

AGRO- TERRORISM

VILLAINS, VICTIMS AND
COUNTER-MEASURES



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CHAPTER NINETEEN

Risks of Food Adulteration: Types, Causes and Methods

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BACKGROUND INFORMATION

FOOD IS essential for energy, sustenance of life and carrying out of different metabolic activities. It is one of the basic needs of every living being and is composed of carbohydrates, water, fats and proteins, which can be eaten or drunk by animals, including humans, for nutrition or pleasure (Karim, 2020; FAO/WHO, 2007). Foods in our daily diet include vegetables, fruits, legumes, pulses, grains, etc. which can either be consumed raw or made into delicacies. Almost all foods are of plant or animal origin. Animals are used as food either directly or indirectly by the products they produce. Meat is an example of a direct product taken from an animal, coming from either muscle systems or organs. Products from animals include milk which in many cultures is drunk or processed into dairy products such as cheese, butter. Also, birds and other animals lay eggs, which are often eaten, and bees produce honey, nectar from flowers, which is a popular sweetener in many cultures (Awasthi *et al*, 2014).

Food adulteration is described as the act of either adding extraneous substances (adulterants) into food items or products or reducing essential nutrients partly or wholly for financial gain or due to carelessness and lack of proper hygienic conditions during processing, storing, transportation, and marketing (Asyrat and Belete, 2015). It is a legal offense and when the food fails to meet the legal standards set by the government, it is said to have been adulterated. It takes place when substances that degrade the quality of food are intentionally or unintentionally added to it. Some of these substances may be harmful.

Adulteration in food has been a concern since the beginning of civilisation, as it not only decreases the quality of food products but also has effects on health (Sangita *et al*, 2017). Food adulteration is usually done through mixing, substituting, abstracting, and concealing the quality of the food product. Adulteration can be viewed in different ways, either mixing or substitution of inferior substances to the one which is superior to the adulterants or removal of some valuable constituents from a given food

product (Mansuri, 2011). Adulteration can also be the addition of a non-food item to increase the quantity of the food item in raw or prepared form, preservation purpose, and improvement of appearance which can be done either intentionally or unintentionally (Misgana, 2020).

Adulterants are usually chemical substances that should not be contained within our food or beverage and may be intentionally added to more expensive substances to increase visible quantities and reduce manufacturing costs, or for some other deceptive or malicious purpose (Anita and Neetu, 2013). The substances, typically termed adulterants, could be chemicals or any material of inferior quality or useless which are not to be present in the food and may be intentionally added to reduce manufacturing costs or for a cruel purpose (Anita and Neetu, 2013). The adulterant may be present in any form and any quantity. Adulterants are mostly harmful and pose the ability to lower the potency of the product. Even if the adulterant is not harmful, it reduces the nutritional value of the food to a greater extent. Some adulterants are also identified as carcinogenic or lethal when exposed to them for a longer period. Different types of adulterants are used to adulterate different types of food.

Food adulteration is becoming a big challenge to food processors in Nigeria, despite the effect on people's health. The problems of adulteration makes the food items used in our daily life unsafe and unhygienic for use due to poor handling (Asrat *et al*, 2012). According to Opia (2020), it is now an evolving problem in Nigeria that has led to the deaths of many people especially the vulnerable groups that include mostly children, the elderly and immune-compromised persons. In general, adulteration of food items has a very serious impact on producers/farmers, processors or manufacturers/enterprises, consumers and government (Choudhary *et al*, 2020). And the implications for national development is enormous. Increased public awareness and consumer education about the dangers of food adulteration are key factors to successful food legislation in Nigeria.

Generally, the main reason for food adulteration is for economic gain and not necessarily to improve the nutritive quality of the food product. Other reasons may be to increase shelf life and to fetch higher cash income by increasing the volume of the food material. Food adulteration is a major concern for the food processors. The process reduces the quality of the food substance, and its consumption may be fatal to the health of the consumer (Choudhary *et al*, 2020). While increasing profit margins-initiated adulteration done by some selfish producers, processors, and retailers, this is due to dishonesty and lack of accidental quality assessment on products suspected (Asrat and Zelalem, 2014). Despite the increasing awareness of the need to know and combat food deceit, little has been done to obtain

consumers' knowledge and perceptions of food adulteration (Edward *et al.*, 2022). While most research studies focus on food hygiene, there is a lack of information about consumers' knowledge regarding food adulteration. The health of the consumer who is innocent about the content of the food to be consumed is therefore at stake. However, not all adulterants are harmful to human health.

WHAT MAKES A FOOD ADULTERATED?

A food is described to be adulterated when any one of the following characteristics is attained:

- (1) The food item sold by a vendor is not of the nature, substance, or quality demanded by the purchaser or which it purports to be,
- (2) The food item contains any substance affecting its quality or if it is so processed as to injuriously affect its nature, substance, or quality,
- (3) Any inferior or cheaper substance has been substituted wholly or partly for the article, or any constituent of the article has been wholly or partly abstracted from it to affect its quality or if it is so processed as to injuriously affect its nature, substance, or quality,
- (4) The food material has been prepared, packed, or kept under insanitary conditions whereby it has become contaminated or injurious to health;
- (5) The food item consists wholly or in part of any filthy, putrid, disgusting, rotten, decomposed, or diseased animal or vegetable substance or being insect-infested, or is otherwise unfit for human consumption;
- (6) The food is obtained from a diseased animal;
- (7) The food contains any poisonous or other ingredients, which is injurious to health;
- (8) The container of the food item is composed of any poisonous or deleterious substance, which renders its contents injurious to health;
- (9) The food material contains any prohibited colouring matter or preservative, or any permitted colouring matter or preservative above the prescribed limits;
- (10) The quality or purity of the food falls below the prescribed standard, or its constituents are present in proportions other

standard or its constituents are present in proportions other than those prescribed, whether or not rendering it injurious to health.

TYPES OF FOOD ADULTERATION

Intentional Adulteration

This is when a food item is deliberately adulterated with substances that look similar to the constituents of the food. This could be intended to increase its weight and gain more profit. The most frequent type of adulteration of this category is color adulteration (Misgana, 2020). Examples of intentional adulteration are the addition of water to liquid milk, extraneous matter to ground spices or the removal or substitution of milk solids from the natural product. Intentional adulteration is the inclusion of inferior substances having properties like the foods in which they are added; thus, they are difficult to detect (Choudhary *et al*, 2020).

The adulterant could be physical or biological in nature and is done to promote the level of their essential nutrients after reduction of a given amount to increase their profit margin by several chemicals like urea and melamine; and increase its volume by adding substances such as starch, flour, cane sugar, vegetable oils, water, skim milk, sand, chalk powder, molasses, stone, brick powder, ergot, chicory, roasted barley powder, ground papaya seeds, etc. into various food items (Choudhary *et al*, 2020). **Objectionable substances** such as **foreign matters** (plastic particles, glass, metals, wood, stones, sand, etc.), undesirable parts of raw plants (parts of stems, roots, twigs, etc.) and filth (such as insects, rodent parts, rotten items, mould, etc.) can also be present in foods as adulterants. Awasthi *et al* (2014) reported that this form of adulteration is the most dangerous form because of amounts of nutrients deducted and extraneous substances added into food items that are done by business-oriented people without any care for how they would affect humans.

Incidental Adulteration

This type of adulteration is due to a lack of proper hygienic conditions for food products and drinks from the production site to the consumption table. Unintentional (incidental) adulteration is a result of ignorance or the lack of facilities to maintain food quality (Misgana, 2020). If a food item contains some poisonous or deleterious materials above a regulatory limit, it may render harmful effects upon consumption. For instance, **Brie Cheese** is adulterated with *Listeria monocytogenes*. Food can be adulterated when it is contaminated by microbial pathogens such as bacteria, fungi, protozoa, or viruses. For example, the presence of *Salmonella* in fruits,

vegetables, or poultry products makes them adulterated. This kind of adulteration can be extremely harmful and may even cause death.

Accidental food adulteration as the name implies occurs accidentally (incidentally) without our knowledge (Manasha *et al.*, 2016). Accidental adulterants are pesticide residues, the dropping of rodents, larvae in foods, etc. Metallic contamination with arsenic lead and mercury can also occur accidentally. Accidental adulterants also involve pests such as rodents and insects that trespasses the food to a high degree and produce impurity in the form of excreta, bodily secretions, and spoilage through micro-organisms. The most common accidental adulterants are pesticides, dichlorodiphenyltrichloroethane (DDT), and residues present in the plant product (Pandit *et al.*, 2002). The maximum permissible limit for DDT is 3 ppm which sometimes is over crossed (Kannan *et al.*, 1997).+

Metallic Contamination

Metallic contaminants may enter the food supply chain through environmental contamination or during the food production process and they may be present in food in trace amounts (Deepti, 2014; World Health Organization 2017). It may happen accidentally or even intentionally. Arsenic from pesticides, lead from water, and effluent from chemical industries, tin from cans are some of the metallic contaminants which could be considered another incidental type of adulterant in foods (WHO, 2017).

Packaging Hazard

The containers or materials in which the food is packed may also interfere and mix with the constituents of the food, leading to packaging hazards.

Natural Adulteration

This occurs due to the presence of certain chemicals, organic compounds, or radicals naturally occurring in foods that are injurious to health and are not added to the foods intentionally or unintentionally. Some of the examples are toxic varieties of pulses, mushrooms, green and other vegetables, fish, and seafood. About 5,000 species of marine fish are known to be poisonous and many of these are among edible varieties (Manasha, 2016).

Causes of Food Adulteration

Many factors have been reported as the causes of food adulteration. Majorly in Nigeria, factors such as food insecurity and economic benefits to food processors are germane in food adulteration. As the nation's population is growing at alarming rate, food is often adulterated to meet the needs of the

populace. Other factors that may contribute to food adulteration identified by Choudhary *et al*, 2020; Dane, 2019 and Lakshmi, 2012 are listed below:

- (a) **Food insecurity:** it is a prevailing challenge in the world and most of the developing countries are significantly affected, including Nigeria. In order to meet the food needs of the people amidst poverty, food adulteration is widespread. It is therefore obvious that when there is food shortage in a country, food processors and other agents exploit the opportunity to add chemical or biological substances to their products to maximise profit.
- (b) **Traders' profit motivation:** traders practice food adulteration because they feel it is a part of their business strategy. Foods can be adulterated by food processors because of greed for increased profit margins. Impurities can be put in food items intentionally e.g. adding water into milk to increase volume and make more profit.
- (c) **Illiteracy of the public:** this is the lack of awareness/knowledge of proper food consumption. Illiterates may not be aware of the harmful effects or disease outbreaks caused by consuming adulterated foods.
- (d) **Lack of efficient food laws:** food adulterations are practiced when there are no efficient and effective food laws to punish perpetrators of the act. When there are efficient food laws, food adulteration will be reduced drastically
- (e) **Lack of Government initiatives:** If the Government is serious with the issue of food adulteration by doing the needful, the menace will be eradicated or reduced to the barest minimum. There will be increase in food adulteration if the government does not have initiative to stop it.
- (f) **Demand-supply imbalance:** This is due to a rapidly growing population. When there is an increase in the demand for food more than what is supplied to the market due to rapidly growing population, food processors are tempted to cash on the situation by adulterating available stocks.

FORMS OF FOOD ADULTERATION

According to Choudhary *et al* (2020); Dane (2019, food adulteration assumes the following forms:

- (1) **Mixing:** this is when sand, stone, dust, clay, mud, and pebbles are mixed with food particles e.g. grains, pulses and other crops.
- (2) **Substituting/Replacing:** Some healthy constituents are substituted or replaced with cheaper and low-quality ones, which alter the nutritional values of the food and may even impose a health hazard.
- (3) **Using Decomposed Food:** This method indicates mixing decomposed food with healthy or good ones. Food that even conceals damage or inferiority in any manner is also considered to be adulterated. Also, the deliberate mixing of healthy food with questionable quality food leads to the final product being adulterated.
- (4) **Additions of Toxic Substances:** Food adulteration also involves the mixing of food with toxic substances to gain higher profit and increase sales. For example, the addition of colour, dyes, or harmful unpermitted preservatives to attract prospective customers.
- (5) **Misbranding:** This is when there is an altering of the manufacturing dates, expiry dates, list of ingredients or misleading ingredient derivatives, and so on to deceive prospective customers
- (6) **Artificial Ripening:** Adding chemicals to the fruits and vegetables, which speed up the ripening process, is also considered food adulteration. For example, mango is ripened with carbide for meeting commercial demand against supply.

Food Adulteration and its Consequences

Adulterated foods can lead to different health problems after consumption and are considered one of the major problems of everyday life (Mansuri, 2011). Chemical adulterants and colors which are added to food many times prove to be fatal as they pose an onset of health risks or hazards because of the high percentage of carcinogens present in them. Some adulterated food may also affect our organs directly and without much delay by leading to heart, kidney, liver, and many more organ disorders and failure. According to Sangita *et al* (2017), adulterations expose society to many diseases ranging from mild to life threatening. For example, asthma, skin diseases, and cancer are caused by intake of fish, fruits, meat, or milk adulterated with chemicals like formalin. Human health is highly sensitive to food adulteration and sometimes shows immediate side effects like diarrhea, dysentery, and vomiting. For example, coffee powder substituted with date seed powder or tamarind can cause diarrhea (Laura, 2014).

The ugly outcome of intake of adulterated food items leads to harmful

effects such as stomach disorder, dizziness, joint pains, diarrhea, liver disorder, dropsy, gastrointestinal problems, respiratory diseases, cardiac arrest, glaucoma, carcinogenic effects, paralysis, etc. Therefore, health concerns related to food adulteration can be understood to include food poisoning, stomachache, indigestion, loose stools, cough, fever, vomiting or nausea and aphthae in the mouth. Thus, food adulteration occurs globally and in many facets and affects almost all food commodities. It not only constitutes a considerable economic problem but also may lead to serious health issues for consumers and has implication for national development. It is found that there are various chemicals and colors used in fruits and vegetables which are very poisonous for health. Calcium carbide used for ripening of mangoes, bananas, plantains and copper sulphate used to ripen fruits faster. All these have been implicated in human health.

Table 19.1: Examples of Adulterants in Food Products and their Harmful Effects

Food Product	Adulterant	Harmful Effects
Milk and Curd	Water and starch powder	Stomach disorders
Grains	Dust, pebbles, stones, straw, weed seeds, damaged grain, etc.	Liver disorders, toxicity in the body, etc
Pulses/ Beans	Dyes, chemicals, and lead chromate	Stomach disorders
Coffee powder	Chicory, tamarind seeds powder	Diarrhea
Tea	Artificial colouring agents	Liver disorders
Sugar	Chalk powder, washing soda, urea, etc.	Stomach disorders and kidney failure
Pepper	Dried papaya seeds and blackberries	Severe allergic reactions including stomach and skin irritations
Edible Oils	Mineral oil, Karanja oil, castor oil, and artificial colours	Gallbladder cancer, allergies, paralysis, cardiac arrest, and increased LDL cholesterol
Turmeric powder	Pesticide residues, sawdust, chalk dust, industrial dyes, metanil yellow dye arsenic, lead metal etc.	Cancer and Stomach disorders

Chilli and coriander powder	Redbrick powder, rhodamine B dye, red lead, dung powder, soluble salts, water-soluble synthetic colours, and other common salts	Metal toxicity, cancer, lead poisoning, tumour, variations in blood pressure, and other stomach-related disorders
Fruits and vegetables	Chemical dyes, malachite green, calcium carbide, copper sulphate and oxytocin saccharin wax	Stomach disorders, vomiting, and dyes used are highly carcinogenic
Tomato sauces	Pumpkin pulp, non-edible artificial colours, and flavours	Gastritis and inflammation of vital organs
Ice cream	Pepper oil, ethyl acetate, butyraldehyde, nitrate, and washing powder. The kind of gum is added which is prepared by boiling different animal parts including the tail, udder, nose, etc.	Dreadful diseases that affect organs including lungs, kidneys, and heart

Source: Raju *et al* (2017); Choudhary *et al.*, (2020)

CONCLUSION

Food adulteration has an impact on food materials in various forms thus affecting their properties. Food adulteration in a developing country like Nigeria is a serious problem as there are less strong regulatory bodies unlike developed world. These adulterations have many public health and economic implications. Some of the major risks of food adulteration include adulterants present in the food triggering stomach issues, liver or kidney damage, cardiac issues along with other health ailments (e.g. cancer), the addition of food colours or artificial flavours causing dizziness, headaches, fatigue, etc. Unscrupulous processors can alter the nutritional values of food, thus leading to a deficiency of important nutrients in the body.

A better coordination among all the bodies charged with responsibilities for food safety and adulteration, capacity building by training of personnel, producers and regulators is also vital towards achieving success in implementation of food safety legislation. Food processors, especially the Small and Medium-sized Enterprises (SMEs) should be urged to form associations for ease of government support through training and awareness creation.

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