearance of pink colour which disappears on dilution with water shows the presence of turmeric. If the colour persists, metanil yellow (an artificial colour) or a not permitted coal tar colour is present.

**Food:** Chili powder

**Adulterant:** Brick powder, salt powder or talc powder

**Method for detection:** To a little powder of chilli add small amount of conc HCl and mix to the consistency of paste, dip the rear end of the match stick into the paste and hold over the flame, brick red flame colour due to the presence of calcium salts in brick powder.

**Food:** Green chilli and other green vegetables

**Adulterant:** Malachite green

**Method for detection:** Take a cotton piece soaked in liquid paraffin and rub the outer green surface of a small part of green vegetable. If the cotton turns green, we can say the vegetable is adulterated with malachite green.

### **Methods for Detection of common adulterants in miscellaneous products**

**Food:** Saffron

**Adulterant:** Dried tendrils of maize cobs

**Method for detection:** Genuine saffron will not break easily like artificial. Artificial saffron is prepared by soaking maize cob in sugar and colouring it with coal tar colour. The colour dissolves in water if artificially coloured. A bit of pure saffron when allowed to dissolve in water will continue to give its saffron colour so long as it lasts.

**Food:** Common salt

**Adulterant:** White powdered

**Method for detection:** Stir a spoonful of sample of salt in a glass of water. The presence of chalk will make solution white and other insoluble impurities will settle down.

**Food:** Iodinated salt

**Adulterant:** Common salt

**Method for detection:** Cut a piece of potato, add salt and wait a minute and add two drops of lemon juice. If iodinated salt blue colour will develop. In case of common salt, there will be no blue colour.

**Food:** Tea leaves



**Adulterant:** Exhausted tea

**Method for detection:** Spread a little slaked lime on white porcelain tile or glass plate; sprinkle a little tea dust on the lime. Red, orange or other shades of colour spreading on the lime will show the presence of coal tar colour. In case of genuine tea, there will be only a slight greenish yellow colour due to chlorophyll, which appear after some time.

**Food:** Vinegar

**Adulterant:** Mineral acid

**Method for detection:** Test with the Metanil yellow indicator paper, in case, the colour changes from yellow to pink, mineral acid is present

**Conclusion:** The increasing number of food producers and the outstanding amounts of imported food stuffs enables the producers to mislead and cheat consumers. Adulteration is commonly practiced in both branded and unbranded foods in our daily life. Majority of adulteration is intentional adulteration and it affects the people of all the age group. Even today many people are unaware about adulteration and its harmful effects.