

Food Adulteration and Control Measures






by

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UUK
Solutions
FOR ALL UNKNOWN SOLUTIONS



Additive Vs. adulterant

-  **Additives** are substances that are combined with other material for a **beneficial reason**.
-  An **adulterant** is a substance that has a **negative effect** and is added **deliberately** to another substance **despite any consequences**.
-  An example of the an adulterant would be **melamine**, which was added to milk by the Chinese company Sanlu in 2006.
-  Melamine is an industrial chemical that made the **milk appear** as if it **had more protein** content than it actually did.
-  **This adulterant caused the development of kidney stones, resulting in thousands of children becoming ill and several fatalities**

Why adulteration ?

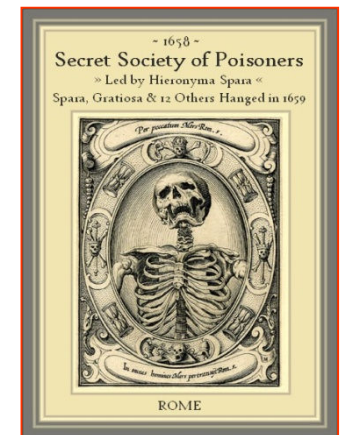
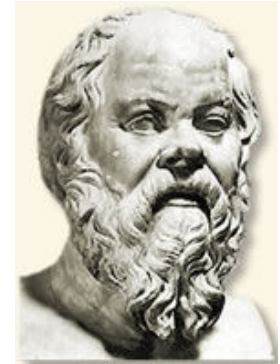
-  VESTED INTERESTS OF INDIVIDUALS FOR PROFITIERING ,
IGNORING PUBLIC HEALTH AND SAFETY
-  May be due to ignorance by individuals (lack of knowledge of
Regulatory provisions and training on adulterants)
-  In addition to individuals adding adulterants to products, **companies** may try to **extend their profit margins** by extending their products.
-  **Example** - Apple Valley International, Inc, substituted the less-expensive beet sugar as an adulterant for orange juice concentrate in the company's frozen orange juice,
-  Maple sugar distributor W. Lyman Jenkins represented a mainly sugar-cane sugar as a pure maple sugar.
-  Both companies faced criminal prosecution.
-  While neither of these incidents resulted in any illnesses, people were defrauded because these products were misrepresented.

Earlier History

-  One form of adulteration, or adding adulterants, that has been used throughout history is the **deliberate addition** of adulterants (poisonous) to foods or beverages with the intent of killing another individual.
-  **Poisoning symptoms** could be misinterpreted as **symptoms of other diseases or illnesses.**

Victims of food adulteration

- UK** People who have been victims of poisoning include the famous Greek philosopher **Socrates** (c. 469 BC–399 BC), who, after being sentenced to death by the Greek state for impious acts, **drank a beverage laced with hemlock** (Poisonous plants in the Apiaceae family)
- UK** Italian witch **Hieronyma Spara**, who was ultimately hanged on orders from the Catholic Church, **taught** young Roman women **how to murder their husbands** using **arsenic** during the 1600s.
- UK** In 1984, followers of Bhagwan Shree Rajneesh (1931-1990), also known as "**Osho**," **spiked salad bars** in Oregon with **salmonella**, (To keep anti-Rajneesh voters from reaching the polls), resulting in **more than 750 illnesses**, which was perhaps the **first act of bioterrorism** in the **United States**.





What is treated as food adulteration ?

Any article of food is adulterated if :

 If any **inferior or cheaper substance** has been substituted wholly or in part,

 If any constituent of the article has been **wholly or in part abstracted**

 If the article has been **prepared, packed or kept under insanitary conditions**


 If the article consists in part **filthy, rotten, decomposed or diseased animal or vegetable or is infested with insects**

What is treated as food adulteration ?

Any article of food is adulterated if :

 If the article **is obtained from diseased animal**

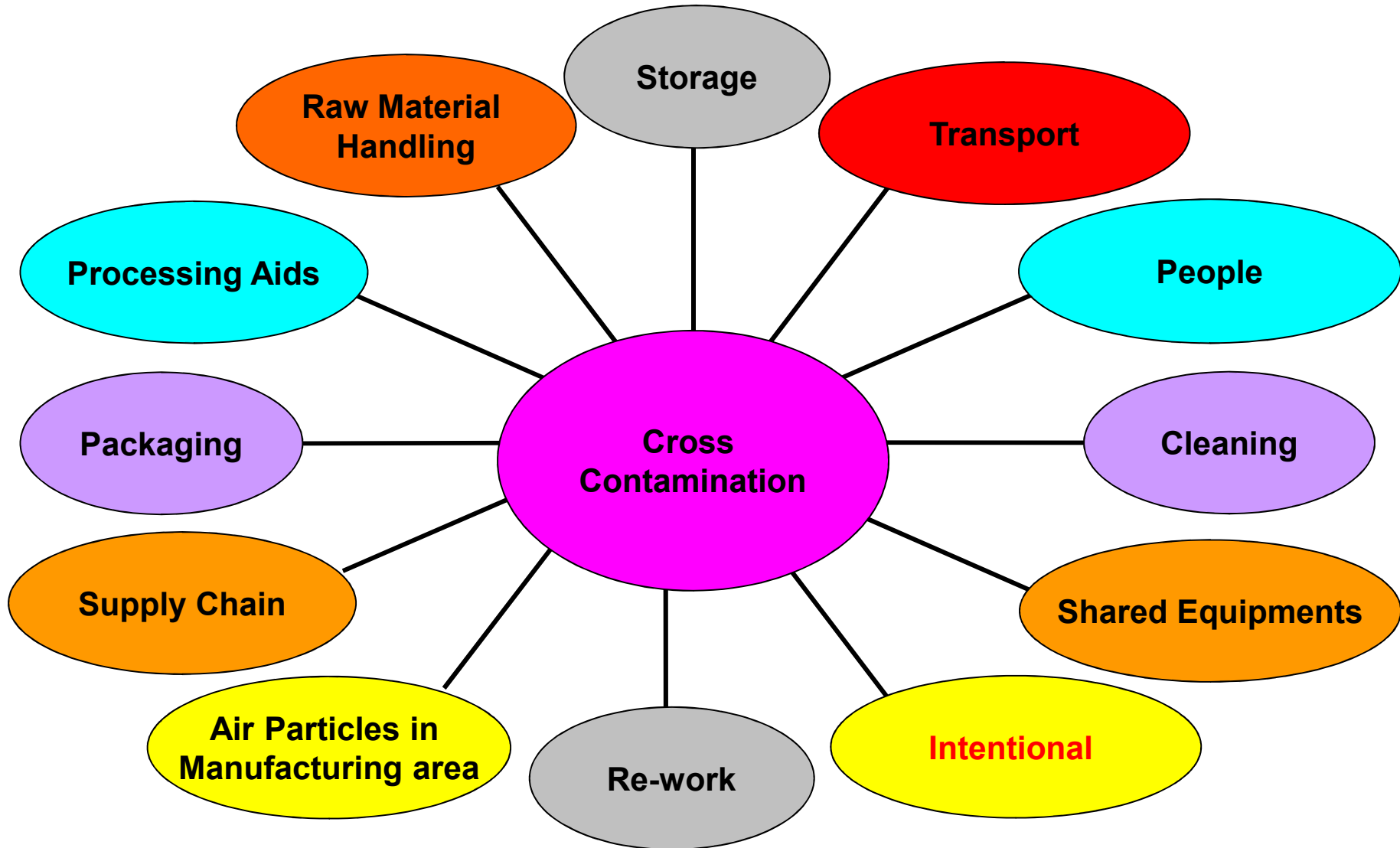
 If the article contains any **poisonous ingredient**

 If the article has **unprescribed colouring substance** or the colouring substance is in **excess** of the prescribed limits.

 If the article contains any **prohibited or excessive preservatives.**

 If the quality or purity of the article **falls below prescribed standard**

Potential Sources of adulterant entry / contamination into the food



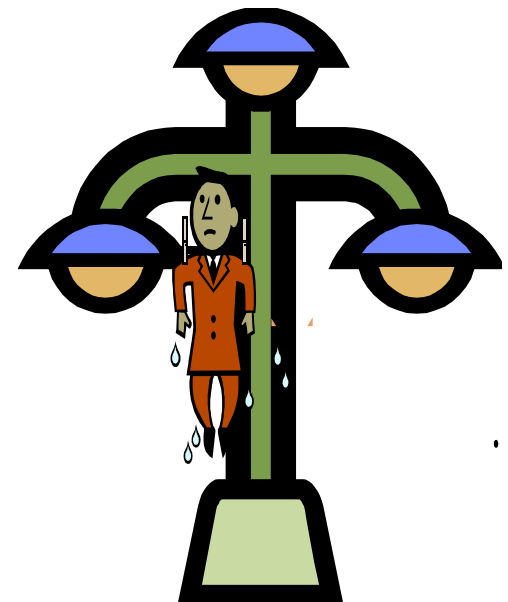
Possible control strategy

"Hang them(who does adulteration) on the nearest lamp post

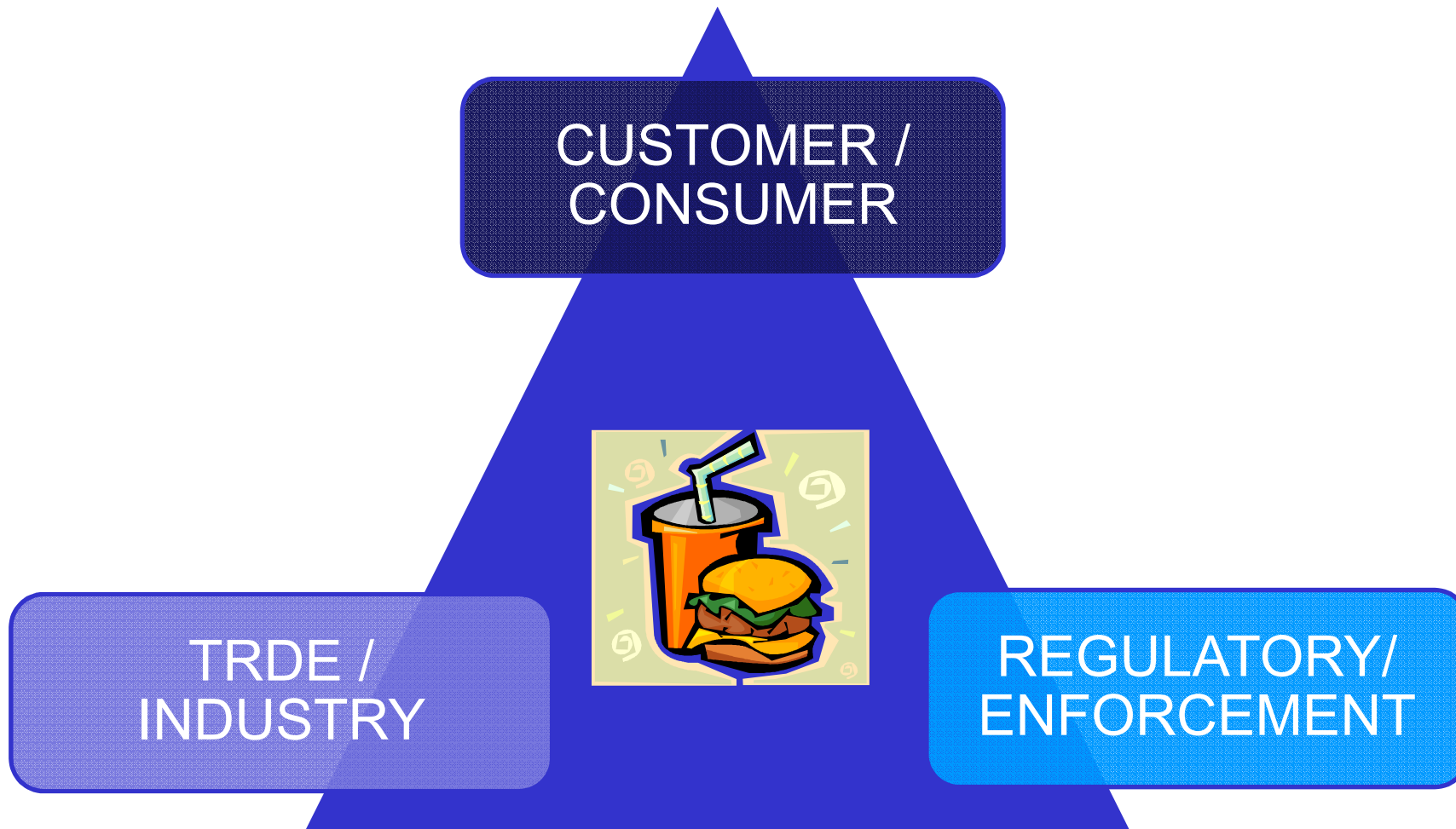
and

adulteration will disappear"

But this alone will not work

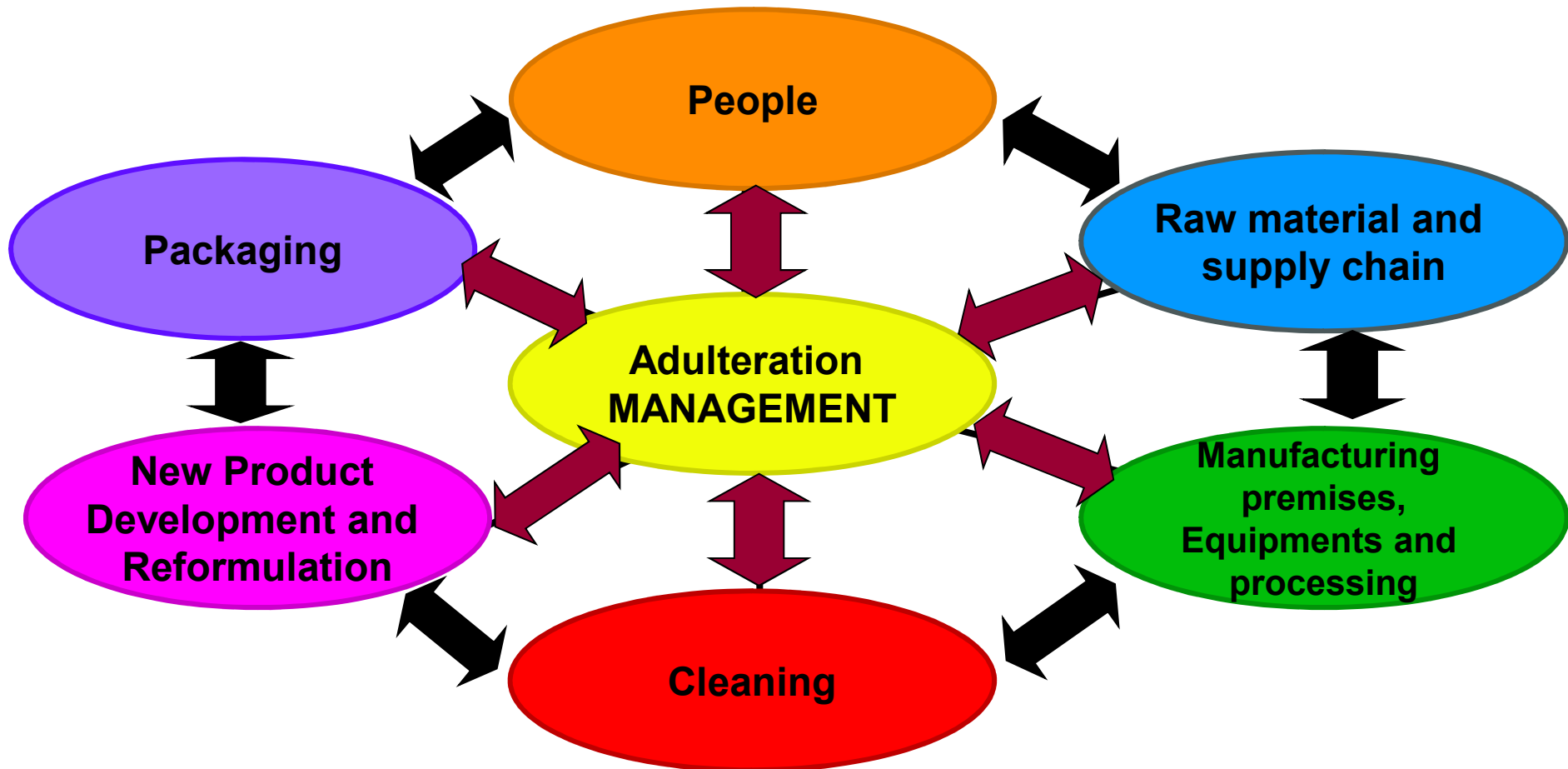


Triangular approach to control adulteration



Management of adulterants by industry

UK The key aspects of food and drink manufacturing businesses to be considered in the management of adulterants/ contaminants entry are illustrated in figure





All must know

**Injurious Adulterants/Contaminants in
Foods and their Health Effects**

A- Food Adulterants

S.No	Adulterant	Foods Commonly Involved	Diseases or Health Effects
1	Argemone seeds Argemone oil	Mustard seeds Edible oils and fats	Epidemic dropsy, Glaucoma, Cardiac arrest
2	Artificially coloured foreign seeds	As a substitute for cumin seed, Poppy seed, black pepper	Injurious to health
3	Foreign leaves or exhausted tea leaves, saw dust artificially coloured	Tea	Injurious to health, cancer
4	TCP	Oils	Paralysis
5	Rancid oil	Oils	Destroys vitamin A and E
6	Sand, marble chips, stones, filth	Food grains, pulses etc.	Damage digestive tract
7	Lathyrus sativus	Khesari dal alone or Mixed in other pulses	Lathyrism (crippling spastic paraplegia)

B-Chemical Contaminant

S.No	Adulterant	Foods Commonly Involved	Diseases or Health Effects
8	Mineral oil (white oil, petroleum fractions)	Edible oils and fats, Black pepper	Cancer
9	Lead chromate	Turmeric whole and powdered, mixed spices	Anemia, abortion, paralysis, brain damage
10	Methanol	Alcoholic liquors	Blurred vision, blindness, death
11	Arsenic	Fruits such as apples sprayed over with lead arsenate	Dizziness, chills, cramps, paralysis, death
12	Barium	Foods contaminated by rat poisons (Barium carbonate)	Violent peristalsis, arterial hypertension, muscular twitching, convulsions, cardiac disturbances
13	Cadmium	Fruit juices, soft drinks, etc. in contact with cadmium plated vessels or equipment. Cadmium contaminated water and shell-fish	'Itai-itai (ouch-ouch) disease, Increased salivation, acute gastritis, liver and kidney damage, prostrate cancer

B-Chemical Contaminant

S.No	Adulterant	Foods Commonly Involved	Diseases or Health Effects
14	Cobalt	Water, liquors	Cardiac insufficiency and myococardial failure
15	Lead	Water, natural and processed food	Lead poisoning (foot-drop, insomnia, anemia, constipation, mental retardation, brain damage)
16	Copper	Food	Vomiting, diarrhoea
17	Tin	Food	Colic, vomiting
18	Zinc	Food	Colic, vomiting
19	Mercury	Mercury fungicide treated seed grains or mercury contaminated fish	Brain damage, paralysis, death

C- Bacterial Contaminant

S.No	Adulterant	Foods Commonly Involved	Diseases or Health Effects
20	Bacillus cereus	Cereal products, custards, puddings, sauces	Food infection (nausea, vomiting, abdominal pain, diarrhoea)
21	Salmonella spp.	Meat and meat products, raw vegetables, salads, shell-fish, eggs and egg products, warmed-up leftovers	Salmonellosis (food infection usually with fever and chills)
22	Shigella sonnei	Milk, potato, beans, poultry, tuna, shrimp, moist mixed foods	Shigellosis (bacillary dysentery)
23	Staphylococcus aureus Enterotoxins- A,B,C,D or E	Dairy products, baked foods especially custard or cream-filled foods, meat and meat products, low-acid frozen foods, salads, cream sauces, etc.	Increased salivation, vomiting, abdominal cramp, diarrhoea, severe thirst, cold sweats, prostration
24	Clostridium botulinum toxins A,B,E or F	Defectively canned low or medium-acid foods; meats, sausages, smoked vacuum-packed fish, fermented food etc.	Botulism (double vision, muscular paralysis, death due to respiratory failure)

D- Other Contaminant

S.No	Adulterant	Foods Commonly Involved	Diseases or Health Effects
25	Clostridium. Perfringens (Welchii) type A	Milk improperly processed or canned meats, fish and gravy stocks	Nausea, abdominal pains, diarrhoea, gas formation
26	Diethyl stilbestrol (additive in animal feed)	Meat	Sterlites, fibroid tumors etc.
27	3,4 Benzopyrene	Skoked food	Cancer
28	Excessive solvent residue	Solvent extracted oil, oil cake etc.	Carcinogenic effect
29	Non-food grade or contaminated packing material	Food	Blood clot, angiosarcoma, cancer etc.
30	Non-permitted colour or permitted food colour beyond safe limit	Coloured food	Mental retardation, cancer and other toxic effect.

D- Other Contaminant

S.No	Adulterant	Foods Commonly Involved	Diseases or Health Effects
31	BHA and BHT beyond safe limit	Oils and fats	Allergy, liver damage, increase in serum chloesterol etc.
32	Monosodium glutamate(flour) (beyond safe limit)	Chinese food, meat and meat products	Brain damage, mental retardation in infants
33	Coumarin and dihydro coumarin	Flavoured food	Blood anticoagulant
34	Food flavours beyond safe limit	Flavoured food	Chances of liver cancer
35	Brominated vegetable oils	Cold drinks	Anemia, enlargement of heart
36	Sulphur dioxide and sulphite beyond safe limit	In variety of food as preservative	Acute irritation of the gastro-intestinal tracts etc.
37	Artificial sweetners beyond safe limit	Sweet foods	Chances of cancer

E- Fungal Contaminant

S.No	Adulterant	Foods Commonly Involved	Diseases or Health Effects
38	Aflatoxins	Aspergillus flavus-contaminated foods such as groundnuts, cottonseed, etc.	Liver damage and cancer
39	Ergot alkaloids from Claviceps purpurea Toxic alkaloids, ergotamine, ergotoxin and ergometrine groups	Ergot-infested bajra, rye meal or bread	Ergotism (St. Anthony's fire-burning sensation in extremities, itching of skin, peripheral gangrene)
40	Toxins from Fusarium sporotrichioides	Grains (millet, wheat, oats, rye, etc)	Alimentary toxic aleukia(ATA) (epidemic panmyelotoxicosis)
41	Toxins from Fusarium sporotrichiella	Moist grains	Urov disease (Kaschin-Beck disease)
42	Toxins from Penicillium inslandicum, Penicillium atricum, Penicillium citreovirede, Fusarium, Rhizopus, Aspergillus	Yellow rice	Toxic mouldy rice disease

E- Fungal / Viral/ Parasitic Contaminant

S.No	Adulterant	Foods Commonly Involved	Diseases or Health Effects
43	Sterigmatocystin from <i>Aspergillus versicolour</i> <i>Aspergillus nidulans</i> and <i>bipolaris</i>	Foodgrains	Hepatitis
44	<i>Ascaris lumbricoides</i>	Any raw food or water contaminated by human faeces containing eggs of the parasite	Ascariasis
45	<i>Entamoeba histolytica</i> Viral	Raw vegetables and fruits	Amoebic dysentery
46	Virus of infectious Hepatitis (virus A)	Shell-fish, milk, unheated foods contaminated with faeces, urine and blood of infected human	Infectious hepatitis
47	Machupo virus	Foods contaminated with rodents urine, such as cereals	Bolivian hemorrhagic fever

F- Natural Contaminant

S.No	Adulterant	Foods Commonly Involved	Diseases or Health Effects
48	Flouride	Drinking water, sea foods, tea, etc.	Excess fluoride causes fluorosis (mottling of teeth, skeletal and neurological disorders)
49	Oxalic acid	Spinach, amaranth, etc.	Renal calculi, cramps, failure of blood to clot
50	Gossypol	Cottonseed flour and cake	Cancer
51	Cyanogenetic compounds	Bitter almonds, apple seeds, cassava, some beans etc.	Gastro-intestinal disturbances
52	Polycyclic Aromatic Hydrocarbons(PAH)	Smoked fish, meat, mineral oil-contaminated water, oils, fats and fish, especially shell-fish	Cancer
53	Phalloidine (Alkaloid)	Toxic mushrooms	Mushroom poisoning (Hypoglycemia, convulsions, profuse watery stools, severe necrosis of liver leading to hepatic failure and death)

F- Natural Contaminant

S.No	Adulterant	Foods Commonly Involved	Diseases or Health Effects
54	Solanine	Potatoes	Solanine poisoning (vomiting, abdominal pain, diarrhoea)
55	Nitrates and Nitrites	Drinking water, spinach, rhubarb, asparagus, etc. and meat products	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.
56	Asbestos (may be present in talc, Kaolin, etc. and in processed foods)	Polished rice, pulses, processed foods containing anti-caking agents, etc.	Absorption in particulate form by the body may produce cancer
57	Pesticide residues (beyond safe limit)	All types of food	Acute or chronic poisoning with damage to nerves and vital organs like liver, kidney, etc.
58	Antibiotics (beyond safe limit)	Meats from antibiotic-fed animals	Multiple drug resistance, hardening of arteries, heart disease



Quick Detection Tests

Quick Detection Tests

Food Article	Adulterant	Simple Method for Detecting the Adulterant
Milk	Water	Put a drop of milk on polished vertical surface. The drop of pure milk either stops or flows slowly leaving a white trail behind it. Whereas milk adulterated with water will flow immediately without leaving a mark.
Milk	Urea	Take 5 ml of milk in a test tube and add 2 drops of bromothymol blue solution. Development of blue colour after 10 minutes indicates presence of urea.

Quick Detection Tests

Food Article	Adulterant	Simple Method for Detecting the Adulterant
Ice Cream	Washing Powder	Put some lemon juice, bubbles are observed on the presence of washing powder
Sugar	Chalk	Dissolve sugar in a glass of water, chalk will settle down at the bottom, similarly for salt
Silver Foil	Aluminium Foil	On ignition genuine silver foil burns away completely leaving glistening white spherical ball of the same mass while aluminum foil is reduced to ashes of black Grey colour.



Quick Detection Tests

Food Article	Adulterant	Simple Method for Detecting the Adulterant
Honey	Water	A cotton wick dipped in pure honey burns when ignited with a match stick. If adulterated presence of water will not allow the honey to burn, if it does will produce a cracking sound.
Coffee	Chicory	Gently sprinkle the coffee powder on surface of water in a glass. The coffee floats over the water but chicory begins to sink down within few seconds. The falling chicory powder particles leave behind them a trail of colour, due to large amount of caramel they contain
Tea	Coloured Leaves	Rub leaves on white paper, artificial colour comes out on paper.
Tea	Used Tea	Tea leaves sprinkled on wet filter paper. Pink or red spots on paper show colour
Tea	Iron Fillings	Move a magnet through the sample. Iron will stick to the magnet.



Quick Detection Tests

Food Article	Adulterant	Simple Method for Detecting the Adulterant
Bajra	Ergot infested Bajra	Swollen and black Ergot infested grains will turn light in weight and will float also in water
Wheat flour	Excessive sand & dirt	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.
Wheat flour	Excessive bran	Sprinkle on water surface. Bran will float on the surface
Wheat flour	Chalk powder	Shake sample with dil. HCl Effervescence indicates chalk.
Food grains	Hidden insect infestation	Take a filter paper impregnated with Ninhydrin (1% in alcohol.) Put some grains on it and then fold the filter paper and crush the grains with hammer. Spots of bluish purple colour indicate presence of hidden insects infestation



Quick Detection Tests

Food Article	Adulterant	Simple Method for Detecting the Adulterant
Common spices like Turmeric, chilly, curry powder, etc.	Colour	Extract the sample with Petroleum ether and add 13N H_2SO_4 to the extract. Appearance of red colour (which persists even upon adding little distilled water) indicates the presence of added colours. However, if the colour disappears upon adding distilled water the sample is not adulterated.
Spices(Ground)	Powdered bran and saw dust	Sprinkle on water surface. Powdered bran and sawdust float on the surface.
Coriander powder	Dung powder	Soak in water. Dung will float and can be easily detected by its foul smell.
Coriander powder	Common salt	To 5 ml. of sample add a few drops of silver nitrate. White precipitate indicates adulteration.
Badi Elaichi seeds	Choti Elaichi seeds	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.

Quick Detection Tests

Food Article	Adulterant	Simple Method for Detecting the Adulterant
Red Chilly Powder	Rodamine Culture	Take 2gms sample in a test tube, add 5ml of acetone. Immediate appearance of red colour indicates presence of Rodamine.
Red Chilly Powder	Brick powder grit, sand, dirt, filth, etc.	Brick powder settles fast chilly powder settles slowly when put in water or in a mixture of chloroform and carbon tetrachloride in a beaker
Cumin seeds (Black jeera)	Grass seeds coloured with charcoal dust	Rub the cumin seeds on palms. If palms turn black adulteration is indicated.
Mustard Seeds	Argemone Seeds	Argemone seeds have rough surface and mustard seeds on pressing is yellow inside while Argemone seed is white.

For HCL one can use Tezab /Acid at your home, used for cleaning toilets. For acetone , one may use nail polish remover

Quick Detection Tests

Food Article	Adulterant	Simple Method for Detecting the Adulterant
Turmeric Powder	Lead Chromate	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.
Turmeric Powder	Metanil Yellow	Add few drops of conc. Hydrochloric acid (HCl) to sample. Instant appearance of violet colour, which disappears on dilution with water, indicates pure turmeric. If colour persists Metanil yellow is present.
Turmeric Powder	Starch of maize, wheat, tapioca, rice	A microscopic study reveals that only pure 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.

For HCL one can use Tezab /Acid at your home, used for cleaning toilets. For acetone , one may use nail polish remover

Quick Detection Tests

Food Article	Adulterant	Simple Method for Detecting the Adulterant
Black Pepper	Papaya seeds/light berries, etc.	Float the sample in alcohol or Carbon tetrachloride. The mature black pepper berries sink while papaya seeds and light black pepper float.
Asafoetida (Heeng)	Soap Stone or earthy matter	Shake a little portion of sample with water and allow to settle. Soap stone or earthy matter will settle down at the bottom.
Asafoetida (Heeng)	Soap stone, other earthy matter	Shake a little quantity of powdered sample with water. Soap stone or other earthy matter will settle at the bottom.
Asafoetida (Heeng)	Chalk	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.

Quick Detection Tests

Food Article	Adulterant	Simple Method for Detecting the Adulterant
Ghee	Mashed Potato Sweet Potato, etc.	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
Ghee or Butter	Vanaspathi	Take 5 ml. Of the sample in a test tube. Add 5 ml. Of Hydrochloric acid and 0.4 ml of 2% furfural solution or sugar crystals. Insert the glass stopper and shake for 2 minutes. Development of a pink or red colour indicates presence of Vanaspathi in Ghee.
Ghee	Rancid stuff (old ghee)	Take one teaspoon of melted sample and 5 ml. Of HCl in a stoppered glass tube. Shake vigorously for 30 seconds. Add 5 ml. Of 0.1% of ether solution of Phloroglucinol. Re-stopper & shake for 30 seconds and allow to stand for 10 minutes. A pink or red colour in the lower(acid layer) indicates rancidity
Ghee	Synthetic Colouring Matter	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.

Quick Detection Tests

Food Article	Adulterant	Simple Method for Detecting the Adulterant
Dal arhar, moong, washed channa	Metanil Yellow	Extract the colour with Luke warm water from the sample of pulses, add drops of HCl. A pink colour indicates presence of Metanil yellow.
Pulses	Metanil Yellow(dye)	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.
Pulses	Lead Chromate	Shake 5 gm. Of pulse with 5 ml. Of water and add a few drops of HCl. Pink colour indicates Lead Chromate.
Pulses/Besan	Kesari dal(Lathyrus sativus)	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.

Quick Detection Tests

Food Article	Adulterant	Simple Method for Detecting the Adulterant
Saffron	Coloured dried tendrils of maize cob	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.
Common Salt	White powdered stone	Stir a spoonful of sample salt in water. Chalk will make the solution white and other insoluble impurities will settle down.
Vegetable oil	Castor oil	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.
Vegetable oil	Argemone oil	Add 5 ml, conc. HNO_3 --to 5 ml.sample. Shake carefully. Allow to separate yellow, orange yellow, crimson colour in the lower acid layer indicates adulteration.
Green vegetables like chilli	Malachite green	Take a small part of the sample and place it over a moistened white blotting paper, the impression of the colour on paper indicates the presence of malachite green



What Next ?


 Food Adulteration occur in rural as well as urban areas.

 Purchaser in doubt can approach the company concerned.

 Can get the sample tested from FSSAI approved lab

 Complain to FSSAI

Regulatory provisions - FSSAI

 If any person manufactures for sale, stores, sell imports or distributes any article of food which is adulterated or misbranded, he is liable under the FSSA 2006 Act to be punished with imprisonment and fined.

52	Deficiency in Quality	Misbranded Food (Adj. Off. Can issue corrective action)	Up to 3.0 lakh
57 (i) (ii)	Deficiency in Quality	Processing/sale of adulterant - not injurious to health - injurious to health	Up to 2.0 lakh Up to 10.0 lakh
59	Unsafe Food		
(i)	- does not result in injury	Up to 1.0 lakh	Upto 6 months
(ii)	- results in non-grievous injury	Up to 3.0 lakh	Upto 1 year
(iii)	- results in grievous injury	Up to 5.0 lakh	Upto 6 years
(iv)	- results in death	Not less than 10.0 lakh	Not less than 7 years - upto Life imprisonment

THANKS

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The logo for UKSOLUTIONS features the letters 'U', 'K', and 'S' in a stylized, bold, sans-serif font. The 'U' and 'K' are connected at the top, and the 'S' is positioned to the right. Below the letters, the word 'SOLUTIONS' is written in a smaller, all-caps, sans-serif font. The entire logo is set against a dark blue background.