Food Adulteration , contaminants and detection

Introduction;

Adulterated food is impure, unsafe and it is a legal term meaning that a food product fails to meet federal or state standards. If any inferior or cheaper substance has been substituted wholly or some part. Which may result in the loss of actual quality of food item.

These are the some of the common adulterants used in food items for various reasons. In the United States, the Food and Drug Administration (FDA), regulates and enforces laws on food safety and has technical definitions of adulterated food in various United States laws.

Dear Students, in to-day's lecture, we will discuss about "Food Adulteration , contaminants, and detection"

1: Common food adulterants and detection

2: Chemical Contaminant

3: Fungal contaminant

4: Natural Contaminant

5: Environmental contaminants

1: Common food adulterants and detection

Food adulteration is defined as 'the intentional addition of non-permitted foreign matter'to get profit and increase the weight of the products , to give better colour ect..

1:Milk - starch is added

Test:Add a few drops of tincture of Iodine or Iodine solution. Formation of blue colour indicates the presence of starch. Iodine solution is easily available in the medical stores

2:Butter, Vanaspati or Margarine is added

Test: Take about one teaspoon full of melted sample of butter with equal quantity of concentrated Hydrochloric acid (HCL) in a stoppered test tube and a pinch of sugar. Shake for one minute and let it for five minutes. Appearance of crimson colour in lower (acid) of Vanaspati or Margarine.

The test is specific for sesame oil which is compulsorily added to Vanaspati and Margarine. Some coal tar colours also give a positive test. If the test is positive i.e. red colour develops only by adding strong Hydrochloric acid (without adding crystals of sugar) then the sample is adulterated with coal tar dye. If the crimson or red colour develops after adding and shaking with sugar, then alone Vanaspati or Margarine is present.

3: Black pepper, papaya seed is added

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

Diseases or Health Effects: Injurious to health

4:Cloves ,Volatile oil extracted (exhausted cloves)

Test: Exhausted cloves can be identified by its small size and shrunken appearance. The characteristic pungent of genuine cloves is less pronounced in exhausted cloves.

5:Mustard seed ,argemone seeds are added

Test: Mustard seeds have a smooth surface. The argemone seed have grainy and rough surface and are black in colour. It can be separated out by close examination. When Mustard seed is pressed inside it is yellow while for Argemone seed it is white.

Diseases or Health Effects: Epidemic dropsy,Glaucoma,Cardiac arrest.

6:Turmeric powder,metanil yellow artificial colour is added

Test: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) a now permitted coal tar colour is present.

7: Chilli powder added artificial colours

Test:Sprinkle the chilli powder on a glass of water. Artificial colorants descend as coloured streaks.

8:Chilli powder added water soluble coal tar colours

Test: Water soluble artificial colour can be detected by sprinkling a small quantity of chillies or turmeric powder on the surface of water contained in a glass tumbler. The water soluble colour will immediately start descending in colour streaks.

9: Asafoetida (Hing) added, Soap stone or other earthy materialis

Shake little portion of the sample with water and allow to settle. Soap stone or other earthy mailer will settle down at the bottom.

In compounded asafoetida due to presence of starch, a slight turbid solution may be produced. However, this will settle down after keeping.

10:Asafoetida (Hing) added Foreign resin

Test:Burn on a spoon, if the sample burns like camphor, it indicates the sample is pure.

Pure hing burns like aromatic camphor

11:Spices, added saw dust and Powdered bran

Test: Sprinkle on water surface. Powdered bran and sawdust float on the surface.

12: Green chilli and green vegetables- malachite green is added.

Test: 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.

13:Green peas- Artificially coloured

Test:Take a little amount of green peas in a 250 ml beaker add water to it and mix well. Let it stand for half an hour. Clear separation of colour in water indicates adulteration.

14: Coriander powder-- Dung powder is added

Test: Soak in water. Dung will float and can be easily detected by its foul smell.

15: Ghee- Synthetic Colouring Matter

Test: Pour 2 gms. Of filtered fat dissolved in ether. Divide into 2 portions. Add 1 ml. Of HCl to one tube. Add 1 ml. Of 10% NaOH to the other tube. Shake well and allow to stand. Presence of pink colour in acidic solution or yellow colour in alkaline solution indicates added colouring matter.

16: Dal, moong, washed channa -,Metanil Yellow added

Test: Extract the colour with Luke warm water from the sample of pulses, add drops of HCl. A pink colour indicates presence of Metanil yellow.

17: Saffron Coloured dried tendrils of maize cob

Test:Pure saffron will not break easily like artificial. Pure saffron when allowed to dissolved in water will continue to give its colour so long as it lasts.

18: Common Salt White powdered stone

Test: Stir a spoonful of sample salt in water. Chalk will make the solution white and other insoluble impurities will settle down.

19: Vegetable oil adulterated with Castrol oil

Test: 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.

20: Honey added with sugar/jaggery

Test: 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.

21: Pulses/Besan added Kesari dal.

Test:Add 50 ml. Of dil.HCl to a small quantity of dal and keep on simmering water for about 15 minutes. The pink colour, if developed indicates the presence of Kesari dal.

22:Turmatic added Lead Chromate

Test: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 colour indicates presence of Lead Chromate

Coffee powder: Here adulterant is Tamarind seeds, chicory powder ,used to add bulk and colour .It 's harmful effect is that it can cause diarrhea, stoma chicory causes, giddiness and severe joint pains.

23: Ghee- added,Mashed Potato,Sweet Potato, etc

Test:Boil 5 ml. Of the sample in a test tube. Cool and a drop of iodine solution. Blue colour indicates presence of Starch. colour disappears on boiling & reappears on cooling

2: Chemical Contaminants

Uttar Pradesh inventing synthetic milk - a deadly cocktail of urea, caustic soda and vegetable oil. There are some reports of fruits, particularly mangoes, being ripened with calcium carbide and fish being made to appear fresh with formalin. All adulterants such as calcium carbide and formalin are banned from use in food items - whether raw or packaged - since they are known to be toxic. Some of them have even been classified as carcinogens or cancer causing substances.

Chemical contaminants can be found as organic and inorganic molecules in products used day to day by almost everybody. These include plastics, resins, pharmaceuticals, disinfectants, deodorants, detergents, petroleum products, pesticides and biocides.

For many of these substances accumulation into aquatic environments can cause environmental problems. Chemical contaminants are often transported by water as it flows across the land, roads, and other impermeable surfaces. With little prior treatment, many of these contaminants may eventually discharge into waterways.

1: Lead- chromate, added to Turmeric whole and powdered, mixed spices.

Diseases or Health Effects : Anemia, abortion, paralysis, brain damage

2: Methanol- Alcoholic liquors.

Diseases or Health Effects: Blurred vision, blindness, death

3: Arsenic- Arsenic Fruits such as apples sprayed sprayed

Diseases or Health Effects : Dizziness, chills, cramps, over with lead arsenate Dizziness, chills, cramps, paralysis, death

4: Barium- Foods contaminated by rat poisons (Barium carbonate)

Diseases or Health Effects: Violent peristalisis, arterial hypertension, muscular twitching, convulsions, cardiac disturbances

5: Cadmium- Fruit juices, soft drinks, etc. in contact with cadmium plated vessels or equipment. Cadmium contaminated water and shell-fish

Diseases or Health Effects : Itai-itai (ouch-ouch) disease, Increased salivation, acute gastritis, liver and kidney damage, prostate cancer.

6:Mercury -Mercury fungicide treated seed grains or mercury contaminated fish

Diseases or Health Effects: Brain damage, paralysis, death.

7:BHA and BHT- beyond safe limit Oils and fats

Diseases or Health Effects :Allergy, liver damage, increase in serum chloresterol etc. 32 Monosodium glutamate(flour) (beyond safe limit)- Chinese food, meat and meat products Brain damage, mental retardation in infants.

8:Lead,added-Water, natural and processed food

Diseases or Health Effects: Lead poisoning (foot-drop, insomnia, anemia, constipation, mental retardation, brain damage)

9: Brominated vegetable oils added to Cold drinks

Diseases or Health Effects :Anemia, enlargement of heart

10: Food flavours -beyond safe limit Flavoured food Chances

Health Effects: liver cancer

11:Sulphur dioxide and sulphite- beyond safe limit In variety of food as preservative

Health Effects: Acute irritation of the gastrointestinal tracts etc.

12: Non-permitted colour or permitted food colour beyond safe limit- added to coloured foods

Diseases or Health Effects: Mental retardation, cancer and other toxic effect.

13: BHA and BHT beyond safe limit- added to oils and fats

Diseases or Health Effects: Allergy, liver damage, increase in serum chloresterol etc

14: Monosodium glutamate(flour) (beyond safe limit: added to Chaines food,meat products

Diseases or Health Effects: Brain damage, mental retardation in infants

3: Fungal Contaminants

Fungi are ubiquitous plant pathogens that are major spoilage agents of foods and feedstuffs. The infection of plants by various fungi not only results in reduction in crop yield and quality with significant economic losses but also contamination of grains with poisonous fungal secondary metabolites called mycotoxins. The ingestion of such mycotoxin-contaminated grains

by animals and human beings has public health significance, because these toxins are capable of causing diseases in man and animals.

Some mycotoxins are:

1. Aflatoxins – carcinogens found in mouldy nuts.

2. Ochratoxins – cause kidney disease and are produced in cereals such as maize and barley.

3. Patulin – associated with mouldy apples and poisoning has arisen from drinking contaminated fresh apple juice.

What is Aflatoxin : Aflatoxin is a type of mycotoxin produced by Aspergillus molds. Aflatoxin is probably the most well known mycotoxin, besides trichothecene, and the most researched. This is because aflatoxins are very toxic and highly carcinogenic.

You can also find information about mycotoxins in general at the Mycotoxins page and information about trichothecene mycotoxins at Trichothecene.

Aflatoxin Symptoms

How badly a person is affected by aflatoxin mycotoxins depends on things like the person's age, gender, level of exposure, duration of exposure, health, strength of their immune system, diet and environmental factors.

There are two main ways people are usually exposed to aflatoxins. The first is when someone takes in a high amount of aflatoxins in a very short time. This can cause:

- Liver damage
- Liver cancer
- Mental impairment
- Abdominal Pain
- Vomiting
- Convulsions
- Edema
- Pulmonary Edema

- Hemorrhaging
- Disruption of food digestion, absorption or metabolism
- Coma
- Death

Aflatoxicosis - Aflatoxin Poisoning

The technical term for poisoning by aflatoxin mycotoxins is aflatoxicosis. This usually occurs from eating food contaminated with aflatoxin mycotoxins.Aflatoxicosis is not contagious and drugs and antibiotics do little to help. Aflatoxicosis damages the liver more than any other organ. Aflatoxin mycotoxins also suppress the immune system.

Aflatoxin in Food

The American Food and Agriculture Organization estimates that 25% of the food crops in the world are affected by mycotoxins. Of these mycotoxins, aflatoxins are the biggest problem. Corn, cottonseed and peanuts are the crops most at risk of being contaminated by aflatoxins. Aspergillus also commonly grows on beans, rice, tree nuts and wheat. It grows less often on other grains and nuts and causes Liver damage and cancer.If animals are given feed contaminated with aflatoxins then aflatoxin mycotoxins can end up in milk, eggs and meat. Aflatoxin M1 and M, which are often found in cow's milk, are metabolites produced by animals which have eaten aflatoxins.

Ergot alkaloids from Claviceps purpurea Toxic alkaloids, ergotamine, ergotoxin and Ergot-infected bajra, rye meal or bread Ergotism (St.Anthony’s fireburning sensation in ergotamine, ergotoxin and extremities.

What are ochratoxins?

Ochratoxins are a small group of chemically related toxic fungal metabolites (mycotoxins) produced by certain moulds of the genera Aspergillus and Penicillium growing on a wide range of raw food commodities. Some ochratoxins are potent toxins and their presence in food is undesirable.

How do they affect human health?

OTA is a potent nephrotoxin and causes both acute and chronic effects in the kidneys of all mammalian species tested. The sensitivity of different species varies, but a level of 200 µg/kg in feed over three months is sufficient to cause acute damage to the kidneys of pigs and rats. There are no documented cases of acute OTA toxicity in humans.

Where do they come from?

In tropical and sub-tropical regions, OTA is produced mainly by Aspergillus species, particularly the widespread A. ochraceus. But in temperate climates (Canada, Northern Europe and parts of South America), the main producer is Penicillium verrucosum.

What is patulin?

Patulin is a toxic fungal metabolite (mycotoxin) produced by certain moulds of the genera Penicillium,Aspergillus and Byssochlamys growing on various food commodities, especially fruit. Patulin exhibits a number of toxic effects in animals and its presence in food is undesirable.

Chemically, patulin is a polyketide lactone. It is a relatively small molecule (C7H6O4) and is soluble in water.

Contaminated foods: Patulin occurs most often in apples that have been spoiled by mould growth, or in products made from spoiled apples, such as apple juice, pies and conserves. It has also been found in other fruits, including pears and grapes, in vegetables and in cereal grains and cheese.

How does it affect human health?

Most of the information on the toxicity of patulin is derived from animal studies and there is little or no experimental, or epidemiological, data on acute or chronic toxicity in humans.

At relatively high doses, patulin is acutely toxic in mice and rats, causing gastrointestinal lesions, distension and haemorrhage in the stomach and small intestine.

Is it stable in food?:Patulin is relatively heat stable and is not destroyed by pasteurisation of apple juice at 90oC for 10 seconds. However, it is broken down in fruit juice and other foods in the presence of sulphur dioxide used as a preservative. It does not appear to survive fermentation processes and is not usually found in alcoholic drinks, such as cider, but the toxicity of its breakdown products is uncertain.

Diseases or Health Effects: It causes itching of skin, ergometrine groups extremities, itching of skin and also it causes peripheral gangrene.

Toxins from Fusarium sporotrichioides Grains (millet, wheat, oats, rye,etc)

Diseases or Health Effects: Alimentary toxic aleukia(ATA) (epidemic panmyelotoxicosis)

Toxins from Fusarium sporotrichiella Moist grains Urov disease (KaschinBeck disease).

Virus of infectious Hepatitis (virus A) Shell-fish, milk, unheated foods contaminated with faeces, urine and blood of infected human Infectious hepatitis

4:Natural Contaminant

Adulterant Foods Commonly Involved Diseases or Health Effects

1: Flouride Drinking water, sea foods, tea, etc.

Diseases or Health Effects: Excess fluoride causes fluorosis (mottling of teeth, skeletal and neurological disorders)

2: Oxalic acid Spinach, amaranth, etc.

Diseases or Health Effects: Renal calculi, cramps, failure of blood to clot

3:Gossypol Cottonseed flour and cake

Diseases or Health Effects: Cancer

4: Cyanogenetic compounds Bitter almonds, apple seeds, cassava, some beans etc.

Diseases or Health Effects: Gastro-intestinal disturbances

5: Phalloidine (Alkaloid) Toxic mushrooms

Diseases or Health Effects: Mushroom poisoning (Hypoglycemia, convulsions, profuse watery stools, severe necrosis of liver leading to hepatic.

6: Solanine Potatoes Solanine poisoning

Diseases or Health Effects : It causes vomiting, abdominal pain and diarrhoea

7: Nitrates and Nitrites Drinking water, spinach rhubarb, asparagus, etc. and meat products.

Diseases or Health Effects: Methaemoglobinaemia especially in infants, cancer and tumors in the liver, kidney, trachea esophagus and lungs. The liver is the initial site but afterwards tumors appear in other organs.

8:Asbestos (may be present in talc, Kaolin, etc. and in processed foods) Polished rice, pulses, processed foods containing anti-caking agents, etc.

Diseases or Health Effects :Absorption in particulate form by the body may produce cancer.

9:Pesticide residues (beyond safe limit)

Diseases or Health Effects: All types of food Acute or chronic poisoning with damage to nerves and vital organs like liver, kidney, etc.

10:Antibiotics (beyond safe limit) Meats from antibiotic-fed animals

Diseases or Health Effects: Multiple drug resistance hardening of arteries, heart disease

5. Conclusion:

Food adulteration is defined as 'the intentional addition of non-permitted foreign matter'to get profit and increase the weight of the products , to give better colour ect. Common man unaware of the adulteration or contaminant ,they may be carcinogenic and damage the to live better and heakthy life.vital organs like liver, kidney, etc. Some are natural contaminants and they are also dangerous for health. These are simple common test to detect adulterants identification .

Some chemicals realesed during cooking or heating related chemicals, such as acrylamide and other chemical contaminants in food such as benzene, dioxins, ect.

Aacrylamide?: Acrylamide is a chemical that can form in some foods during high-temperature cooking processes, such as frying, roasting, and baking. Acrylamide in food forms from sugars and an amino acid that are naturally present in food; it does not come from food packaging or the environment.

Acrylamide forms from sugars and an amino acid (asparagine) during certain types of high-temperature cooking, such as frying, roasting, and baking.