

An Overview of Food Adulterants and their Health Impacts.

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Abstract- Food adulteration is a major harmful cause in both the developed and less-developed countries. “Adulterant” means any substance which could be compelled the food unsafe for containing extraneous matter. This review has shown that the use of Melamine, Calcium Carbide, argemone oil, Synthetic food colors, artificial sweeteners, and Formalin in foods (fruits, fishes, and vegetables, etc.) turns into silent toxic that is damages our health and reasons numerous serious illnesses. Also, this review has shown that the fishers and the dried fish stocker in Bangladesh have using DDT as a required preserver of dried fish without regarding health danger matters. The concentration levels of adulterants in the collected samples are higher which may cause health disease to the consumers for a long time. From raw vegetables and fruits to milk and milk foodstuffs to fish, meat, and treated food—every food item is adulterated. Melamine, Formalin, Argemone oil, DDT, Acesulfame potassium (Ace-K), Aspartame, Neotame, Saccharin, and Sucralose safety limits are 0.2 mg per kg, ≤ 0.1 ppm, 100 ppb per gram in oil, 0.5 mg/m³, 32.8, 50, 3, 15, 5 ADI (mg/kg bw/day) respectively. We intend the rigorous action should be taken against the violators of food safety laws & at the same time, we all should be aware of the serious impacts of food adulteration.

Index Terms- Food; Adulterant; Public Health; Safety Limit; Health; Hazard

Highlights

- Food adulteration is a major harmful cause in both the developed and less-developed countries.
- Adulterant could be compelled the food unsafe for containing extraneous matter.
- From raw vegetables and fruits to milk and milk foodstuffs to fish, meat, and treated food—every food item is adulterated.
- We all should be aware of the serious impacts of food adulteration.
- Calcium carbide is used to quickly ripen fruits artificially and contain toxic materials.

INTRODUCTION

Adulterant food involves the infusion of vain, harmful, unnecessary substances to food which decreases the first-

class of foods. The trouble of adulteration makes the food objects used in our everyday life unsafe and unhygienic for use due to poor managing. Adulteration in food items can motive extraordinary have an effect on health without our information. If we generally tend to actively take part in these adjustments then we are able to result in a healthy and non-venturous destiny for the imminent generations¹. Food is adulterated when foods quality is decreased which affected by the addition of materials that are harmful to human health & these adulterated food cause harmful effects in different health problems such as stomach disorders, giddiness, joint pain, diarrhea, liver disorders, dropsy, gastrointestinal problems, respiratory distress, edema, cardiac arrest, glaucoma, carcinogenic effects, paralysis, kidney failure, etc². Melamine, an organic base, has wide industrial applications. Because of its high nitrogen content (66%) by mass, to give a false impression of high protein content in various foods it has been unwisely added³. Melamine-contaminated milk products are dangerous for infants who had consumed, On September 12, 2008, Chinese Ministry of Health (CMH) officials established that melamine in the urine and kidney stone of infant patients⁴. Milk is the major source of protein, fat, carbohydrate, vitamins, and minerals required by both infants and adults. Unluckily milk adulteration is a big issue in the whole world. Some specific reasons for milk fraud may including a big gap between demand & supply, perishable condition of milk, low purchasing capability, and lack of compatible test method for detection of milk frauds⁵. Calcium carbide is used to quickly ripen fruits artificially and contain toxic materials such as arsenic and phosphorus which causes blindness and skin irritation⁶. In recent many farmers without knowing any harmful effects of calcium carbide, use it to quickly ripen fruits artificially, calcium carbide contained higher exposure to arsenic that can lead to cancer of the lung, liver, and kidney^{7,8}. Acetylene gas also called carbide gas that use to quickly ripen fruits artificially and if calcium carbide reacts with water then acetylene gas is produced which harmful to the neurological system^{6,8}.

In Bangladesh, calcium carbide is used to quickly ripen green fruits artificially, such as bananas, mangoes, guavas, papayas, tomatoes, and pineapples^{9,10}. The sellers or producers are achieved profit by using hazardous chemicals and these chemicals are giving attractive appearance than the natural foods, and these chemicals are direct input in food to consequences for public health and cause complex diseases, including cancer, who are consuming these chemicals¹¹. Added these harmful colors for

making food products are attractive, appealing and appetizing & also used in the various types of sweets, some cultural foods named beguni, peaju, etc, which causes indigestions, vomiting, diarrhea, allergy, asthma, several kinds of neurological diseases and even cancer^{12, 13}. Formalin is a toxic substance that can cause hazards and injurious to the health. Formalin is used in milk as an adulterant and increased the shelf life of milk. Consumption of formalin of an elevated dose can cause vomiting, abdominal pain, and diarrhea. Formalin also attacks the optic nerve and damages the power of the eye^{14, 15}. Here we discuss many other food adulterants and their health impacts.

Adulteration of Milk with Melamine & its health impacts

Melamine added to infant formula in mainland China which a massive effect on melamine-associated urinary stones among children, these reports are published in September 2008¹⁶. 294,000 children were diagnosed who had urinary stones and 51,900 hospitalized, in there are 6 died who had consumed the melamine-contaminated milk formula, these reports are published by the Chinese Ministry of Health three months later. In any person who had consumed melamine which clung to other substance, assemblage & urinary system facilitates crystal formation^{17, 18}. Kidney stones are caused by melamine which differs from calcium oxalate and phosphate stones that's why a radiographic examination is unrevealed^{18, 19}. Every person especially infants are affected in unanticipated pathologies & new disease for which people are affected by melamine toxicity that's been put on the chemical in nature. Forthwith, 4 deaths had consumed exposure to melamine which is used in plastic manufacturing, it's were reported in China, furthermore, 50,000 illnesses presenting in about 12,000 were hospitalized²⁰.

Melamine Toxicity

In 2007, in North America, many pets were ill & deaths to the formation of melamine cyanurate crystals which affected the kidneys of these animals²¹. Although, it is not a carcinogenic compound and has low oral acute toxicity; but it causes renal and urinary problems, melamine causes severely infant death when it reacts with cyanuric acid into the body²². Forthwith, there are 6 deaths furthermore 50,000 infants have been hospitalized who had consumed milk powdered baby food tainted with melamine, it's were reported in China in 2008²³. Melamine is the toxic element that dose on a par with common table salt with an LD50 of more than 3 g/kg of bodyweight²⁴. Maximum melamine limit established by Codex Alimentarius of 1mg/kg for powdered infant formula, 0.15mg/kg for liquid infant formula, and a maximum level of 2.5mg/kg for milk and milk products or milk-derived ingredients²⁵.

Melamine transmission to milk

In some conditions melamine can find in milk and dairy products are as follows:

1. Adulteration to Milk product to "fake" protein²⁶
2. Nitrogenous substances are used as fertilizers that are containing melamine.
3. Transfer of melamine from plastics used in milk packaging materials²⁴

When the cows graze melamine fertilized pasture then melamine will transfer to milk and tissue, transfer time maybe 8 hrs with the efficiency of 3% for the low and 2.1% for the high melamine concentration pasture²⁷ International Journal of Environmental Science and Technology has been reported that the amount of melamine in dairy products displayed concentrations in the following increasing order:

Infant formula > cheese > coffee mate > yoghurt > Milk²⁸

Occurrence of melamine in milk and dairy products

In general the following data have been published by International Food Safety Authorities Network (INFOSAN) about melamine contamination of milk and dairy products. Such as samples of biscuits, cakes and confectionery (0.6-945.86mg/kg); liquid milk and yoghurt products (0.5-648mg/kg); frozen desserts (39- 60.8mg/kg); powdered milk and cereal products (0.38-1143mg/ kg); processed foodstuff (0.6-41 mg/kg); food-processing ingredients (1.5-6694mg/kg); and animal feed (116.2-410mg/ kg)²⁹. Since some countries have presented only positive concentrations that the maximum levels they have established for melamine in food, whereas other countries submitted data on any positive determinations^{30, 31, 32, 33, 34}. Some reports about the occurrence of melamine in milk and dairy products have been summarized in Table 1.

Levels of Contamination and Types of Products Affected

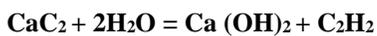
Observing these limitations that we present the most complete amassed of global data from the 2 October 2008 event to 31 January 2009 in Tables 2 and 3. Table 2 abbreviates 326 individual analytical results for melamine in a variety of food products: an analysis of dairy products conducted by China's General Administration of Quality Supervision, Reconnoiter and Isolation as of 3 October 2008 (n = 77), and the consequences stated by other national food-safety authorities (n = 249), as published on official web sites or reported directly to WHO via INFOSAN (up to 31 January 2009), Table 3 shows the total number of positive results, reported as individual results as abbreviated in Table 2³⁰.

Melamine-Contaminated Pet Food

Industrially synthesized chemical product is melamine (1, 3, 5-triazine-2, 4, 6-triamine) which is broadly used by laminates, coatings, plastic, dishware, and kitchenware. Animal foodstuffs are added with melamine to patronage their protein contents on the ascertained test which determines nitrogen content as a delegate for protein, that's why in Asia and North America in 2004 and 2007 the dogs and cats are caused the renal failure³⁷. In 2007, pet food was associated with melamine toxicity which is used to make animal feed, FDA stating that human health from consuming food and consuming food from animals (ingested tainted feed) was a few low risks. The dose of melamine toxicity in rats and cyranic acid is 3.1 g/kg (LD50) & 7.7 g/kg (LD50) doses respectively. Pet food is dangerous which was the nephrotoxicity of melamine was 1st observed in pet foods for which in the United States were found kidney problem in cats & dogs, it's discussed among the pet food, melamine, and cyanuric acid^{38, 39}. Sanlu Group (Shijiazhuang, Hebei province China) produced infant formula in August 2008, which was taken on high concentrations of melamine⁴.

Calcium Carbide:

Calcium carbide is used to quickly ripen fruits artificially and contain toxic materials such as arsenic and phosphorus which causes blindness and skin irritation ⁶. In recent many farmers without knowing any harmful effects of calcium carbide, use it to quickly ripen fruits artificially, calcium carbide contained higher exposure to arsenic that can lead to cancer of the lung, liver, and kidney ^{7,8}. Acetylene gas also called carbide gas that use to quickly ripen fruits artificially and if calcium carbide reacts with water then acetylene gas is produced which harmful to the neurological system ^{6, 8}. Many countries in South Asia like India, Bangladesh, and Nepal are much more use calcium carbide and are also used in different parts of the world. Calcium carbide reacts with water then acetylene gas is produced & the reaction is –



Calcium carbide contains traces of arsenic and phosphorus hydride, which harmful to the neurological system ⁴⁰. In Bangladesh, calcium carbide is used to quickly ripen green fruits artificially, such as bananas, mangoes, guavas, papayas, tomatoes, and pineapples ^{9,10}. The sellers or producers are achieved profit by using hazardous chemicals and these chemicals are giving attractive appearance than the natural foods, and these chemicals are direct input in food to consequences for public health and cause complex diseases, including cancer, who are consuming these chemicals ¹¹. Calcium carbide also called masala, that's one of the toxic chemical groups mainly used for quickly ripening fruits artificially for economic benefit ^{6, 50}. A carcinogenic compound like Calcium carbide, which causes short-term effects such as mouth ulcers, headaches, mental confusion, seizures, sleepiness, and long-term effects as memory loss, hypoxia, and cerebral edema. Certainly, its take on many toxicities like arsenic (As) and phosphorus (P), may cause neurological disorders ⁶. Nowadays many chemicals that are used to ripen fruits artificially such as –

- ethylene,
- methyl jasmonate,
- calcium carbide,
- ethephon and
- Ethylene-glycol ^{40,42,43,44}.

Consequently, many countries are used calcium carbide for low costs, such as Bangladesh, India, and Pakistan ^{40, 43}. Calcium carbide is applied to any fruits that calcium carbide reacts with water then acetylene gas is produced which are similar to ethylene in terms of ripening fruits ⁴⁰. Its alkaline in nature and provoking to mucosal tissue in the abdominal intestine, causes of stomach disorder after eating carbide-ripened mangoes & Workers are also in direct contact with calcium carbide when applying it to fruits that cause a serious health threat as impurities like arsenic and phosphorus found in alkaline calcium carbide and can cause kidney failure by consumption of ethylene glycol ^{43,44}. The natural process of Fruit ripening is interrupted by various chemicals that effects fruits gradually becomes sweet, colored, and gets soft and palatable ^{45, 46, 47, 48, 49}. In the advancement of science and technology concerns about fruit ripening mostly to consumer's demand and other economic factors & although, recently

concerned about the effects of non-natural ripening has become problematic because of numerous health illnesses ^{43, 50, 51, 52}.

During the offseason, put sense on the customers' demand fruit-sellers are used chemicals to quickly ripen fruits artificially and its easy process to ripening fruits by chemicals before the due season. Although, it's difficult to distinguish between artificially ripened fruits and naturally ripened fruits during the actual season of ripening. Fruit-sellers achieve a high profit of seasonal fruits by sold artificially ripen green fruits even during the due season to meet the high demand and helps during transportation and distribution issues & in situation these fruits take several days between transporting and distributing fruits from the farmers' house. Then these fruits are collected from farmers to local storage points & whereas also the retailers collect fruits and sell to household customers, in these fruits are wide transportation routes for different parts of the world, it may take several days consuming from plucking fruit in the tree to reaching it to consumer's basket. During this time the naturally ripened fruits can become overripe, inedible, and damaged during the harsh condition of transportation, that's an economic loss, then fruit sellers without knowing harmful for health help to prevent these losses by using various chemicals acts as ripening agents which are toxic and these are associated with serious health problems like heart disease, skin disease, lung failure and kidney failure ^{43,50,53,54}. Later, Scientists observed that regular intake of artificial.ripened fruits may cause dizziness, weakness, skin ulcers, and heart-related diseases ^{50,51,56,57, 58}. Many countries in South Asia like India, Bangladesh, and Nepal are much more use calcium carbide and it is ban due to its harmful feats ⁴⁴.

DDT:

Dichlorodiphenyltrichloroethane, is also known as DDT, which is a colorless, tasteless, and odorless crystalline chemical compound, used as an insecticide, and harmful for environmental impacts ⁵⁹. There are certain ways to adulterate the food such as formalin treatment for preservation, addition of calcium carbide for acceleration of ripening process, and also inclusion of DDT powder in sutki and so on ^{6, 60}. Some unexpected features of infestation are that the fishermen do not dry fishes properly due to loss of weight that's why protected to dry fish from infestation they regularly use a combination of organochlorine (DDT and heptachlor) insecticides ⁶⁰. Farmers expounded to DDT trading have an increased outbreak of nonallergic asthma ⁶¹. Organochlorine compounds are generally correlated to diabetes ⁶². A study of malaria workers who use these Organochlorine compounds being their profession found a major risk of cancers of the liver and biliary tract ⁶³. Also causes to puberty increases the risk of breast cancer ⁶⁴. Moreover, there is no specific legislation to control it and use of hazardous industrial chemicals ⁶⁵.

However, Six samples of dry fishes which are used by DDT and these are: Bombay duck (Loitty), Ribbon fish (Chhuri), Anchovy (Teilla phasa), Croaker (Poa), Chinese pomfret (Rupchanda) and Indian salmon (Lakhua) were analyzed to determine the composition of DDT.

Textile Color:

Synthetic food colors are factory-made products that do not appear in nature & it is soluble in water and many food products

can be used by Synthetic food colors without any further processing^{67, 68, 69}. Added these harmful colors for making food products are attractive, appealing and appetizing & also used in the various types of sweets, some cultural foods named beguni, peaju, etc, which causes indigestions, vomiting, diarrhea, allergy, asthma, several kinds of neurological diseases and even cancer^{12, 13}. Added to these harmful colors in the foods it will be 100 mg kg-1 or litre-1 of food as the consumed maximum limit of permissible colors⁷⁰. According to recently published a report in Current Sciences, some synthetic dyes such as auramine, metanil yellow, lead chromate, rhodamine, Sudan-3 and 4, orange-2, and malachite green are causes to serious health hazards being mutagenic and potentially carcinogenic⁷¹.

Causes of Synthetic Food Colour Adulteration

1. Priority in Consumers demands color and variety in foods.
2. Food products look superior, attractive, and thereby increase sales and profit.
3. Also Priority in consumer ignorance, carelessness^{72, 73, 74}.

Formalin:

Formalin is a toxic substance that can cause hazards and injurious to the health. Formalin is used in milk as an adulterant and increased the shelf life of milk. Consumption of formalin of an elevated dose can cause vomiting, abdominal pain, and diarrhea. Formalin also attacks the optic nerve and damages the power of the eye^{14, 15}. The addition of formalin in food is an intensive crime. Now the public got the deception about formalin which is used in food by various live telecast discussions, campaigns, talk show, among every part of the country^{76, 77, 78}. Formalin is a generic term that describes a solution of 37 to 40 percent formaldehyde gas dissolved in water^{79, 80}. It is broken by sunlight in the air but it is stable in liquid form. It can quickly spread in the brain, liver, and testis by diffusion. It can be easily absorbed by our intestinal mucosa. Uses of formalin in various sectors such as pressed wood products, paper, textile fibers, adhesives and plastics, carpeting, foam insulation, cosmetics, nail hardeners, disinfectant, some finger paints, and some cleaning products^{81, 82, 83}. Its main roots of exposure in environments are air, smoking, dermal exposure, and water^{84,85}. In food items such as fruits, vegetables, fishes, meats, milks formalin is used for a long time preserve. Traditionally it is used in paints, plastics, textile, nail varnish, constructive industries, to keep the human body for a long time for medical purposes. But it is a course in human health⁸⁶. Many shopkeepers used formalin for attractive and fresh-looking of food and they also want to gain more profit. Applying formalin is varied in various foodstuffs, but in fruits use of formalin is excessive. So it is also a great issue for human health⁸⁷. Many quality controllers have neglected the existence of formalin in processed food and raw food in the market. But now it is a measure issue of ensuring safe food among carnivorous and vegetarian consumers. In the adulterated area is riskier for adding formalin in food but if any measure step doesn't take immediately then it will be a curse in our human life in the next^{88,89}. Nowadays it is a great health concern to abuse formalin in total raw foodstuff. If it continues for a long time then this nation will be developed as a weak nation⁵⁰. As Bangladesh is a tropical country with its hot

and humid atmosphere; fruits, vegetables, fishes, meat, milk, and other perishable food is tend to decay. Formalin is used highly and illegally in fishes to keep it fresh, vegetables (tomato and cucumber), fruits (apple and grapes) milk, drinks, sweetmeat, ice-cream and. It is easy to use so fishermen are eager to use it rather than ice block. Asthma, abdominal pain nausea vomiting can occur by its toxic effects^{90, 91}. It also expedites DNA-protein crosslink mainly in the frontal regions of the nasal tissue through inhaled exposure in rodent animals^{92,93}.

Health effect:

Formalin harms human health. When handlers handle it then it will affect their eyes, nose, and throat very badly because of its formaldehyde vapor. Formalin tolerable level is 0.05 ppm but when it exceeds about 0.3ppm in the air then this level may cause impatience in the sensational part of the human body such as eyes, nose, throat, and also difficult to breathe⁹⁴. A level > 5-30ppm of formalin in the air may cause health crises. Asthma, ulceration, necrosis of the mucous membrane pain with inflammation can occur. A protective layer of skin can destroy it. Skin loses its oiliness and became dry, cracking, flaking. Formalin also affects the digestive system, respiratory system, cardiac, nephrological. Neurological problem and also causes cancer^{95, 96, 97}. Formalin is a toxic solution to all age's people also animal with formaldehyde solution. Even 37% doses of formalin can cause a human death because it can convert as formic acid in the human body. As a result, blood turns into acidic form and difficult to breathe. Consuming it can cause serious injury to the health. It can affect our digestive system, damaging our liver brain, bone marrow, body defense, and also injuring the fetus in pregnant women. Formalin has bad effects on the brain and causes loss of memory called dementia. Defense mechanisms also hamper, anemia and blood cancer can occur. It can abate the human reproductive system and decrease the fertility system. Birth defects can occur and fetuses don't develop, IQ can be reduced for its consumption. All ages; children and older people do not safe from formalin because the defense mechanism is very poor. Many said that formalin does not remove by washing. Nowadays formalin is used in the whole foodstuff such as fruits, vegetables, milk, fish and other food sources which is important food sources for all age's people. It is a silent killer for our future generation because the activity of formalin is very slow and flows through into the human blood. If it keeps remaining in our blood for a long time then it can develop digestive, cardiac, nephrological. Respiratory, and neurological problems along with cancer^{98, 99, 100, 101}.

Recognition (Test) of food adulteration:

Test of food adulterations easy technique, low cost & less time invented by Bangladesh University of Engineering Technology (BUET) institute. Buyers can now be confident of food safety themselves by consuming a litmus-like paper intended by Buet researchers to regulate the presence of formalin in food stuffs. Besides this modest test will fee just Tk 1 every single strip. Rings on the chemically-treated paper will change purple to appearance that the liquid sample has formalin in food stuffs. The deep light the colour presents, the supplementary formalin is there in the food stuffs. The analytic paper can notice formalin attentiveness as low as a few ppm to as high as 1,000 ppm. Formalin Test in Food Items: Simple solution, minimum cost¹⁰².

Argemone oil:

Gall bladder contains carcinoma which can invade on gastrointestinal tract resulting development of cancer ¹⁰³. For its poor prognosis majority of gall, bladder analyses are delayed. At the presentation time of the tumor, this prognosis is reliant on histological subtype, grade, and stage. Overall the rate of GBC survival patients is 5% with 5 years under the provision. 165 years old women are in GBC patients ¹⁰⁴. Gallstones also involve increasing GBC ¹⁰⁵. The region of Asia –Pacific GBC is a malignant form that is attracted in the gastrointestinal ¹⁰⁶. In the northern part of India, the incidence rate is not valueless, among the 100000 population 4.5 were men and 10.1 were women ¹⁰⁷. But it is not the similar insight of Chile to India. In Chile, the incidence rate is 7.5 per 100000 people ¹⁰⁸. There are some various factors involved in GBC which are chronic infection of the biliary tract (cholelithiasis), typhoid carrier state, dietary factors, genetic predisposition, chemical carcinogens, cigarette smoking, high parity, post-menopausal state, and obesity ^{104,105}. India as a subcontinent country, west region of India peanut oil is used as edible oil, coconut oil is used in the south region. And in the northern and eastern regions of India mustard oil is used as edible oil. Mustard oil is the yield from Brassica nigra ¹⁰⁹. Mustard oil also has health benefited for hair and skin massage. But now this oil is adulterated by argemone seed oil ¹¹⁰. Argemone oil has a toxic effect on benzophenanthridine alkaloids, sanguinarine, and dihydrosanguinarine ¹¹¹. Argemone Mexicana seed and mustard seeds are both found in India. Mustard oil yields from mustard seeds also argemone oil yield from argemone Mexicana seed. Argemone oil is very injurious for human health for its properties. It is used as adulterants for its yellowish color. Human fall in dropsy as a dreaded disease for its ¹¹². By consuming argemone oil causes hypertension, Dropsy, glaucoma, diarrhea, vomiting, and anemia for its non-edible portion and also contains two alkaloids sanguinarine and dihydro-sanguinarine. Sanguinarine has also toxic properties which are carcinogenic ¹¹³. The most important symptoms of dropsy are Vomiting, anorexia, palpitation, nausea, diarrhea, dyspnea, hyperpigmentation of body parts, burning sensation of eyes, crepitations in the lungs, and gallop rhythm bilateral pitting edema of lower limbs, erythema, breathlessness, tachycardia, and hepatomegaly ¹¹⁴. There are several countries where epidemic dropsy is revealed, Burma, Fiji Island, Nepal, and South Africa. From time to time several intermittent cases have been reported in different states of India, including Andhra Pradesh, Bihar, Delhi, Maharashtra, Madhya Pradesh, Rajasthan, Uttar Pradesh, and West Bengal. Sanguinarine is an interconvertible alkaloid that has been used in tubes of toothpaste and oral rinse products in Europe and the United States ^{115, 116}. Sanguinarine can bind with DNA by interaction with GC-rich regions ^{117, 118}. Sanguinarine can cause DNA damage in the liver, bone marrow, and blood cells in mice. It also has carcinogenic potential in mouse skin ^{119, 120, 121}. Argemone oil invades the capillaries cause the leakage of serum albumin. As a result, capillary permeability is large ¹²². It also produces intoxication in the skin, liver, lungs, kidneys, and heart by the experimental and clinical supervision ¹²³. Butter yellow is a synthetic color that is in light pale cheaper oil and also adds in mustard oil. The chemical name of butter yellow is 30-methyl -4-dimethyl-aminoazobenzene. In India using a rate of butter yellow is more than the percentage of Uttar Pradesh is 3.5%. In 2002 July 50%

are used in Lucknow with artificial color butter yellow in mustard oil ¹²⁴. Butter yellow has binding power with DNA and creating genotoxic and mutagenic responses ¹²⁵. For its toxicities, it can damage the human hepatic cell, produce skin tumors and cause cancer in the respiratory tract ^{125, 126}. Now butter yellow is banned for its toxicity and more reaction capacity. In India, gall bladder cancer is shown now Gangetic basin state. Because they consumed more mustard oil and mustard oil is more adulterated oil in India. So the incidence rate of Gall bladder cancer is high in India for adding argemone oil and butter yellow in mustard oil ¹²⁷.

Artificial Sweeteners:

There is some controversy with artificial sweeteners for health hazards. An animal study has shown that body weight gain by causing of artificial sweetener. In rate artificial sweeteners is given in response to insulin and study showed that blood sugar doesn't increase because it is stored in tissues. But artificial sweeteners increased caloric intake, increased body weight, and increased adiposity ¹²⁸.

Aspartame:

Aspartame uses in meat, milk, fruits, and vegetables, tabletop sweeteners, carbonated soft drinks, yogurt, and confectionery. Some animal studies have shown that aspartame contains/pretenses palliative, antipyretic and anti-inflammatory action. Interference of aspartame with rheumatoid factor activity has been anticipated to relieve the pain and immobility resulting from chronic inflammation of joints ^{130, 131, 132}. Aspartame is capable to produce an allergic reaction that is responsible for diketopiperazine a compound form of aspartame ¹³³. Aspartame exceeds 86 degrees then it converts into formic acid. After that, it causes metabolic acidosis ¹³⁴.

Saccharin:

One animal study has shown that consumption of products containing saccharin may lead to increased body weight and obesity by interfering with fundamental homeostatic and physiological processes ¹²⁹. Permitting to the Intercontinental Agency for Research on Cancer, portion of the World Health Organization, "Saccharin and its salts were relegated from Group 2B, perhaps cancer-causing to humans, to Group 3, not classify able as carcinogenic to humans, despite sufficient evidence of carcinogenicity to animals, for the reason that it is cancer-causing by a non-DNA-reactive tool that is not applicable to human being for the reason that of dangerous interspecies changes in urine conformation ¹³⁵. One animal study has shown that if saccharin-containing products consume then it break down fundamental homeostatic and physiological processes and causes increased body weight and obesity ¹²⁹.

An Overview of food Adulterants and their Safety limits, and Health hazards:

Table 11 shows that total 7 food Adulterants and their Safety limits, and Health hazards as per review of many papers.

CONCLUSION

The impact of food adulteration will be a burial for the next generation. Adulterated food and the use of chemicals on

foodstuffs are ruining our future generation, the impact of food adulteration falls most on children and aged people. Children are dropping their disease confrontation power for impure foods. Their medical expenditures will increase day by day which will cast a serious impact on the socio-economic conditions. So the entire nation is at a terrible risk due to food adulteration. Conferring to the World Health Organization and Food & Agriculture Organization, approximately 45 lakh people in Bangladesh are existence infected with numerous diseases every year. The administration must be stricter in this concern. Rigorous action should be taken against the violators of food safety laws. At the same time, we all should be aware of the serious impacts of food adulteration.

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TABLE 1. The worldwide occurrence of melamine in milk and dairy products.

Country	Matrix	No. of sample	No. of positive sample	Range (mg/kg)	References
China	Infant milk formula	8	100%	9.49-258	31
	Growing up milk formula	8	100%	7.75-251	
	Full Cream Milk Powder	6	100%	29.1-39.7	
India	Pasteurized milk	7	100%	0.028-0.071	32
	Powdered milk	10	100%	0.0001-0.0006	33
Newzeland	Dairy products	180	6 (>3%)	>1 – 20	30
Canada	Dairy products	80	60 (75%)	0.0043-0.346	30
America	Dairy products	44	100%	0.137-0.249	30
United kingdom	Dairy products	21	-	33-259	30

Iran	Yoghurt	15	100%	0.2-1.12	28
Milk		15	100%	0.12-0.41	
	Infant formula	15	96%	0.31-4.52	
Cheese		15	93%	0.14-3.16	
	Coffee mate	15	100%	0.05-1.52	
Turkey	Pasteurized milk	100	0	-	34
	Powdered infant formula	50	0	-	
	Fruit yogurt	50	44%	Mean: 294±98	
	Soft cheese	50	2%	Mean: 121	
	Milk powder	50	8%	Mean: 694±146	

TABLE 2. Products positive for melamine

Product category	No. of positive products	Reported by Chinese authorities					
		No. of samples with different levels of melamine (mg/kg)					
		< 1	1 to ≤ 2.5	2.5 to ≤ 10	10 to ≤ 100	100 to ≤ 1000	> 1000
Powdered infant formula	22	2	1	2	13	3	1
Liquid milk & yogurt	24	4	5	15	0	0	0
Powdered milk products	31	0	1	2	7	10	11
Total	77	6	7	19	20	13	12
Reported by other national authorities							
Liquid milk & yogurt	17	0	4	7	5	1	0
Powdered milk products	23	14	3	2	3	1	0
Snack foods	13	1	1	5	6	0	0
Frozen processed foods	15	5	3	2	5	0	0
Ammonium bicarbonate	2	0	0	0	0	2	0
Nondairy creamer	1	0	1	0	0	0	0
Protein powder	2	0	0	2	0	0	0
Dried egg powder & liquid eggs	5	3	1	1	0	0	0
Whole eggs	4	0	0	4	0	0	0
Animal feed	4	0	0	2	1	0	1
Frozen dairy products	5	0	0	2	3	0	0
Confectionary products	158	0	4	92	53	9	0
Total	249	23	17	119	76	13	1

TABLE 3. Range of melamine levels detected in various food products (Reported by Chinese authorities)

Product category	Contamination range (mg/kg)	No. of positive products
Powdered infant formula	0.1-2569	22
Liquid milk & yogurt	0.6-648	52
Powdered milk products	<1-6196	56
Frozen dairy products	4.4-60.8	6
Confectionary products	0.3-945.9	200
Snack foods	0.5-54	17
Frozen processed foods	0.5-41	20
Ammonium bicarbonate	33.4-508	4
Nondairy creamer	1.5-6694	2
Protein powder	3.8-8.3	2
Dried egg powder & liquid eggs	0.1-5	8
Whole eggs	2.9-4.7	4
Animal feed	3.3-21000	7

TABLE 4. Reported number of children affected by melamine in China (of 22.4 million patients screened) as of 1 December 2008 ^{35 **}

Status	Number	Percentage of reported cases
Cases reported	294000	100
Cases hospitalized	51900	17.6
Hospitalized cases already discharged	51039	17.4

Hospitalized cases still in serious condition	154	0.05
Cases still in hospital	861	0.3
Deaths	6	0.002

**As the incident developed, updates on affected infants and children were provided by the Chinese Ministry of Health. The most recent update confirmed a total of 6 deaths and 294,000 cases associated with the consumption of melamine-contaminated milk and milk products as of 1 December 2008 ³⁵.

TABLE 5. Concentration of Calcium carbide ⁴¹.
Chemicals **concentration**

Calcium carbide acts as a carcinogen	0.468 mM in the blood causes mild effects in human
	3.9 mM results in life-threatening conditions

TABLE 6. List of commonly used chemicals for fruit ripening and their effects on human health ⁴⁰.

Name and chemical structure	Possible health effect
Calcium carbide (CaC ₂)	<ul style="list-style-type: none"> • Direct consumption of acetylene gas released by calcium carbide can reduce oxygen supply in the brain. • Calcium carbide in general is alkaline and can irritate in the mucosal tissue in the abdominal region • Arsenic and phosphorous found in industrial grade calcium carbide can cause dizziness, frequent thirst, irritation in the mouth and nose, weakness, permanent skin damage difficulty in swallowing, vomiting, skin ulcer, etc
Ethephon (C ₂ H ₆ ClO ₃ P)	<ul style="list-style-type: none"> • No reported adverse effect on human health for limited concentration (maximum residue limit: 1ppm to 50ppm depending on fruits)
Ethylene (C ₂ H ₄) and methyl jasmonate (C ₁₃ H ₂₀ O ₃)	<ul style="list-style-type: none"> • Comparing to calcium carbide and ethylene glycol, ethylene and methyl jasmonate are less (or non-) toxic for human consumption; however, they are relatively expensive as fruit ripening agents
Ethylene glycol (C ₂ H ₅ O ₂)	<ul style="list-style-type: none"> • Direct consumption of ethylene glycol may cause kidney failure

TABLE 7. DDT concentrations in the dry fish samples (the concentrations are in ppb unit) ⁶⁶.

*Name of the sample	Organochlorine insecticides
	DDT (ppb)
Bombay duck (Loittya)	44.395
Indian salmon (Lakhua)	233.727
Ribbon fish (Chhuri)	43.158
Chinese pomfret (Rupchanda)	7.849
Anchovy (Teilla phasa)	19.416
Croaker (Poa)	16.404

*Parenthesis indicates the Bengali name

TABLE 8. The adulterated food samples and their Synthetic food color ⁷⁵.

Name of the food	color
Kaju pista leechi	Pink
Burfi	Light Brown
Jam	Red
Boondi Laddoo	Yellow
Laddoo	Light orange

TABLE 9. Rf values of samples and standards ⁷⁵.

Synthetic food Color	Rf value of standard
Pink	0.16
Parrot green	0.58
Light green	0.25
Dark Green	0.56
Dark orange	0.52
Light orange	0.21
Dark brown	0.22
Light Brown	0.45
Red	0.27
Yellow	0.25

TABLE 10. Safety limit for Artificial Sweetenars ¹³⁶.

Artificial Sweetenars	Safety limit for ADI (mg/kg bw/day)
Acesulfame potassium (Ace-K)	32.8
Aspartame	50
Neotame	3
Saccharin	15
Sucralose	5

TABLE 11. Overview of food Adulterants and their Safety limits, and Health hazards

Name of the adulterants	Foods adulterated	Safety limits	Health hazards
Melamine	Milk, Frozen foods, Powdered infant formula, Liquid milk & yogurt, Powdered milk products & Frozen processed foods	0.2 mg per kg	Block the urinary tubules, urinary stones among children & Kidney stone, many pets were ill & deaths to the formation of melamine cyanurate crystals which affected in the kidneys of these animals, melamine causes severely infant death when it reacts with cyanuric acid into the body, Pet food is adulterated by melamine causes kidney problem in cats & dogs.
Formalin	fruits, vegetables, fishes, meats, milks	≤ 0.1 ppm	It can affect our digestive system, damaging our liver brain, bone marrow, body defense, and also injuring the fetus in pregnant women. Formalin has bad effects on the brain and causes loss of memory called dementia. Defense mechanisms also hamper, anemia and blood cancer can occur. It can abate the human reproductive system and decrease the fertility system. Birth defects can occur and the fetus doesn't develop, IQ can be reduced for its consumption. All ages; children and older people do not safe from formalin because the defense mechanism is very poor.

Calcium Carbide	bananas, mangoes, guavas, papayas, tomatoes and pineapples but not only used for coloring fruits and vegetabales such as cucumber, tomato but also used for quickly ripens green tropical fruits	-		Cancer of lung, liver, and kidney, mouth ulcers, headaches, mental confusion, seizures, sleepiness, and long-term effects as memory loss, hypoxia, and cerebral edema, Calcium carbide contains traces of arsenic and phosphorus hydride, which harmful for the neurological system, calcium carbide can reduce oxygen supply in the brain
Argemone oil	Mustard oil	100 ppb Argemone oil/gram in oil		Argemone oil invades the capillaries cause the leakage of serum albumin. As a result, capillary permeability is large. It also produces intoxication in the skin, liver, lungs, kidneys, and heart.
DDT	Bombay duck (Loittyta), Ribbon fish (Chhuri), Anchovy (Teilla phasa), Croaker (Poa), Chinese pomfret (Rupchanda) and Indian salmon (Lakhua)	0.5 mg/m ³		Cancer especially in the breast, liver, pancreas, and some reproductive problems & non-allergic asthma, the major risk of cancers of the liver and biliary tract, causes puberty increases the risk of breast cancer.
Sweeteners	meat, milk, fruits, and vegetables,	Sweeteners	Safety limit for ADI (mg/kg bw/day)	Mainly artificial sweeteners cause allergic reaction & metabolic acidosis, Saccharin contains sulfonamides which can cause an allergic reaction in some individuals, Several recent studies have found that saccharin raises blood glucose levels because gut bacteria are changed triggered by sweeteners, Aspartame causes or increases the risk of headaches, dizziness, seizures, Attention Deficit Hyper-activity Disorder(ADHD), birth defects & Alzheimer disease.
		Acesulfame potassium (Ace-K)	32.8	
		Aspartame	50	
		Neotame	3	
		Saccharin	15	
		Sucralose	5	
Synthetic food Colors	Various types of sweets, some cultural foods named beguni, peaju, Laddoo, Jam & Boondi Laddoo	-		Indigestions, vomiting, diarrhea, allergy, asthma, several kinds of neurological diseases, and even cancer & degenerative changes in the stomach, liver, kidney, abdomen, and testes and also found to cause cyanosis.

FIGURE LEGENDS

FIGURE 1. Flow chart of occurrence of melamine in milk and dairy products ³⁶.

