



The Adverse Effects of Food Additives on Consumer Health and Safety -between Necessity and Risk-

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Abstract

Consumer goods purchased in everyday life are rarely free from food additives, whose incorporation is often regarded as a technological necessity. Although food additives have received considerable attention and have been regulated internationally by expert bodies operating under the World Health Organization (WHO), the Food and Agriculture Organization of the United Nations (FAO), and the Codex Alimentarius, the Algerian legislature has likewise addressed and regulated their use in accordance with international standards. Nevertheless, food additives continue to raise concerns and may pose risks to consumer health and safety.

Keywords: food additives; producer; consumer; food products; risks.

Introduction

The contemporary world is witnessing rapid technological developments, particularly in industry generally and the food industry specifically. These developments have produced a relatively new and distinct consumer environment in which markets are increasingly filled with food products characterized by technical, scientific, and technological complexity, on the one hand, and by potential risks, on the other. This situation may make it more difficult for consumers to identify the products that best meet their needs. The right to safe food is among the most important rights to which consumers are entitled. It derives from the fundamental right to the protection of human health and bodily integrity by ensuring access to food products that do not entail harm or danger.

For the purpose of developing the food industry and making products more attractive to consumers, producers increasingly use food additives to impart a desirable taste, pleasant flavor, or appealing color to food products. However, the use of such additives without adequate controls may infringe consumer rights, undermine the principle of food safety, and expose consumers to health risks.

The benefits of food additives cannot be denied. They have contributed to consumer convenience by extending the storage life of consumer goods, preventing spoilage, maintaining functional characteristics and sensory quality, and limiting bacterial growth in food. Yet these advantages do not eliminate the possibility of adverse effects.



This concern has been reinforced by a number of modern scientific studies. From time to time, certain food additives are prohibited or their authorizations are withdrawn after evidence emerges that they may cause serious illnesses. Even additives that are regulated and regarded as safe continue to be subject to scrutiny. This demonstrates the concern of international and national competent authorities, which devote considerable attention to food additives both before and after authorization in order to strengthen consumer protection.

Accordingly, this study examines the adverse effects of food additives on consumer health and safety in the tension between technological necessity and potential risk. It addresses the following research questions: Are the legal controls established by the Algerian legislature for the use of food additives sufficient to protect consumers? Has the legislature prescribed sanctions for violations of those controls?

To answer these questions, the study first examines the concept, types, and uses of food additives (Part One), and then considers the risks associated with food additives and the legal framework governing their use (Part Two).

Part One: The Concept and Types of Food Additives

Historically, various methods and techniques were used to improve food products, extend their shelf life, and broaden their availability. Drying, for example, reduces moisture in food and thereby inhibits microbial activity; meat and vegetables were traditionally exposed to solar heat for this purpose. Salting and pickling were also widely used, with common salt serving as an important preservative capable of limiting bacterial and fungal growth in products such as butter, cheese, fish, and meat. Fermentation was another preservation technique, relying on energy produced through oxidation reactions such as those involving yeast.¹ Smoking, one of the oldest preservation methods inherited from prehistoric times, was applied particularly to fish and meat both for preservation and to impart a desirable flavor.² Honey and oils were also used. Food additives later emerged as a technological alternative and a new technique in food production, making it possible to preserve foods while maintaining their natural characteristics and biological components. Against this background, this Part first defines food additives and then discusses their types and fields of use.

I. Concept of Food Additives

Despite the importance of food additives and their close connection with consumer health and safety, no single comprehensive definition has gained universal acceptance. This is partly because the subject has both a legislative dimension and a technological or scientific dimension.

1. International Definition of Food Additives

In 1956, the Joint FAO/WHO Expert Committee on Food Additives (JECFA)³ introduced an early international definition, describing a food additive as “any substance having no nutritional value that is intentionally added to food in small quantities in order to improve its appearance, taste, texture, or storability.”⁴ This definition was criticized because it did not take account of substances added to increase nutritional value, such as vitamins and minerals, while residues of



pesticides or chemicals migrating into food from packaging materials may constitute unintended additions.

The definition was subsequently revised. A food additive was then described as any substance that is not itself normally consumed as food and is not normally used as a food ingredient, whether or not it has nutritional value, and that is added for technological purposes during manufacture, packing, packaging, or transport, with the expectation that it will become a component of the food or affect its properties.

The revised definition still does not include antibiotics, hormones, toxins released by bacteria or fungi, chemicals migrating from packaging materials, or contaminants. Nor, like the earlier definition, does it include substances added specifically to increase nutritional value, such as vitamins and minerals.⁵

The Codex Alimentarius Commission defines a food additive as a substance that is not normally consumed as food in itself and is not regarded as an essential food ingredient, irrespective of whether it has nutritional value, where its addition serves a technological function in manufacturing, preparation, packing, packaging, storage, transport, or in relation to sensory properties including appearance, taste, odor, and texture.^{6,7}

Arab Standard No. 380/1987 likewise defines a food additive as any substance not normally consumed as food in itself and not normally used as a conventional food ingredient, whether or not it has nutritional value, where its addition for a technological purpose—including sensory purposes—during production, preparation, manufacture, processing, packing, packaging, transport, or storage results, directly or indirectly, in the substance or its by-products becoming a component that affects the characteristics of the food in one way or another.⁸

2. Legislative Definition of Food Additives

Executive Decree No. 12-214, which lays down the conditions and procedures governing the use of food additives intended for human consumption, defines food additives in Article 3 as follows:⁹

“A food additive is any substance that:

is not normally consumed as a foodstuff in itself and is not normally used as a specific ingredient of the foodstuff;

may or may not have nutritional value; and

is intentionally added to a foodstuff for a technological or organoleptic purpose at any stage of manufacture, transformation, preparation, processing, conditioning, packaging, transport, or storage, with the result that it affects the characteristics of the foodstuff and becomes, directly or indirectly, or through one of its derivatives, a component of that foodstuff.”

The Algerian legislature therefore follows the international approach to defining food additives. Such additives may be natural or synthetic substances intentionally added to foods in order to improve sensory characteristics such as flavor, texture, and visual appearance, to extend shelf life, or to facilitate preparation and processing.



A substantially similar definition was adopted in Article 3(14) of Executive Decree No. 05-484 on the labeling and presentation of foodstuffs, under which a food additive is any substance not normally consumed as a foodstuff in itself and not normally used as a specific food ingredient, whether or not it has nutritional value, whose intentional addition for a technological or organoleptic purpose at any stage of manufacture, transformation, preparation, processing, conditioning, wrapping, transport, or storage may lead directly or indirectly to its incorporation, or that of one of its derivatives, into the foodstuff and may alter its characteristics in any manner.¹⁰

The expression “food additives” does not apply to contaminants or to substances added to food for the purpose of maintaining or improving nutritional properties.

It may therefore be concluded that the definition adopted by the Algerian legislature is essentially the same as the international definition, subject to minor differences in drafting.

The purposes underlying the use of food additives are fundamentally food-related. They include improving and preserving food, protecting food intended for consumers, enhancing its nutritional value and usefulness, and thereby supporting growth and production.¹¹

II. Types of Food Additives and Their Fields of Use

Because lists of food additives are continually updated, there is no permanently fixed list. New additives may be introduced, while others may be removed after evidence demonstrates risks to consumer health and safety. Terminology also differs from one country to another. Identification is difficult both because of these differences and because many additives bear long and complex scientific names. Specialists in the European Union therefore developed codes to identify them and sought to standardize their names irrespective of whether they are of animal, plant, or mineral origin.¹²

The international system used for food additives in Algeria relies on the International Numbering System (INS),¹³ which corresponds to the European numbering system without the letter “E.”¹⁴ Article 13 of Executive Decree No. 12-214 confirms this approach by providing that the list of authorized food additives, their definitions, technological functions, and numbers under the International Numbering System are set out in Annex I to the Decree.

On the basis of the Joint Ministerial Order of 14 February 2002,¹⁵ and the annexes to the above-mentioned Decree, food additives may be classified as follows:

1. Color Additives

Color additives have become widely used in many foods. They give foods and beverages distinctive colors that attract consumers, particularly children.

They may be described as substances extracted, separated, or derived from plant, animal, or other sources, with or without the use of a simple compound, and which impart a distinctive color when added to food either alone or through interaction with another substance.



The U.S. Food and Drug Administration (FDA)¹⁶ defines a color additive as a dye, pigment, or other substance manufactured, extracted, or isolated from plants, animals, minerals, or other sources that, when added to food, drugs, or cosmetics, imparts a particular color.¹⁷

2. Preservatives

Preservatives are substances added to inhibit or stop the decomposition of food by microorganisms, thereby extending storage life. By prolonging shelf life, they make rapidly perishable foods available to consumers even outside their normal season. Traditional examples include sugar, salt, and vinegar, while synthetic examples include sodium benzoate and ascorbic acid. Certain preservatives can prevent or inhibit bacterial activity and growth.¹⁸ They are generally added in small quantities, depending on the type of food, the production method, and the microorganism responsible for spoilage. Their inhibitory effects extend to microorganisms, bacteria, fungi, and yeasts, thereby limiting their activity and proliferation.¹⁹

3. Antioxidants

Antioxidants are added to foods in order to prevent oxygen from reacting with food components and thereby delay rancidity caused by contact between air (oxygen) and certain foods, particularly oils, fats, and fat-soluble vitamins. Such reactions may alter color, taste, and odor.²⁰ Rancidity spoils food and may render it harmful to consumer health.²¹

4. Emulsifiers

Emulsifiers facilitate the formation of a homogeneous mixture between two liquids that do not normally mix, such as water and oil. They can give products a gel-like consistency, prevent food from becoming watery, improve solubility and texture, and are widely used in products such as mayonnaise, chocolate, and ice cream. Common food emulsions include water-in-fat emulsions, as in butter and margarine, and oil-in-water emulsions, as in mayonnaise.²²

5. Stabilizers

Stabilizers are substances that increase the viscosity of the aqueous phase of a product, making it more difficult for fat droplets or solid particles to move and merge. This helps prevent separation or sedimentation and contributes to a stable, creamy texture. Stabilizers are used, for example, in processed cheese to prevent fat separation and achieve a smooth, cohesive consistency. They are also important in milkshakes because they reduce sedimentation of other ingredients.²³

In many food products, emulsifiers and stabilizers do not operate independently. Instead, they may interact synergistically to improve final product characteristics. Certain emulsifiers may possess stabilizing properties, while stabilizers may enhance the efficiency of emulsification.

6. Thickeners

Thickeners are generally natural hydrophilic carbohydrate substances, such as gums, pectin, and starch, or chemically modified complex carbohydrates. They are added to improve the texture of a wide range of food products and are also used in dairy desserts, beverages, and infant foods.²⁴



7. Flavoring Substances

Flavoring substances are added to impart a distinctive flavor to foods or to replace flavor lost during processing. In many cases they may also contribute to preservation. Examples include sodium chloride, calcium, cloves, vanilla, anise, and monosodium glutamate, which is widely used in dried products, potato products, and soft drinks. Flavorings are also used in beverages, pastries, confectionery, and ice cream.²⁵

8. Sweeteners

Sweeteners are used to impart a sweet taste to food products. Examples include sugar and high-fructose corn syrup. Saccharin is an artificial sweetener²⁶ with a sweetness more than 200 times that of sucrose. The article further states that cyclamate, which is approximately 30 to 40 times sweeter than sucrose, has been prohibited because of concerns regarding its effects.

Part Two: Risks of Food Additives to Consumer Health and Safety

The issue of food additives and their risks did not become a major focus of governmental and scholarly attention until the cyclamate controversy. In 1969, a Canadian laboratory reported that the artificial sweetener cyclamate, which had been added to certain beverages, was carcinogenic after approximately twenty years of use.²⁷ Another study in the United States reported harmful effects of color additives and flavorings on children. These developments led to renewed testing and evaluation of food additives, to prohibitions in several countries, and to regulatory measures requiring the U.S. Food and Drug Administration to review safety questions relating to food additives.²⁸ This Part therefore examines, first, the risks of food additives to consumer health and, second, the legislative framework governing their use.

I. Risks of Food Additives to Consumer Health

The presence of additives in food indicates that the product has undergone processing and, according to the cited literature, may therefore present health concerns.²⁹ At the same time, the use of food additives is required to be safe, to respond to a technological need, not to mislead consumers, and to serve a useful function.³⁰ The potential adverse effects differ according to the type of additive and its biological effects, as discussed below.

1. Risks Associated with Artificial Colors

The article reports that artificial colors found in many consumer foods have been associated with adverse effects in children, including effects on brain function, intestinal function, thyroid enlargement, kidney damage, anemia, and reduced immunity through cumulative exposure. It further states that artificial chocolate coloring has been linked to digestive harm in children. The cited literature also discusses titanium dioxide,³¹ an odorless powder used as a colorant to enhance whiteness or opacity in foods, and refers to concerns relating to carcinogenicity as well as possible adverse effects on the digestive and immune systems. The substance may be found in confectionery, sauces, and certain dairy products.



2. Risks Associated with Emulsifiers and Stabilizers

The article states that certain emulsifiers, including lecithin and carrageenan, which are used to stabilize mixtures and prevent separation, may cause gastrointestinal side effects and may stimulate inflammatory responses in normal colonic epithelial cells through pathways associated in the cited literature with lymphoid or B-cell processes. Guar gum is also described as capable of causing rare allergic reactions, while some emulsifiers may reduce bacterial diversity in the gut.

3. Risks Associated with Preservatives

Nitrates, nitrites, and sulfites are used to extend shelf life and prevent spoilage. The article reports that they may cause allergic reactions, including itching and urticaria (hives), a raised red or pink itchy rash, as well as anaphylaxis, a sudden and potentially life-threatening systemic allergic reaction. Sulfites present in various foods and beverages may also aggravate asthma.

The article further states that phosphoric acid, used as a preservative and acidity regulator, may interfere with iron absorption and thereby contribute to anemia. It is also said to interfere with calcium absorption, which may contribute to bone fragility and skeletal problems, and to affect muscular structure. It is frequently used in carbonated beverages and in the manufacture of phosphate fertilizers.³²

The article further states that the European Food Safety Authority addressed the use of azodicarbonamide (ADA),³³ which is used in some jurisdictions as a dough improver and bleaching agent in baked goods and other foods. According to the article, heating may produce decomposition products associated with carcinogenic concerns, while inhalation may cause asthma and other respiratory problems.

4. Risks Associated with Antioxidants

Butylated hydroxyanisole (BHA) is primarily used as an antioxidant and preservative in foods and food packaging. The article notes that it has been classified under California Proposition 65 in relation to carcinogenicity and that the International Agency for Research on Cancer has classified it as possibly carcinogenic to humans. These classifications are described as relying in part on evidence of tumors in animals. The article further refers to concerns about endocrine disruption, including possible effects at high doses on testosterone levels and thyroid hormones.

5. Risks of Food Additives to Mental and Behavioral Well-Being

The article argues that concerns regarding food additives are not limited to children's physical health but may extend to behavioral and mental well-being. It refers to a 2007 study by researchers at the University of Southampton in the United Kingdom that examined associations between children's consumption of foods containing sugars, preservatives, salicylates, and sodium benzoate and increased hyperactive behavior. According to the article, sustained consumption may contribute to symptoms of hyperactivity in susceptible children.

It also refers to studies conducted at a national health institute suggesting that dietary modification involving foods high in sugar was associated with improvement in a small



proportion of children with hyperactivity. Researchers identified in the source as Nussbaum and Bigler are also cited for the proposition that foods containing dyes and preservatives added to ready-made products may contribute to attention disorders in children.³⁴

The article further cites medical literature discussing gluten found in wheat, barley, and oats, and casein found in dairy products, in relation to autism-spectrum disorders in children. It refers to a study attributed to Hovarth, which proposed that autism may be associated with prolonged early exposure of the central nervous system to opioid-like compounds potentially derived from incomplete digestion of dietary gluten or casein.

II. Legal Framework Governing the Use of Food Additives

The Algerian legislature has devoted substantial attention to food additives because of their connection with consumer health and safety. Its position may be inferred from Article 8 of Law No. 09-03 on Consumer Protection and the Suppression of Fraud, as amended and supplemented by Law No. 18-09.³⁵ Like other legal systems, Algerian law permits the incorporation of food additives into foodstuffs intended for consumers. In order to protect consumers, Executive Decree No. 12-214 was adopted to specify the conditions and procedures governing the use of such additives in foods intended for human consumption.³⁶

Article 5 of the same Decree requires that the nutritional value of food be preserved when additives are incorporated. It also recognizes situations in which an additive may constitute a necessary component of dietary foods, including products containing carbohydrates, fats, proteins, vitamins, and minerals. Where additives are used to improve preservation, stabilize food, or improve organoleptic properties, they must not alter the nature or quality of the food in a manner that misleads consumers.³⁷

Where an additive is used as a processing aid during a particular stage of preparation for consumption, it must not be used to conceal the effects of low-quality raw materials or inappropriate technological methods.

Because food additives fall within the producer's safety obligation, Algerian law requires food products to be free from dangerous substances capable of rendering them harmful to consumers, whether through acute or chronic effects.³⁸ Products placed on the market must be safe in light of their reasonably foreseeable lawful use and must not harm consumer health, safety, or interests.³⁹

To protect consumers from the effects of food additives, the legislature subjects additives to specifications established by Algerian standards. Where no national standard exists, applicable international standards are to be used. The Algerian framework thus adopts international requirements concerning specifications and purity.⁴⁰

The Algerian legislature nevertheless departs from international standards in one respect by requiring food additives incorporated into foodstuffs to be halal.⁴¹ It also does not authorize carry-over of food additives through raw materials or ingredients in certain categories, including preparations intended for infants under 12 months of age, preparations for young children older



than 12 months and younger than three years, foods for special medical purposes, and complementary foods for infants and young children.⁴²

The legislature has also specified the quantities of additives that may be used in each product through annexes and tables establishing maximum authorized levels. Annex III to Executive Decree No. 12-214 contains a list of food additives permitted for incorporation into foodstuffs together with maximum limits. Failure to comply with these limits may create risks to consumer health.

The legislature did not limit its intervention to the requirement that food additives be safe. It also imposed on producers an obligation to inform consumers about products placed on the market. Food labeling is one of the principal legal mechanisms through which this duty to inform is discharged. Labeling encompasses a wide range of statements, writings, signs, marks, characteristics, images, representations, or symbols linked to a product and appearing on packaging, documents, notices, labels, tags, seals, or other accompanying materials indicating the nature of the product, regardless of the medium used. The essential objective is to provide consumers with the information necessary to make informed choices regarding the suitability of food products for their health and safety.

Food additives are subject to specific disclosure requirements under Article 12 of Executive Decree No. 12-214. Labels must indicate the name of each additive and its number under the International Numbering System (INS), followed by its technological function, the wording “for food purposes,” and the maximum quantity of each additive.

The same legal text also addresses the use of two or more additives in additive mixtures, mixtures of flavoring substances, foods containing incorporated sweeteners, and additives intended for the food industry. Each category is subject to specific information that must be communicated to consumers.

Conclusion

The principal findings of the study, together with a number of recommendations, may be summarized as follows:

Although food additives may be used in consumer products only pursuant to authorization and strict legal procedures, they continue to represent a potential source of risk to consumer health and safety. The reason may lie in exceeding authorized quantities or limits, using additives to conceal defects or poor product quality, repeated exposure, or excessive consumption.

The Algerian legislature has established legal controls governing the use of food additives but has not provided specific sanctions for violations of those controls either in Law No. 09-03 on Consumer Protection and the Suppression of Fraud or in Executive Decree No. 12-214. This may weaken the effectiveness of consumer protection.

Applying Article 71 of Law No. 09-03 on the basis that food additives fall within the safety obligation results in a fine ranging from DZD 200,000 to DZD 500,000 for violations of



mandatory food-safety requirements. The study considers this sanction relatively limited when compared with the potential seriousness of harm to consumers.

Executive Decree No. 12-214, which specifies the conditions and procedures governing the use of food additives, does not apply to food intended for animal consumption, whereas Law No. 09-03 permits the incorporation of food additives into food intended for both human and animal consumption, notwithstanding the importance of animals as a basic source of food.

The mechanisms established by the legislature contain certain shortcomings that may be addressed through the following proposals:

Adopt specific legal provisions prescribing sanctions for violations relating to the use of food additives, in order to avoid confusing consumers.

Establish specialized scientific bodies and teams to monitor regularly consumer products containing food additives that are offered for consumption, with a view to identifying expected and unexpected adverse effects.

Develop public-information and advertising campaigns to alert consumers to products found to be defective or unsafe because of food additives.

Promote a consumer culture that emphasizes the importance of food labeling and the ability to read and understand labels correctly, while strengthening legal awareness and encouraging consumers to report violations.

Encourage consumers to purchase products containing lower levels of food additives, to maintain balance in consumption, and to avoid excessive intake.

Consider introducing affordable laboratory tests for the early detection of allergy to food additives. Such testing could represent an important preventive measure capable of reducing harm associated with excessive consumption.

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