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# Ensuring Food Quality and Safety: The Role of Additives in Modern Food Production

Review Article

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## Abstract

The National Food Administration (NFA) ensures food quality and safety. This involves conducting thorough risk evaluations for both microbes and chemicals, including food enhancers. These additives, such as antioxidants, preservatives, colorants, flavor enhancers, and antimicrobial agents, are crucial for maintaining food quality and safety. They are categorized into preservatives, antioxidants, emulsifiers, stabilizers, thickeners, sweetening agents, pH adjusters, and flavor enhancers. The Joint FAO/WHO Expert Committee on Food Additives (JECFA) assesses their safety for international trade. Food additives slow degradation, enhance flavors, compensate for nutrient loss, and improve visual appeal. They are divided into nutritional enhancers and technological additives. Nutritional enhancers address malnutrition, while technological additives extend shelf life, enhance flavor, and alter texture. Antimicrobials and antioxidants play key roles in controlling spoilage and oxidation.

**Keywords:** Food Additives; Antioxidants; Preservatives; Colorants; Flavor Enhancers; pH Adjusters.

## Introduction

The primary objective of the National Food Administration (NFA) is the protection of food quality and safety. This involves conducting thorough risk evaluations for both microbes and chemical substances, which include contaminants as well as food enhancers, found within food products. The utilization of food enhancers primarily serves to maintain and enhance food quality in various aspects. Such additives should either offer benefits to consumers or be essential for the processing and distribution of food products, all while being deemed safe from a toxicological perspective. Regulating the application of these additives in foodstuffs is crucial to ensure that their consumption remains at levels considered safe, necessitating assessments of how much of these additives are consumed through foods in which they are present [1].

Materials with minimal or no nutritional content are often utilized in the manufacturing or preservation of food products or animal feed, particularly in industrialized nations. These include a variety of agents such as antioxidants, preservatives, colorants, flavor enhancers, and antimicrobial agents, as well as carriers, fillers, and other similar compounds. The same materials can also serve as pharmaceutical aids when they are incorporated into medications instead of food items. To maintain the taste or improve the look and flavor of food, additives are incorporated. Such additives have a long history of use, such as using vinegar for pickling to preserve food, curing meats with salt like bacon, sweetening confections, or employing sulfur dioxide in certain wines. The rise of processed food in the latter part of the 20th century has led to the introduction of a greater number of additives, including both those derived from natural sources and those that are synthetic[2].

## Type of food additives

Food additives can be categorized into several types, including agents that prevent microbial growth, substances that inhibit oxidation, synthetic dyes, flavor enhancers, compounds that bind

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with metal ions, and substances that provide thickness and stability to food products. Preservatives like salt, vinegar, sorbic acid, and calcium propionate are commonly added to items such as salad dressings, bakery products, spreads like margarine, cheeses, and pickled vegetables. To protect high-fat foods from spoilage, antioxidants such as vitamins C and E, along with synthetic preservatives BHT and BHA, are utilized. Chelating agents, including malic, citric, and tartaric acids, are essential in maintaining the taste, color, and freshness of food, preventing undesirable changes.

**The primary categories of food additives and their uses:**

**Color Additives:** The incorporation of color additives and dyes into basic food items is generally restricted. This is due to both a cautious approach towards additives and the high volume in which these foods are consumed.

**Preservation Agents:** These substances are utilized to prevent the incursion and spoilage of food by microorganisms like bacteria, molds, and fungi. They also guard against toxins that these microorganisms might produce. Historically, methods such as air-drying, smoking, salting, and fermenting were used for preservation. While these traditional methods are still in practice, modern techniques including heat processing, freezing, and chemical preservatives have become prevalent. Antioxidants: Fats and fruit-based foods are kept from spoiling and changing color with the help of antioxidants. They also help safeguard certain vitamins known to be vulnerable to deterioration, such as vitamins A, D, E, and B.

Emulsifiers, Stabilizers, and Thickeners, Including Anti-Caking Agents: A wide array of substances falls under this category, all designed to modify the texture of food. Among these, some have raised consumer concerns, such as the anti-caking agent sodium ferrocyanide (E 535) found in table salt.

**Sweetening Agents:** Sweeteners are broadly divided into two categories: natural and synthetic. Natural sweeteners provide caloric value and can be further classified into sugars.

**pH Adjusters:** This group includes various acids, bases, and salts, such as glutamic acid and its derivatives (E620-625), which are commonly used to enhance flavor. These additives have sometimes been the subject of media attention and public discourse.

**Flavor Enhancers:** Used to impart specific flavors or aromas, these additives are either synthetically manufactured or naturally extracted. While some synthetic flavor enhancers also exist in nature, others do not. They can be used alone or in combinations. With around 2,500 substances available in the market, the regulation of flavor enhancers has not been as stringent as with other food additives [1].

**Requirement for food additives**

The Joint FAO/WHO Expert Committee on Food Additives (JECFA) is the international body responsible for evaluating the safety of food additives for use in foods that are traded internationally [3].

The allowed food additives in Singapore are detailed in the Food Regulations, which can be found in specific parts:

a) There are Regulations that sections outline the approved types of food additives and, where applicable, the conditions for their usage. The document "Types of food additives and their functions" in this Guidance Information provides further details on the technological roles of each category of food additive.

b) Third and Fourth Schedules - The food additives included in these two Schedules are authorized only for the food categories listed within them and must not exceed the prescribed maximum levels.

c) Fifth, Sixth, and Eighth Schedules - The additives mentioned in these Schedules are permissible in food production, aligning with Good Manufacturing Practice, unless they are explicitly banned by particular food standards. Good Manufacturing Practice dictates that the amount of any additive should be as low as necessary to achieve its intended purpose.

d) Seventh Schedule - This list specifies the nutrient supplements that can be safely and appropriately added to foods, with particular attention to the nutritional needs of the intended consumer demographic. Nutrient supplements added to infant formulas must adhere to the requirements in the designated Regulation [4].

**Benefits of food additives**

These agents are crucial for food processing companies. Additives serve multiple purposes in foods: they help to slow down food degradation, intensify flavors, compensate for nutrients lost during processing, and improve the visual appeal of food products [1].

Food additives fall into two primary groups: nutritional enhancers and technological additives. Nutritional enhancers are introduced to food to bolster its nutritional content, historically serving as an important measure to combat malnutrition-related illnesses. For instance, the addition of iodine to table salt helps prevent goiter, while the inclusion of vitamins A and D in margarine aims to forestall health issues stemming from a lack of these essential nutrients. Although such deficiency-related diseases are not prevalent in Europe currently, which has lessened the imperative for food enrichment, the emphasis has shifted towards technological additives. This review will concentrate on the application and safety of these technological substances. They are predominantly utilized to extend food's shelf life (through the use of preservatives and antioxidants), to enhance flavor (via sweeteners and flavor enhancers), or to alter texture (with the help of emulsifiers and thickening agents). Approximately 300 technological additives have been sanctioned for use today, and these can be further categorized into distinct subgroups [1].

in regard to preservatives (including antimicrobials and antioxidants), The antimicrobials are added to food for two purposes: to control natural spoilage of food and/or to avoid /control contamination by microorganisms, including pathogenic ones (of food safety concern)[5].

Antioxidants form a distinct category within the broader class of preservatives. Their role is to inhibit the oxidation process within molecules, which they accomplish by contributing a hydrogen

atom or an electron. Through this donation, they become oxidized into a more stable radical form, which, unlike other radicals, does not propagate additional chemical reactions. This stability halts further degradation, thereby maintaining the existing condition of the substance [6, 7].

Benzoic acid, which is synthesized through the oxidation process of toluene, is commonly used as an antimicrobial substance. Its efficacy extends across a range of microorganisms including yeasts, bacteria, and fungi. The way it works is by disturbing the cellular membranes and obstructing the metabolic activities within the microbial cells, ultimately causing stress and the buildup of harmful anions [8].

dyes, are substances that are added to food to change its appearance or to enhance its visual appeal for consumers. These additives can be categorized into five main types: azo dyes, quinophthalone-based compounds derived from quinolone yellow, triarylmethane derivatives, xanthene dyes, and pigments related to indigo [9].

Perez-Alfonso et al. (2012) indicated that both thymol and carvacrol were effective in inhibiting fungal growth, with the predominant efficacy by thymol [10].

Benzoic acid along with its derivatives, benzoates, are commonly present in beverages like soft drinks and beer, as well as in products like margarine and various acidic edibles. Their primary purpose is to prolong the edibles' usability period and to serve as a barrier against the growth of mold and bacteria. Meanwhile, nitrites and nitrates are typically added to cured meats such as sausages, hot dogs, bacon, ham, luncheon meats, and smoked fish. These additives help to preserve the longevity and safety of the food, maintaining the color of meats and dried fruits. Sulfites, on the other hand, are found in items like dried fruit, shredded coconut, and fillings for fruit pies, where they similarly act to increase preservation and prevent the proliferation of mold and bacteria. [2].

## Conclusion

Food additives ensure that food can be delivered around the world maintaining its quality and safety, without losses in an ever growing competitive market. Their role is becoming more and more important with the increase in consumption of highly processed food due to changing lifestyles of modern citizens. Nevertheless, the food additives should be used judiciously according to the legal requirements.

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