

Frequently Used Additives in the Food Industry and Their Toxicological Effects on Human Health

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Abstract – Food additives are chemicals added to foods to keep foods fresh, improve their flavor and texture, and extend shelf life by preventing the growth of microorganisms. Many additives used for these purposes are considered safe by international organizations and are carefully regulated. It is thought that the intensive use of food additives, which contributes to the rapid growth of today's food industry, brings with its undesirable health consequences that directly affect public health. Recent clinical findings and animal experiments have shown that additives such as artificial sweeteners, food dyes, sodium nitrite, and monosodium glutamate can cause health problems such as heart problems, diabetes, obesity, and insulin resistance. Therefore, it is necessary to monitor both the use and risk assessments of food additives. This review, it is aimed to evaluate the harmful effects and toxic potentials of some commonly used food additives on human health.

Keywords – Food Additives, Food Safety, Toxic Effects, Risk Assessment

I. INTRODUCTION

Food additives are complementary substances that are not consumed alone, are used as an auxiliary in the food industry, and provide the improvement of food in many ways [1]. They are used to preserve the factors such as structure, appearance, smell, taste, and shelf life, to provide stabilization, and to prevent or correct unwanted changes during the production, preparation, processing, packaging, transportation, and storage of the food [2]. The intended purpose of using these excipients may be to improve the texture of the food, increase its nutritional value, make it attractive in color, increase its durability, prevent the development of microorganisms, or extend its shelf life [3, 4].

The Joint Food Additives Expert Committee (JECFA), which was established with the joint work of the World Health Organization (WHO) and the Food and Agriculture Organization (FAO), conducts safety research in food additives [5]. In order to examine the reliability of additives, long-

term laboratory studies are expected to be examined and approved by authorized institutions [6].

In these studies, it is observed whether a toxic effect or susceptibility to any disease occurs in 85% of the life span of the animals used as subjects, and an ineffective dose is determined. This dose also called the daily dose, is determined as 1 milligram per kilogram of the subject's weight. In humans, 1% of this amount per kilogram of body weight is considered as the amount that will not cause a problem when taken daily. If different results are obtained in different studies conducted over time, the effects of additives and the amount of toxic dose may change [7, 8].

Additives can be obtained from many different sources. Additives can be obtained from plants such as lecithin, soybeans, and corn, or from animal or animal and human waste. For example, gelatine from bone and skin waste of pigs, cattle, or other animals; carmine from red louse; shellac, again of a louse species; meat human, horse, or pig hair; rennin from the bovine or bovine stomach; Pepsin is obtained from pork stomach. Additives such as

glycerine, lecithin, mono and diglycerides, beta-carotene, and benzoic acid can be obtained from animal and plant wastes or produced synthetically [9, 10].

A. *Numbering of Additives*

The E code is added to the numbering of additives allowed to be used in the food industry by the European Union. For example, the commonly used monosodium glutamate (MSG) is the food additive number 621 and is called E621. In order to avoid confusion that may arise in international transactions, this numbering is done in the same way in every country [11].

The substance with the E code has been approved by the authorized institutions as a result of long studies and accepted as safe. JECFA (FAO/WHO Joint Committee of Experts on Food Additives), EFSA (European Food Safety Authority), and FDA (US Food and Drug Administration) evaluate all toxicological studies related to the identified substance [12]. As a result of the evaluation, it determines that this substance should be used in foods and in what amount. In this regard, standards called Codex Alimentarius prepared in Europe are used. In our country, legislation is created by the authorities of the Ministry of Food, Agriculture, and Livestock based on European Union regulations [13, 14].

B. *Classification of Additives*

Food additives are classified into four groups according to their use:

1. Preservatives

They are used to protect foods from microbial spoilage such as bacteria, mold, yeast, and to extend their shelf life [15].

- a. Antimicrobials: Nitrate, nitrite, benzoic acid, sulfur dioxide, sorbic acid, and propionic acid.
- b. Antioxidants: Vitamin C, gallates, beta hydroxy acid, butyl hydroxytoluene.

2. Those that improve the texture of food and factors in the cooking stage

- a. Acidity regulators: They regulate pH in order to prevent and destroy microbial growth in food.

- b. Emulsifiers: They provide homogeneous dispersion of materials of different densities while mixing.
- c. Stabilizers (thickeners, sweeteners): prevent the separation of homogeneously dispersed substances.
- d. Anti-caking agents: They provide the fluidity of powder mixtures in solution.
- e. Fermentation promoters, fillers, ripeners, moisture regulators, bleaches, and brighteners.

3. Color and flavor enhancers

- a. flavor enhancers
- b. flavorings
- c. Colorants
- d. Sweeteners

4. Nutritional value preservatives and enhancers

- a. Regaining the nutritional factors lost during the process
- b. Adding vitamin values that are thought to be deficient.

C. *The Most Frequently Used Additives in The Food Industry*

Artificial Sweeteners

Artificial sweeteners such as Aspartame (E951), Sucralose (E955), Saccharin (E954) are sweeter than sugar and its derivatives. Therefore, it is used in fewer amounts and reduces the calorie content of the food [16]. Although artificial sweeteners seem like an excellent alternative to natural sugar, research shows that regular consumption can lead to unwanted effects. When the mentioned studies are examined, it has been observed that the sweeteners used in foods may be associated with the risk of type 2 diabetes and weight gain, and obesity [17, 18].

High Fructose Corn Syrups

These additives are liquid sweeteners produced from cornstarch. It does not create a feeling of satiety when consumed, it is only used to sweeten foods. Since it is more economical and of higher quality, it largely replaces sucrose in ready-to-eat foods. For this reason, it has been observed that the amount of fructose consumed daily has increased significantly [19].

When the latest studies are examined, excessive fructose consumption from high fructose corn syrup causes undesirable conditions such as obesity, type 2 diabetes, hypertension, cardiovascular diseases, coronary diseases, oxidative stress, pathological changes, adverse metabolic changes, increased plasma triglyceride level and hepatic insulin resistance [20]. These are used in products such as chocolate, wafers, instant pudding, instant cakes, ketchup, biscuits, and coke [21, 22].

Artificial Food Dyes

Food dyes are chemicals used to color and give a lively appearance to many products, from confectionery to various spices. Food colorants differ according to their source, color tones or chemical structures [23]. These additives are highly water soluble. They are generally stable against heat, light, acid, alkali, and preservatives. Therefore, their shelf life is quite long. It is aimed that the product attracts the attention of the consumer and is attractive by means of various food dyes used in the food industry [24, 25].

In several studies using experimental animals, it has been reported that the use of high amounts of synthetic food dyes causes allergy and asthma symptoms [26, 27].

Sodium Nitrite

Sodium nitrite are additives used to prevent microbial growth in foods and to preserve them for a longer period of time. They are crystalline materials that are colorless and powdery. These auxiliary elements are frequently used in packaged beef, fish and poultry, processed meat products such as salami, sausage, sausage, and some types of cheese [28, 29].

Nitrite and nitrate are additives that adversely affect human health when used in foods at a certain dose. According to studies, these substances can cause anemia due to the toxic effects they can cause. It even reacts with secondary amines in our body to form nitrosamines. Nitrosamines have been proven to cause cancer [30].

Trans Fats

Trans fats are at the top of the list of harmful food additives. Trans fat; It is used in margarine, spreadable breakfast oils, ready-made animal foods, packaged chocolate, wafers, biscuits, cakes, chips, cookies, and cucumber sauces [31].

Studies with trans fatty acids have shown that trans fatty acids play an active role in the regulation of physiological processes such as inflammation, lipid metabolism, autophagy, apoptosis, oxidative stress, and endoplasmic reticulum stress. It has been noticed that some of these pathways are dysregulated by trans fatty acids [32, 33].

According to studies, foods produced using trans fat cause an increase in LDL cholesterol, which we define as bad cholesterol, and a decrease in HDL, which is good cholesterol. LDL accumulates in the walls of the arteries, causing hardening and narrowing of the arteries. In addition, the frequent use of foods containing trans fat can cause important diseases such as heart disease, diabetes, obesity, and stroke [34-36].

Carrageenan

Carrageenan is a food packaging material composed of bio-based polymers because it has sufficient resources, is non-toxic, and degrades easily within a few weeks at a given humidity and temperature [37]. Polysaccharides, proteins and lipids are often used as film-forming substrates for biodegradable packaging materials. In this regard, carrageenan, a hydroxyl-rich material, is considered an important material due to its performance in gelling and film-forming. All types of carrageenan are soluble in water but insoluble in organic solvents, oils, or fats [38, 39].

Carrageenan is considered to be a suitable excipient for halal food consumption. It can also be used easily in vegan and vegetarian diets. It is abundant in sugar and fat, high in quality and considered safe by almost all authorities. For this reason, it is seen as a good alternative to replace harmful additives used in foods [40, 41].

Although carrageenan is considered safe and harmless, polygeenan used in medical imaging is defined as "degraded carrageenan" for a certain period of time. This information raises question marks. Poligeenan is produced from seaweed, but

the downstream processing is completely different. Seaweed collected to obtain polygeenan undergoes a long process by being exposed to high acid and temperature. It is known that the molecular weight of polygeena is 20-80 times lower than that of carrageenan. Low molecular weight allows polygeenan to enter the intestinal epithelium. However, this is not the case in carrageenan [42, 43].

Monosodium glutamate (MSG)

One of the most widely used additives in the food industry is monosodium glutamate, also known as Chinese salt. MSG, or in other words sodium glutamate (L-glutamic acid), is the sodium salt of a naturally produced amino acid [44]. It is used as a food additive (E621) in the form of hydrolyzed protein or as a purified monosodium salt. MSG is typically readily soluble in water and alcohol, but insoluble in organic solvents such as ether. It is a white, odorless, and crystalline powder. It has no melting point but decomposes by overheating when heated at 232°C. The pH value is 7.0. MSG behaves stably and does not deteriorate during food processing [45, 46].

MSG, whose use has increased greatly in recent years, can be used as an additive in canned foods, frozen foods, dietary supplements, baby foods, ready-made sauces, cosmetic materials, vaccines and many other products [47].

Monosodium glutamate is recognized as safe by industry veteran organizations such as FAO, WHO, FDA, JECFA and EFSA. However, various studies conducted in experimental animals have shown that continuous consumption of MSG causes various adverse effects in organs such as the brain, thymus pancreas, testis, kidney and liver. Examples of these side effects include obesity, hypertension, diabetes, headache, asthma and neurotoxicity, hepatotoxicity, and more [48].

MSG can lead to cell death by activating the intrinsic apoptosis pathway. The mechanism of action of MSG-induced damage is related to different organs such as the brain, testis, liver, and the induction of oxidative stress [49]. Oxidative stress is an intracellular condition, in which the levels of reactive oxygen species (ROS) increase, leading to disruption of cellular metabolism by

damaging carbohydrates, lipids, proteins, and nucleic acids. Oxidative stress is associated with many diseases, including neurodegenerative diseases, cardiovascular diseases, atherosclerosis, diabetes, carcinogenesis, and osteoporosis [50, 51].

II. CONCLUSION

Today, food additives are used to improve the quality of foods, increase their nutritional value, give them a more attractive color, increase their durability, prevent the growth and development of microorganisms, and extend their shelf life. Many additives used for these purposes are considered safe and allowed to be used by organizations representing the food industry such as WHO, FAO, FDA, JECFA, and EFSA. However, in various studies on experimental animals, it has been observed that substances such as artificial sweeteners, high fructose corn syrup, food dyes, sodium nitrite, trans fat, carrageenan, and monosodium glutamate cause toxicity contrary to what is believed. It has been reported that using these additives above the specified doses or in the long term can harm human health. These damages cause many important diseases and negatively affect human life.

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