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FOOD ADULTERATION AND UNETHICAL USE OF FORMALIN

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ABSTRACT

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<p>Food adulteration has become a global problem. Adulteration is not only disregarding the human rights for safe food, but also a serious threat to public health with numerous acute and chronic diseases. The physical and mental development has damaged by adulterated food. The consumption of adulterated food is silently poisoning human body everyday which may result a serious bad impact in our future. This thesis describes the health effects of the consumption of adulterated food, a complete narration of adulteration, and the role of the relevant authorities in its disposal. This thesis also focused on most common carcinogenic chemical adulterant called formalin (aqueous formaldehyde) which is widely being used especially in seafood, vegetables and fruits. Formaldehyde is a very useful chemical for various industrial and laboratory applications but its unethical use in food and feeds as a preservative has become a hot topic and matter of headache from last decade. The main purpose of this study is to discuss the possible health hazards of ingestion or inhaling of different adulterants, how people are being exposed into this poison, some possible solutions to eliminate formalin poisoning and to determine the reasons behind food adulteration. The aim of this thesis was to create awareness about food adulteration and to create a positive change in customer and seller thought to value a good product then price.</p>		

Key words

adulteration, cancer, carcinogenic, economically motivated adulteration (ema), formaldehyde, formalin, preservative, textile dye, unethical use

CONCEPT DEFINITIONS AND ABBREVIATIONS

Abbreviations

D.D.T	Dichloro-diphenyl-trichloroethane.
EME	Economically motivated adulteration
FAO	Food and agriculture organization
WHO	World health organization
EFSA	European food safety authority
FSSA	Food safety and standards act
FDA	Food and drug administration

Concept definitions

Food Adulteration In general adulteration means the action of making something poorer in quality by addition of poor substances. Similarly, food adulteration is an act of decreasing food quality by substituting, adding, mixing, false labelling partly or fully with prohibited substances to increase quantity or to increase shelf life of the product unfairly is known as food adulteration.

Formalin Formaldehyde is a chemical, commonly used in industry for manufacturing plastic resins used in particleboard products and as an intermediate product to synthesize different chemicals and this aqueous solution of formaldehyde is called formalin. Formalin is a cadaverous chemical that contains a 37-50% aqueous solution of dissolved formaldehyde (CH₂O). It is flammable, highly reactive with many substances, and easily polymerizes a colourless gas at normal temperature and pressure. In air it decomposes easily in sunlight, with a half-life of about 30-50 minutes (WHO 1999). In aqueous form it is stable for long time.

ABSTRACT
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1 INTRODUCTION

Food security has become an important global issue with international trade and public health consequences. In response to the rise in foodborne illness, the government from everywhere of the world is accelerating their efforts to improve food security. In world Health Conference, a resolution (WHA 53.15) has been adopted calling the World Health Organization (WHO):

“to give greater emphasis on food safety...with the goal of developing suitable, integrated food safety systems for the reduction in health risk along the entire food chain, from primary producer to the consumers” (World Health Organisation 2006).

In the time of indivisibility, interdependence and interrelatedness of human rights, the right to safe food acclaims significant bearing on the right to health, right to food and most importantly right to life (Leon 2014). At present, the food adulteration has become a matter of headache in south Asia especially in tropical countries like India, Bangladesh, Pakistan, China and Nepal where by the reason of hot and humid weather fruits, vegetables, fish, meat and other perishable foods tends to break down quickly. It has been reported that formalin is now widely and illegally used in fish to keep it fresh, in vegetables (tomato and cucumber), in fruit (apple and grapes) in milk, beverages, sweet meat, ice cream and in different seafood almost all over in Asia, contaminated and indiscriminately ignoring the rights for safe food related to health rights. Although it is not only a matter of concern happening in Asia but also in Europe, America and different countries all over the world who are importing fresh fish, vegetables, meat and different food beverages into their country. Food adulteration is now a global problem and different studies through news, local or international journals has shown that foods are highly adulterated in varying degrees with different chemicals which are harmful for human consumption are mostly by sellers, manufacturers, dealers sometimes even fisherman's and farmers. (Ameet Sharma 2017,686-689; Food safety news 2020; The Times of India 2020; Uddin, Wahid, Jasmeen, Huda & Sutrah 2014.)

2 FOOD ADULTERATION

Food preservation process is a common practice from dawn of the civilization where humans are using different chemicals and procedures to keep the food in store unrotten or undamaged for the longer period. The use of different processes with chemicals as preservatives is good and ethical for the business as well as for the future when, those preservatives or chemicals are not harmful for human health. But the problem appears when people are using different harmful chemicals which are dangerous for human health, which is decreasing the natural nutrient level of food to increase the shelf life is adulteration. Due to these food adulterations, the product which are being adulterated are unable to comply with the definition of safe food by the Food and Agriculture Organization (FAO) and World Health Organization (WHO). Adulteration mainly occurred either for more financially gain or carelessness or lack of proper knowledge of hygiene, processing, storing or transportation results consumer is cheated and being victim of different chronic or acute diseases. Adulteration is a common practice especially in tropical countries or developing countries now a days but by the benefits of worldwide global business this problem spreading whole over the world (Food Safety News 2020). However, adulteration in food and food products may be unintentional or intentional. Unintentionally adulteration includes naturally occurring substandard foods, due to lack of rainfall, drought, short storage conditions. Elseways, intentional adulteration is intended to defraud or deceive consumers. This is more serious, which affect the health of the citizens, including innocent children who are consuming these adulterated foods. Adulteration persists at every level of food from preparation to consumption. Most of the food manufacturers, processors, market suppliers, sellers, restaurant owners and so far, are all involved in one way or another in this unethical practice of food adulteration. Food is being contaminated or adulterated by mixing different types of harmful chemicals and toxic artificial colours and by mixing rotten and perishable foods with good product to sell. (Rahman, Sultan & Rashid 2015,1-7; Agriculture goods 2020; Ameet sharma 2017,686-689). For example, Figure 1 shows the food adulterated by toxic artificial colours to create fresh look.

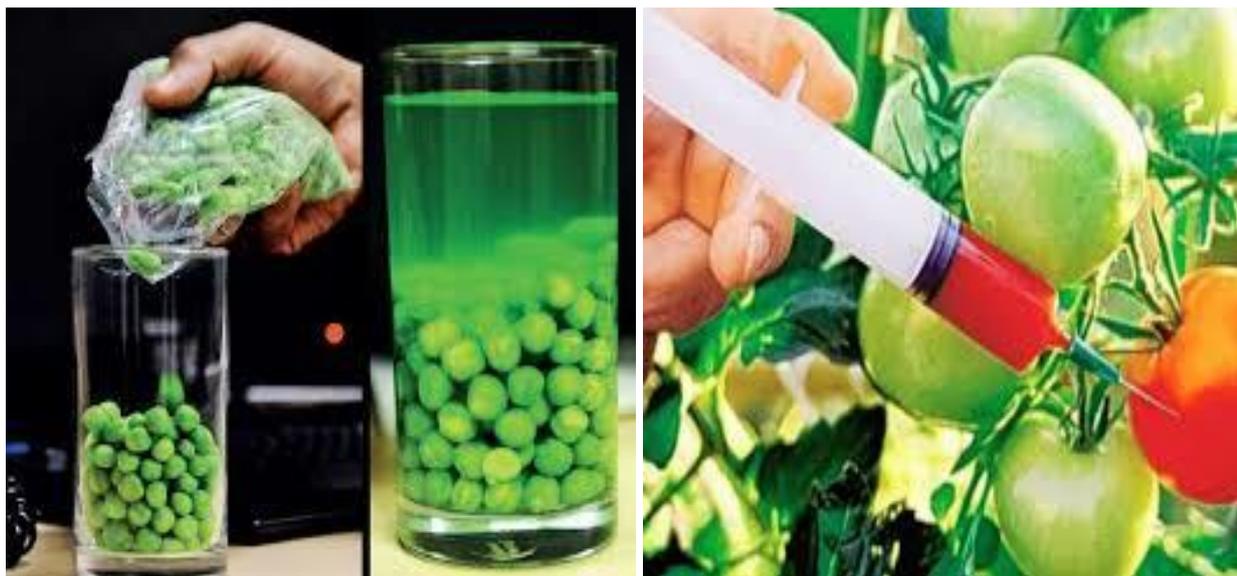


Figure 1: Adulteration by artificial colour mostly textile dye (Pune Mirror 2020).

The use of toxic chemicals in perishable foods is seen at the highest levels that endanger human life (Derek, 2013). The supply of unsafe food has a negative impact on public health, which is serious with acute and chronic diseases. (Rahman M, Sultan M, Rahman M & Rashid M 2015; Food Quality & Safety 2020)

3 TYPES OF FOOD ADULTERATION

Foods are considered adulterated when foods natural quality goes down due to contamination with additives or any foreign chemicals injurious for human health or removing nutrients substances from food. Adulteration of food and food products can be intentional or unintentional. Unintentional adulteration occurs naturally, due to lack of rainfall, drought and poor storage condition. Unintentional adulteration are pesticide residues, rodent droppings, larvae in food. Sometimes metallic or arsenic contamination in food, lead and mercury contamination can also occur accidentally or unintentionally, depends on the soil, air and water properties of the area. It is also including pests such as rodents and insects when they severely break food and produce contaminants at various levels, through microorganisms formed through bodily secretions and pollution. The most common unintentional adulteration are Pesticides, about 1000 pesticides are used around the world to protect crops from insects and these pesticides can remain in the soil and water about 1-2 years which results product contaminated with pesticides. For example, D.D.T is one of the most widely used pesticide which maximum allowable residue limits for different plants is 3 ppm, but sometimes it exceeds unintentionally. Elseways intentional adulteration is done by merchants and traders intentionally who are unashamed and want quick profit to cheat consumers (Kannan et al. 1997; U.S. Environmental Protection Agency 1971,708.).

4 METHODS OF FOOD ADULTERATION AND ADULTERATION IN DEVELOPING COUNTRIES

To lead a healthy life everyone, need to consume fresh fruits and vegetables every day, but these healthy foods are adulterated in different stages before those appear to people hand. Most farmers use different kinds of fertilizers and pesticides to boost production and to save seeds from insect's attacks or diseases. Sometimes they use excess amount of pesticides and fertilizers for more production which results of adulterated, low quality fruits and vegetables. Currently crops, fruits and vegetables are irrigated with wastewater containing detergents, manufacturing waste with high toxic heavy metal concentrations which directly affecting the products. (Agriculture Goods 2020.)

Fruits and fresh vegetables also contaminated with dust grains and smoke while transport or selling in open environment (roadside market, open markets especially in developing countries). To keep the products fresh and good looking for longer period many seller dipping fruits and vegetables in chemical water such as (formalin, copper sulphate) and wax coating. In many cases different colouring dye, dangerous preservatives (not allow in food products), chemicals are using in different food preparation to decrease the expense and to increase the profit unethically. There are different methods are being applied to adulterant foods such as adding or mixing, different kind of dry products are adulterated by adding or mixing. Product likes different crops, seeds, cooking powders are being mixed up with stones, peddles, sands and chalk powder to increase the volume of the product. Besides dipping fruits, vegetables, and fish into harmful chemicals like formalin or different colouring agents to increase products shelf life and appearance has become a common practice in Asian in food markets. Foods are being adulterated by spraying chemicals like carbide to ripe fruits artificially, by using poor preservatives or by adding non-edible materials with good foods. Adulteration also occurred by substitution of good products by cheaper one, mixing decomposed one with good product, hiding food standard, selling expired products or false levelling. (Agriculture Goods 2020.)

The thesis mostly focused on intentional food adulteration which could be control or stop with proper steps. Next page table 1 shows the most common foods are adulterated and the chemicals or adulterants are used to adulterate became a common practice in developing countries.

Table 1. Common Adulterated Foods with adulterants.

Food Article	Adulterants
Milk	Chalk powder, soap powder, starch, formalin, urea, Hydrogen peroxide
Fresh vegetables, fruits, fish, sea foods	Malachite green, oxytocin, saccharin, wax, calcium carbide, copper sulphate, formalin, colour dye
Coffee	Cereal starch, maize, soybean, rye, triticale
Tomato sauces	Pumpkin pulp, non-edible artificial colours, and flavors.
Vinegar	Mineral acid
Curry powder	Starch, food colouring agents, dust
Sugar	Chalk powder, washing soda, urea
Honey	Starch syrup, inverted syrup
Jaggery	Metanil yellow, chalk powder, washing soda
Sweetmeats, Ice cream	Metanil yellow, Pepper oil, ethyl acetate, butyraldehyde, nitrate, washing powder, gum.
Wheat, rice, barley	Dust, stone, pebble, damaged grain
Cloves, Turmeric powder, chili powder, green chili	Yellow aniline dye, non-permitted colourants like metanil yellow
Asafoetida	Soap stone, chalk powder
Salt	White powder, urea
Edible oils and fats, black pepper	Mineral oil (white oil, petroleum fractions)
Fruit juices, soft drinks	Cadmium
Meat and bone meal	Sand, leather meal, blood meal, rock phosphate, formalin
Chilli and Coriander powder	Redbrick powder, Rhodamine B dye, Red lead, dung powder, soluble salts, water-soluble synthetic colours and other common salts.
Jam, Juice and Candies	Non-permitted dyes including metanil yellow and other artificial food dyes.

5 FORMALIN IN FOOD

The widespread applying of formalin in different fruits, vegetables, fish, meats and milks for long term preservation results of enormous threat to human health. Formalin (37 % formaldehyde solution) is traditionally used in industry for different expects but some unethical traders uses those liquids to preserve human foods which is harmful and toxic for human health. Formaldehyde is classified as a protentional human carcinogen, identified by the USA Environmental Protection Agency and International Cancer research Agency as a class 2A carcinogen. On this wise, the use of formaldehyde in food is absolutely unethical, toxic and forbidden. Still industrially it has high demand but the unethical use of formaldehyde in different foods by some dishonest traders resulting a hard-challenging situation for the consumers as well as for the government nowadays. Food adulteration is a crime which becomes a common practise by traders and suppliers in different markets all over Asia and some other European countries. This thesis aims to create awareness about formaldehyde and its adverse effects of its appropriate and inappropriate use for human health. The thesis mostly focused on the food adulteration by formalin (National Toxicology Program 2010). Figure 2 shows the dumped fish adulterated by formalin in India.



Figure 2: Formalin-laced fishes are seen dumped outside at the dumping site in Kohima (Morang express 2020)

6 FORMALINE AND FORMALDEHYDE

Formaldehyde is colourless gas with sharp irritating smell, corrosive, naturally occurring organic compound with formula $\text{CH}_2\text{O}(\text{H}-\text{CHO})$. The aqueous solution of formaldehyde is called formalin. It is colourless with strong pungent odour contain carbon, hydrogen and oxygen in its structure. Formaldehyde is gas in normal temperature and pressure produces naturally in human body. Moreover, there are many fruits which also contain small amount of formaldehyde coating over the skin as natural protective substance for the tree as well. The most common available solution contains 37%,44% formaldehyde and 6%to 13% methanol with water known as formalin (Uddin et al. 2011). The aqueous state of formaldehyde (formalin) is much more corrosive than its gaseous state (formaldehyde).

6.1 Chemical composition

Other common Chemical names: Formaldehyde, Formalin, Methanal, Formol, Methylene oxide

Formaldehyde naturally occurring organic compound with the formula CH_2O molar mass 30,026g/mol.

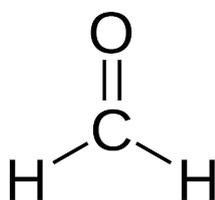


Figure 3: Formaldehyde (Agency for Toxic Substances and Disease Registry. ToxFAQs™ for Formaldehyde. 2008)

6.2 Use of formaldehyde

Formaldehyde is used as a main chemical to manufacture many industrial products. Even if there are many uses of formaldehyde in our daily life. Formaldehyde solution known as formalin is used in laboratories for preservation of animal specimens. It is the most common chemical which is used in laboratories as preservatives. It is also known as embalming. In figure 3 can be see some examples of embalming by formaldehyde.



Figure 4: Animals are preserved by formalin (alamy images 2020).

Due to its superior binding properties formaldehyde is being used extensively in manufacturing of glues and resins which are used in home furnishing items. Formaldehyde is being used as a main chemical in the production of urea formaldehyde resin, melamine resin and phenol formaldehyde resin which have different applications in different sites. As a disinfectant formaldehyde is very effective and capable to obstruct the activities of bacteria, fungi, yeast and mold. An aqueous solution of formaldehyde and certain derivatives like Methenamine is being used in the treatment of skin infections, like urinary tract infections. Formaldehyde is used in pharmaceuticals in the production of different ointment for skins and small amount of formaldehyde is present in some vaccines like flu shot, polio vaccine and DTAP vaccine for its bacterial killing properties.

Despite of many applications of formaldehyde, the harmful effects with pungent and suffocating odour in human body is the reason to limit the use of formaldehyde. Formaldehyde for its excessive binding properties are being used in textile industries with dyes and pigments for better binding between pigments and fabrics which prevent the colours running away from fabrics. These materials also help improve a fabric's resistance to wrinkles and ease clothing care and maintenance. Phenol formaldehyde

resins synthesized by formaldehyde are highly being used in automobile industries to manufacture automobile parts such as, brake linings for its high resistance property to fire. Formaldehyde is a key ingredient to manufactured ink is also used in paint, plastic and cosmetics industries. Due to its thermal properties' formaldehyde is used in the manufacture of thermoplastics used in electrical and electronic applications. Especially formaldehyde is in some way used in natural gas and petroleum industries, construction, paper, wood product industries. (National Toxicology Program 2010; International Agency for Research on Cancer 2004.)

6.3 Unethical use of formaldehyde

Formaldehyde or formalin unethically are being used in different foods and feeds especially which are getting rotten easily or quickly, that's why using of formaldehyde in different foods to increase shelf life of the food has become a very common practise by the traders and suppliers at Asian markets. Different studies show that the percentage of formaldehyde is high especially in seafoods (for example different fishes), different seasonal fruits, milk, vegetables etc. which are toxic for human health (Uddin et al. 2011; Bangladesh Pharmaceutical Journal 2015,1-7).Figure 5,6 showing some examples of unethical use of formalin.



Figure 5: The figure shown the food security department of the state government of India has seized 12,000 kg of fish preserved in formalin ('Operation Sagar Rani'. 12,000 kg of fish seized. 2020).

According to the association for human rights RDRS active in Bangladesh, has surveyed the markets of Dhaka and discovered that 71% of the fruit is treated with chemicals. In addition to formalin, the food is sprinkled with melamine and methanol, to make it look fresher. The figure 6 showing how different harmful chemicals are being applied in fruits to keep longer period or to ripe artificially.



Figure 6: The solution of different chemicals spraying in fruits in Bangladesh (The Sunday Guardian Live 2020).

6.4 Sources of formaldehyde

A highest level of air with formaldehyde detect in indoor air released from various consumer products such as building materials and home furniture. A study shows that the level of formaldehyde ranges from 0,10 to 3,68 ppm in homes. High level of formaldehyde has found especially from newer furniture or buildings than older homes. According to World Health Organisation guideline indoor air formaldehyde concentration should not be more than 0,08 ppm (International Agency for Research on Cancer 2008). The higher formaldehyde level has found from some power plants manufacturing facilities, incinerators and automobile exists emissions. Smoking is another important source of formaldehyde. Nowadays by some dishonest trafficker's food markets are contaminated with different adulterants where innocent people are suffering through harmful chemicals by eating contaminated foods from the market. (National Toxicology Program 2010; International Agency for Research on Cancer 2004.)

7 THE WAYS HOW PEOPLE EXPOSE TO FORMALDEHYDE

Formaldehyde is naturally secreted in our body and other living organisms. Humans produce 42.5 g of formaldehyde per day use in natural metabolism. Human body enzyme breaks down formaldehyde into formic acid which is further broken down into carbon dioxide. Hence most inhaled formaldehyde is broken down by cells lining so, less than a third absorbed by the blood. Low level of formaldehyde is present in different fruits and vegetables naturally occurred which can be metabolized easily by living organisms. The problem spread out when food adulteration with formalin has become a common practice mostly in Asian markets. Additional to that, Kamruzzaman (2016) and Uddin, Wahid, Jasmeen & Naz (2011) surveyed that a high level of formalin is using in different foods especially in the fruits, fish, meat, milk and different vegetables those are getting bad quickly in Bangladesh. These adulterated foods are remarkably at toxic level for human consumption. similar cases could be found in India, Pakistan as well. The use of formalin in food and feeds is a punishable crime and by consuming those adulterated foods every day, consumers encounter with different diseases even cancer. It is true that we are surrounded by the products of formaldehyde which is why it is easy to get expose to formaldehyde. Human body can be exposed to formaldehyde in different ways, by inhaling air containing high levels of formaldehyde from the environment. secondly, by direct contact with formalin can cause skin diseases and the third one is the most hazardous, by consuming different contaminated foods which are been adulterated by formalin. A good amount of formaldehyde exhausted through combustion processes and tobacco smoke to the environment every day. (National Toxicology Program 2010.)

8 HEALTH HAZARDS OF FORMALDEHYDE

Formalin or formaldehyde is that much corrosive that its handler is not even safe. Formaldehyde is a dangerous chemical to people of all ages for both male and female can be affected silently but surely. Intoxication of food and feeds through formaldehyde silently soiled our life as well as our future generation. Eyes and nose are very sensitive to formaldehyde exposure. Human body start responding at low level about 0,3 ppm formaldehyde in air cause irritation in eyes, nose, throat, and respiratory tract resulting watery eyes, sneezing, headache and nasal polyps. High level of formaldehyde (5-30 ppm) in humans can trigger or develop asthma symptoms, chest pain, coughing, wheezing, and bronchitis. Genuine inhalation or ingestion can cause severe pain with inflammation, ulceration mouth, oesophagus, stomach and necrosis of the mucous membranes, which is connected almost every internal organ of the body (Kamruzzaman 2016; Uddin et al. 2011). Formaldehyde solution formalin when contacts to skin destroy natural protective oils of skin results dryness, flaking, cracking, allergic reactions and dermatitis. To increase the shelf life of fruits abusers often dripped fruits into the formalin solution which is remarkably harmful for health. Research has shown that long term ingestion of formaldehyde can develop respiratory, digestive, cardiac, nephrological and neurological problems, along with cancer. (Uddin et al. 2011; Kamruzzaman M & Hakin M:A, 2015; Yesmin et al. 2010; Rahman et al. 2012). It has been reported that only 30 ml of formalin solution contain 37 % formaldehyde declared as lethal dose of formalin can cause rapid death of human (National Toxicology Program 2010). Water solution of formaldehyde called formalin is very corrosive which is why its ingestion cause severe damage in upper digestive system. The person who affected by formalin poison may develop nausea, vomiting blood, and diarrhoea with bloody stool, blood from the urine, breathlessness, vertigo, and circulation failure as symptoms of upper digestive system damage and eventually death. (Rahman et al. 2012; X, Tang et al. 2009). Formaldehyde converted to formic acid by our body metabolism which increase blood acidity results shortness of breath. But long-term explosion of formaldehyde has delayed effect such as kidney failure (The British Medical Journal 1924), liver damage, bone marrow disorder, weaken body immune system and bad effect on fetus in pregnant women. Studies shows that prolong time explosion of formaldehyde or its solution can cause some acute damages of human health. It can develop bronchitis (chronic cough), pneumonia, Asma and also can affect brain causes such as dementia and loss of memory. When body contaminated by formalin travel through blood flow, it can cause bone marrow depression results anaemias and at the severe stage blood cancer. This poison also weakens human body defences result repeated attacks of diseases. (Rahman et al. 2012; X, Tang et al. 2009; National Toxi-

cology Program 2010; Kamruzzaman & Hakin 2015). Formalin effects on pregnancy and the reproductive system has been studied in both humans and in laboratory animals (Monticelli et al. 1989,515-527; Johannsen et al. 1986,1-6). Formaldehyde has been shown to decrease fertility and increase the risk of spontaneous abortion (miscarriage) in humans. In laboratory animals, formaldehyde can harm (birth defects and IQ) the development of fetus and damage sperm. Formalin in food, not only cause severe damage in human body but also can cause cancer. Different studies by Johannsen (1986) and Monticelli (1989) on dog, mice and monkey shown that exposed to formalin with concentration of 6 to 15 ppm for 2 years developed squamous-cell carcinoma (a type of cancer in mucous membrane) in the nose, sinuses, stomach ,respiratory problems as well as some types of blood cancer (leukaemia and lymphoma). (Monticelli et al. 1989,515-527; Johannsen et al. 1986,1-6; Kamruzzaman & Hakim 2015.)

9 IDENTIFYING CHARACTERISTICS OF FOOD CONTAIN FORMALDEHYDE AND SOME TRICKS TO GET RID FROM FORMALIN

Although to stop that crime government already taken several steps but need to be strict about food safety as well as it is important to know how to identify the foods which are contaminated by formaldehyde. There are some common characteristics which could help to identify foods contain formaldehyde such as, the fish which contain formalin can recognize on basis of organoleptic characteristics such as colour, odour, texture and general appearance for example fish is no longer bright red or dark red but still very fresh. This fish does not have fishy smell, clear eyes, red gills, no flies flying around it, easy to flake and flash are loose inside not attached with the bone tightly. Meat contaminated with formaldehyde is stiff and odourless. For different seafoods like shrimp, squid, octopus looks fresh from outside but soft mushy while touched poor elasticity, strange smell, no specific sweetness, or aroma. The fruits which are containing formalin look fresh from outside but not from inside and these fruits will not be spoiled and can keep long time without preservation and some-times it tastes weird and no natural fruity smell. Different fibre foods like noodles taste more crunchy, hard to break, touching without sticky feeling. (The Indian Express 2020.)

It has been suggested that, if the formalin level is high then just throw it away. when formalin level is not that strong then following several tricks might work. A Short trick could be used to neutralize formalin in food, by soaking the food in warm salt water for one hour and wash it before cooking. Immerse fish or fruits in salt water for one hour then soak in a solution of vinegar and water (20 % vinegar and 80 % water) for another hour. For vegetables 90% salt with water dipped for 15 to 20 minutes before washing with normal water help to eliminate formalin from food. Peel the fruits and vegetables before using and washing with chlorinated water might help to remove chemicals (Hakim 2015) Food adulteration is a serious crime should be punished. Government of different countries are taking hard steps against this crime like penalties both financial and imprisonment. Nonetheless the law itself doesn't guarantee that situation will change over a night which is why everyone should be aware while buying foods from the market. Furthermore, the governments should regular monitoring the markets to improve the current situation. (Hakim 2015; The daily star 2020.)

10 REASONS BEHIND ADULTERATION

Food adulteration is mainly economically motivated adulteration (EMA). In most cases food adulteration occurred to increase the profits of the business. The manufacturer can use a cheap filler (illegal as a food) that is easily disguised as a spice to increase sales volume, which reduces the cost of pure spice and increases the final profit margin (Identification and Prevention of Adulteration Guidance Document,2020).

Another reason is the ability to compete. If a manufacturer is unable to meet a customer's quality criteria, he can falsify the product either to try to meet the specification or to compete to meet the price by offering a cheap quality product. For example, in some cases, the adulterated product may be more visually appealing than a pure spice. Cistus is a dark green colour that, when added to oregano, makes a fake flavour more visually appealing than pure oregano. In many cases, mixing different colour classes to achieve colour specification some are not approved for human consumption, then the product is considered adulterated. Customers who are not aware of the adulteration believe they will get a bargain. In some cases, counterfeiting can encourage the operation of a copycat, while others in the market adopt similar practices in order to compete with the adulterating manufacturer. Adulteration can be the result of market-driven, cost-cutting pressures. If suppliers are squeezed to reduce costs, there will come a point where the supplier can no longer maintain its margin. At this point, instead of closing the supplier, the supplier can contaminate the product to lower costs and maintain a functioning margin. Adulterating causes a number of problems for reliable and honest suppliers because they find it difficult to compete on price. Due to poor storage facilities, imbalance market management system and inappropriate transportation system farmers and sellers especially in south Asian countries has trend to preserve goods by applying different kind of illegal chemicals like formalin, calcium carbide to increase the shelf life of foods. Furthermore, to achieve more profit from the business some dishonest traders adding different impurities into the food to increase weight or volume of the product. Sometimes seller increasing the volume with different adulterants to reduce the cost of product and to get more customer by showing lower prices. When the demand for supply is low, the cost of goods has to be reduced to meet the market competition. Again, sudden crisis of authentic ingredients or product supplies with demand a reason of adulteration by dishonest traders. Moreover, the shortage of qualified staff, lack of updated processing strategies, inadequate knowledge about the consequences and related food safety risks are could be the remarkable thought behind food adulterations. Lastly, lack of public awareness, lack of updated infor-

mation of food safety and rights could be the main reasons for outbreaking related to adulteration. Products are generally adulterated to enhance commercial features. Sometimes adulteration may not even be dangerous. In severe pollution problems such as sprinkling water on dried chilies to tolerate excess weight loss, the mixture may be a mixture of aflatoxins. The availability of adulterants makes it easy for traders to adulterate. Adulteration includes too much competition in the markets, too many products, poor buying practice by consumers, lack of punishments and regular market monitoring systems etc. are responsible reasons for food adulteration. Other causes of adulteration include world events. Natural disasters, such as adverse weather conditions and earthquakes, as well as crop damage, can affect both product availability and prices. The result is the introduction of alternative materials that help increase yields to meet global demand and make it available at typical costs. Events such as political unrest, wars and nuclear disasters can also affect product availability and lead to adulteration (Kamruzzaman 2016; Identification and Prevention of Adulteration Guidance Document, 2020; Rahman et al. 2015.)

11 POSSIBLE WAYS TO PREVENT ADULTERATION

To prevent adulteration first we need to understand the reasons behind this. Many countries around the world are concerned about handling food adulteration. To prevent food adulteration governments, consumers, and sellers everyone has to take responsibility from their place. The Food and Drug Administration (FDA) was established in the United States in 1906, and the Food Safety and Standards Authority began operations in India in 2011 (Rahman et al.2015) with trained personnel capable of enforcing laws and understanding its complications from scientific knowledge and background to ensure food safety. Human rights, the accurate detection of crime and the giving exemplary penalties are key issues in combating adulterating problem. Regular monitoring supermarkets, raw markets, industries deal with food could be a key factor to overcome this challenge. Moreover, adulteration is occurring due to lack of proper storages facilities in tropical countries. In tropical countries different food items especially fish, meat, fresh fruits and vegetables rots so easily for hot environment and lack of proper storage facilities. which is why farmers, fisherman's or sellers are getting involved with this crim intentionally or unintentionally, without knowing the harmful effects of these chemicals are being used for adulteration. The government have to ensure the development of storage facilities throughout the country with good transportation system, have to setup proper marketplace instead of open-air marketplace to prevent adulteration. (Kamruzzaman 2016; Rahman et al.2015.)

Ripening fruits artificially is also one strategy that marketers have put in place to increase fruit sales and availability almost every season. Calcium carbide, a colourless compound if pure when reacted with water, releases carbide gas that ripens fruit faster is prohibited by FPA and food safety standards because it tends to be arsenic and phosphorus hydride residues for further use in the fruit ripening process. So, customer should try to avoid non-seasonal fruits and vegetables which will discourage sellers to use those chemicals and bring into the market. (Food and Safety Standard Authority India 2011)

Educating elementary and middle school students about the deadly effects of food adulterating through an academic curriculum. The government and different health organizations should Introduce different training programmes for peoples who are related in food supply to let them know about the deadly effect of adulteration of food and to train them about the use of safe chemicals throughout the country. The availability of all kind of chemicals which are using to adulterant foods, must be controlled strictly. The low authorities should introduce severe and exemplary penalties for food contaminants depending on the size of the offenses and the final impact. Every government have to work to strengthen food control

services with a skilled workforce and qualified analytical tools, together with the proper implementation of Asian-related laws. Farmers have to remember the safe level according to international guidelines of pesticides and various toxic residues while using in field to avoid unexpected contamination. (Rahman et al.2015.)

When talking about preventing adulteration in the first place is essential to maintaining the confidence of manufacturer and consumers. One of the key elements to prevent and discourage adulteration is customer psychology which needs some changes. Customers should value the product quality then its price. They should be aware about the quality then the quantity or price must know that good product come with good price. It will help traders to be confident to serve quality product and will discourage adulteration or copycats. (Identification and Prevention of Adulteration Guidance Document 2020.)

Involvement of health researchers from universities and institutes in the cross-checking of market products through laboratory analysis with independent research with state support and grants would be helpful to justify the results. Government award for information on food fraud syndicate, factory, outlets, supply chain, etc. Promoting ethical practices in the corporate community by participating directly in business leaders might help that community to think before adulterate foods. Overall, everyone from their place in a society must be responsible, aware and supportive to the government to prevent adulteration. (Rahman et al.2015.)

12 LAWS IN DIFFERENT COUNTRIES TO PREVENT FOOD ADULTERATION

The government should take adequate measures to achieve better coordination between law enforcement agencies and other relevant agencies, to control food counterfeiting and to ensure safe food. The imposition of a model penalty should be included in the Food Act. There are several laws and regulations has taken whole over the world to control food adulteration some are mentioned below.

In Bangladesh recently, the cabinet of the government of the people's republic of Bangladesh passed the 2014 formalin control act 2014, which provides for a maximum penalty of life time imprisonment or fine of 20,00000 taka or both, depends of the intensity of the crime to prevent food adulteration. According to the law, traders must be licensed to import, stock, sell, and market formalin. The law provides for a maximum term of imprisonment of 7 years or a fine of 5,00000 taka or both, if the terms of a formalin license are violated and formalin is illegally stored in houses, offices, businesses, or vehicles. The law also provides for a maximum of ten years in prison or a fine of 20,00000 for possession of formalin production equipment. The police can arrest any offender without the permission of the court if the case is done under the law (Bangladesh pure food act 2005) and authorities also using immediate action by introducing mobile court. Figure 5 showing artificially ripened mangoes are being destroyed at Jatrabari wholesale market at Dhaka in Bangladesh.



Figure 5: Rapid action battalion (RAB) mobile court seized around 40 tons mango (alamy images 2020).

In addition, formalin oversight committees will be formed in each region and in every sub district to oversee the implementation of the law (The Daily Star, July 1, 2014). More recently, the government has decided to implement the safe food act 2013 on February 1, 2014 (The Daily Star, January 28, 2015).

In India the Food Safety and Standards Act (FSSA)2006 setting scientific standards for foodstuffs and controlling their manufacture, storage, distribution, sale and import in order to ensure the availability of safe and dignified food for human consumption. All entities involved in the manufacture, storage, transportation or sale of food must require FSSAI registration and comply with FSSAI regulations. According to the law, distributing, importing or exporting, selling or storing adulterated food products will be taken as a crime. The penalty for this offense is a minimum of six months' imprisonment, which may not exceed 3 years, and a minimum fine of 1,000 rupees. Import, manufacture, storage, sale or distribution of substances other than those harmful to health. The penalty is the best six-month prison sentence, which can last up to three years, with a minimum fine of 1,000 rupees. Blocking a food inspector best presents or behaves his sentence with the best possible one-month imprisonment, which can last at least three years, and a minimum of 1,000 rupees. False written warranties are given for any food product. The sentence is the best six-month prison sentence, which can last up to three years, and the minimum fine is 1,000 rupees. Adulterated food, or ingredients harmful to health, is required by our misuse to import, manufacture, store, sell or distribute punishable under the law. Penalty of only one year in prison, which may be the first 6 years, and a minimum penalty of 2,000 rupees. Toxic or other health-damaging ingredients are found in the sale or distribution of food, resulting in death or serious injury. The sentence is one three-year prison sentence, which can extend up to life, and a minimum of 5,000 rupees (Food Safety and Standards Act of India 2006).

The Food and Drug Administration (FDA) has been established in the United States, consisting of trained personnel with the ability to enforce laws to monitor the quality of food and medicine available on the U.S. market. Similarly, countries like USA, China, Dubai, Pakistan etc, gets punished. Stringent type of punishment is given to those people who are involved in adulteration of food. The authorities have announced imprisonment for 6 months to 2 years and penalty up to 5,00000rupees 5 lakhs. Nowadays, the imprisonment is for 3 months and penalty is 1,00000 rupees. But most importantly the punishments depend on the impact of the crime has done.

In Europe European legislation (EC Regulation 178/2002) lays down the general principles and requirements of food law, the establishment of the European Food Safety Authority (EFSA) and also defines procedures in the field of food safety. Article 8 deals with the protection of consumer interests in the

European union (EU) and states that food law must seek to protect the interests of consumers and “provide consumers with a basis for making informed choices about the food they consume. Its purpose is to prevent fraudulent or deceptive practices, food adulteration and other practices that may mislead the consumer. The requirements of Article 8 also distinguish between the criteria of food safety and the criteria of food standards. As a result, the rapid alert system for food and feed (RASFF) was developed in Europe to identify irregularities in the Member States. the emerging risk exchange network (EREN) is the main body for exchanging information on emerging risks between EFSA, MS, the EC and also international organizations. The network is made up of national experts and enables the exchange of information by facilitating access to and exchange of databases through the sharing of databases (Randles, 2012; Louise Manning,2014.).

13 CONCLUSION

Food is one of the most important basic need of human life. Every living thing has to eat to survive but, if that food is toxic, then it will only harm the body instead of nourishing it. Every government have to ensure food safety and security for a healthy and beautiful future and therefore, first of all food adulteration have to stopped. Food adulteration is a curse for a nation as well as for the world. It has become a matter of headache for some nations especially in India, Bangladesh, Pakistan almost all over the South Asia. At present food adulteration has become a very common practice and a hot topic in Asia from last decades but eventually this problem spreading all over the world. In tropical countries where environment is very hot and food is easily spoiled, for which traders use different kind of chemicals on food to keep food product fresh for long time, without thinking about the harmful effects of those chemicals on human body. To stop food adulteration first we need to understand the reasons behind this. All kind of food adulteration is somehow motivated economically. Gaining extra profit is the main and simplest reason for adulteration in food. The goal of making extra profit in the business encourage traders to adulterate foods in almost all cases. Traders in various tropical countries, especially in the hope of making extra profit, mixing various harmful chemicals in food so that the food products stay good for long time. Unscrupulous traders using different harmful chemicals like formalin in various sea foods and fruits to keep the product fresh for long time in hot weather by ignoring its health hazers on human body just for business. Using different harmful textile dye to make products more attractive to the costumer and also adding cheap filler in food products to lower the cost and get more profit. Ability to compete is another reason for food adulteration. Quality food comes with good price but sometimes costumers do not give the value of the quality so that they go for cheaper one or as a result hard for the good manufacturer to compete with other fraud manufacturer. Sometimes seller in adulterates foods to keep products safe from rotten due to lack of frozen storages especially at countryside in developing countries. In most cases, Buyers are attracted to the appearance of the food, for which various unscrupulous traders try to make the food more attractive by dipping food items into different kinds of harmful colours. There are many sellers, farmers or fishers who are being involved with adulteration due to lack of proper knowledge or awareness about the bad impacts of food adulteration in human body which results, contamination with different harmful chemicals in our daily food. Formalin is one of them, lot of used in different foods nowadays. Formalin is an aqueous solution of formaldehyde, which is used as preservative agent to preserve different species in lab. Although formaldehyde and formalin have many uses in industrial process and laboratory but the unethical use of formalin in different food items make this a matter of headache now a days. Different studies show that the percentage of formalin is remarkable high especially in seafoods (for example different fishes), different seasonal fruits, milk, vegetables etc.

which are dangerous for human health. Adulterated foods by formalin is a crime and its classified as a protentional human carcinogen identified by the USA environmental protection agency and international agency for research on cancer as a class 2A carcinogen. Formalin is dangerous for people of all ages long time exposed by formaldehyde or consumption of formalin can results many acute or chronic disease. Formalin after getting into the body might affect silently but it will harm surely. People who often exposed by formaldehyde or formalin might experience irritation in different parts of the body like nose, eyes, respiratory tract), headache, asthma, chest pain, bronchitis, inflammation, dry skin, allergic reaction, respiratory problems along with cancer. Study shown that 30ml of formalin with 37 % formaldehyde can cause rapid death of any human. Food adulteration must stop. So, it is the responsibility of every government to take necessary steps to save their citizens from the curse of food adulteration or to ensure the food safety for their citizens. Laws should be stricter and should give some exemplary penalty to dishonest traders. The government also can help the good manufacturers by giving different facilities for example prizes, less interest loan to appreciate good business practices. Regular monitoring should continue by appropriate agencies to keep food markets safe. Consumers should value the good products should not look always for cheaper one. Simultaneously, different kind of program can introduce to create public awareness about food adulteration would be a great key to prevent adulteration. The food market must be free from adulteration for a safe and healthy future for which, everyone has to fulfil their responsibilities from their sides including the government.

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