

ADDITIVES AND CONTAMINANTS

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Keywords: antibiotics, anticaking agents, antimicrobial agents, antioxidants, dioxin, emulsifier, emulsion, flour improvers, food additive, food contaminant, mycotoxicosis, mycotoxin, PAH, PCB, pesticides, pesticide residues, preservatives, veterinary drugs, veterinary drug residues

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Summary

Different definitions of the term ‘food additive’ are used. One of the simplest definitions is: Any substance added to a food to give it desired property. According to FAO/WHO Codex Alimentarius, food additive means any substance intentionally added to food for technological purposes and/or to improve appearance, flavor, color, texture, storage properties or any other characteristic property of food. The term does not include

substances added to food for maintaining or improving nutritional quality of food; for which the term “enrichment” or “fortification” is generally used.

Although some types of additives (salt, spices, natural coloring materials) were used since hundreds or even thousand years ago, the wide use of chemical additives is connected with development of modern food industry. Bearing in mind the big number of food characteristics to be influenced by additives and also a lot of technological requirements, the number of additives used at this time is high (e.g. the regulations of European Union permit the use of more than 600 different additives). From regulatory standpoint, each of the food additives must provide some useful and acceptable function or attribute to justify its usage. Among generally acceptable functions the improved preservation quality, improvement of functional properties, processing facilitation, and enhanced consumer acceptance may be mentioned. Concerning the food safety the following criteria should be kept in mind:

1. An additive must not have any harmful health effect
2. It must not allow the use of unfit raw material
3. Its use must not make possible the employment of careless and imperfect methods of manufacture
4. It must not retard the action of digestive enzymes
5. It must have no tendency to decompose within the body into substances which have a greater toxicity than that of the additive itself
6. It should lend itself to simple methods of determination and thus simplify the control of food.

Although the permitted additives were thoroughly controlled, the tendency today is the reduction of the use of additives in food production. Usage of additives is discouraged where similar effects can be obtained by economical and good manufacturing practices.

The additives used in food processing may be divided in two groups: (i) naturally occurring compounds or additives isolated from natural sources and (ii) synthetic chemicals. The chemistry of first group is treated in corresponding chapters dealing with main nutrients (proteins, lipids, carbohydrates) and minor food constituents (vitamins, minerals, color compounds, flavor compounds). In this chapter the main synthetic additives (antimicrobial agents, antioxidants, and other chemicals) will be overviewed.

The second part of this chapter is devoted to the main groups of contaminants. The mycotoxins (aflatoxins, fusarium toxins) residues of pesticides, veterinary drugs, dioxins, polycyclic aromatic compounds and toxic metals will be overviewed.

1. Food Additives

Additives used in food processing may be divided into two groups: (i) substances occurring in the nature or isolated from the natural sources and (ii) synthetic chemicals. Keeping in mind the fact that natural additives were discussed in the framework of corresponding food constituents (e.g. emulsifiers in *Lipids*; alternative sweeteners, color and flavor compounds in *Aroma and Color Compounds*) in this chapter primarily the

synthetic additives will be treated.

1.1. Antimicrobial Agents

Antimicrobial agents (often referred to as preservatives) may be defined as substances inhibiting the growth of microorganisms or killing them. They play the main role in food spoilage chemical preservatives with antimicrobial properties in preventing spoilage of foods (See also *Spoilage and Preservation of Foods*). In the framework of this chapter a short overview will be given of frequently used chemicals.

1.1.1. Sulfites and Sulfur Dioxide

Sulfur dioxide has been used for long for preservation of fruits, vegetables and wine. In addition to gaseous sulfur dioxide, sodium – and potassium sulfites (metabisulfites, bisulfites) are also employed for such purposes. It has been shown that sulfur dioxide is most effective as an antimicrobial agent in acid media. That is why it is frequently used in preservation of acidic foods such as major part of fruits.

Sulfur dioxide and sulfites are metabolized to sulfate and are excreted in the urine without any obvious pathological results at the concentration level used generally in food processing. The maximum level of free and bound (sulfuric acid and sulfites may react with some food constituents e.g. sugars) are regulated and controlled. It may be also mentioned that some people e.g. asthmatics are sensitive to sulfur dioxides and their derivatives.

1.1.2. Benzoic Acid and its Derivatives

Benzoic acid has been widely employed as an antimicrobial agent in foods. It is primarily used for preservation of acid foods such as fruit juices, carbonated beverages, pickles and sauerkraut because the antimicrobial effect is connected with undissociated form of benzoic acid. Benzoic acid has been found to cause no deleterious effects in humans when used in amounts limited by food regulations.

Alkyl esters of benzoic acid, named as group parabens, are used in baked foods, soft drinks, beer, jams, jellies, and pickles. Parabens exhibit a low order of toxicity to humans and are excreted in the urine after hydrolysis together with benzoic acid.

1.1.3. Sorbic Acid

Sorbic acid (Fig. 1) and its sodium and potassium salts are widely used to inhibit mold and yeasts in a wide variety of foods, including cheese, baked foods, fruit juices, wine, and pickles. In general, sorbic acid is more active in acid media, it is effective up to pH=6.5.



Figure 1: Sorbic acid

1.1.4. Other Compounds

In addition to frequently used chemicals mentioned above, a lot of other compounds are known which are used for preservation purposes. *Propionic acid* has found extensive use in the bakery field, where it not only inhibits molds effectively but also is active against the rosy bread organism, *Bacillus mesentericus*. The preservation of foods with *acetic acid* (*vinegar*) dates back to antiquity and at present is also widely used.

Also used in foods are sodium acetate and potassium acetate. Acetic acid is also used in such foods as catch-up, mayonnaise, and pickles, where it serves dual function of inhibiting microorganisms and contributing to flavor.

1.1.5. Antibiotics

Antibiotics, a large group of antimicrobial agents produced naturally by a variety of microorganisms, are widely used in medicine. The success of antibiotics in controlling pathogenic microorganisms in living animals has led to extensive investigations into their application in food preservation. A limited number of antibiotics (nisin, chlor-tetracycline, and oxy-tetracycline) are in use, under restricted conditions, in food industry. For example, dipping whole poultry carcasses into solutions of chlor-tetracycline or oxy-tetracycline is permitted. This increases the shelf life of the poultry, and residual antibiotics will be destroyed by usual cooking methods.

1.1.6. Future Trends in Use of Antimicrobial Agents

Due to increased requirements concerning food safety, there is a general trend in food industry that efforts are made to decrease the use of any antimicrobial chemicals in food processing. Efforts are now focused on reduction and future ban of use of antibiotics. Bearing in mind that use of antibiotics in animal husbandry may result occurrence of antibiotic residue in food of animal origin, efforts are extended to reduction of use of antibiotics also in animal husbandry.

The reduction of use of other traditional antimicrobial chemicals is a trend also in food industry by development of new processing- and storage technologies and search for natural plant extracts, constituents with antimicrobial action. Such trend is stimulated by facts that in some cases, due to modern research techniques, a harmful effect of some earlier used compounds was detected and their further application is not permitted.

1.2. Antioxidants

As it is well known, the oxidative deterioration of edible fatty materials is a serious problem because it leads to a decrease in organoleptic quality and nutritional value. Although excluding of oxygen, storage in darkness, avoiding the use of metallic containers may significantly reduce the undesired oxidative changes; in practice additives with antioxidative activity are widely used. Antioxidants are natural and synthetic substances that can delay the onset or slow the rate of oxidation of oxidizable materials. Hundreds of natural and synthetic compounds are known which possess antioxidative properties; however, a limited number of such substances are used in foods. Antioxidants permitted by regulations for use in food were rigorously tested from

point of view of safety. The substances permitted for use in foods should be safe even at excessive doses (at levels 100 times higher than the permitted limit). The total concentration of antioxidants may be generally maximally 0.02% by weight based on the fat content of food.

The most frequently used synthetic antioxidants are monohydric and/or polyhydric phenols with various ring substitutions. Such compounds are the *butylated-hydroxy-anisol (BHA)*, *butylated-hydroxi-toluene (BHT)* (Fig.2.), *tertiary-butyl – hydroxi-quinone (TBHQ)*, and the *propyl-gallate (PG)*. (Fig.3.).

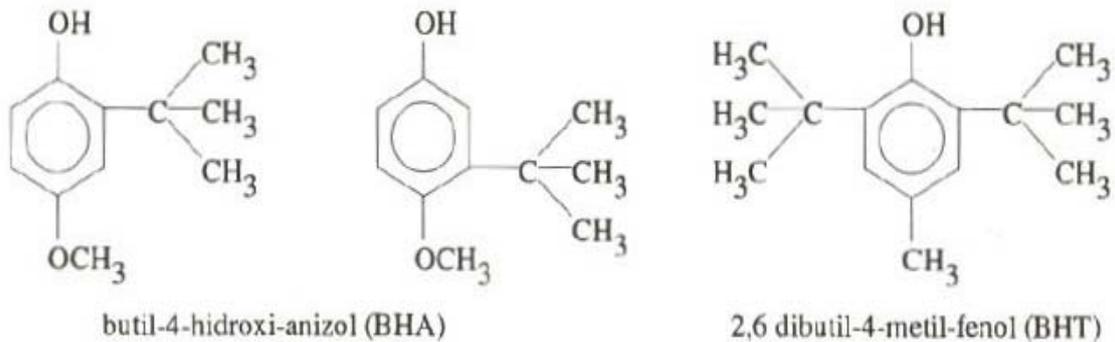


Figure 2: Butylated –hydroxi-anisol and Butylated-hydroxi-toluene

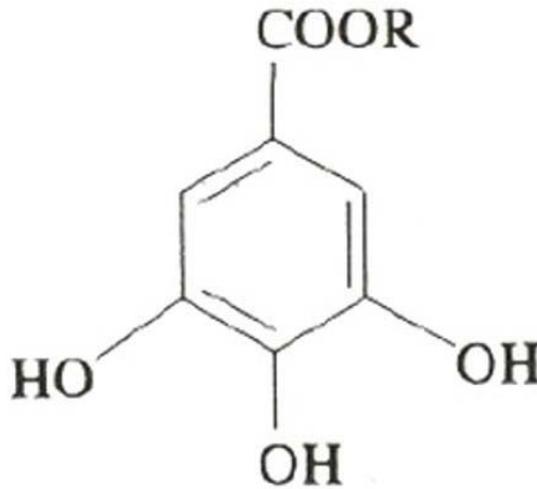


Figure 3: Propyl gallate

Despite the officially declared safety, the general public concern with chemical additives and food safety triggered a continuing search for new antioxidants that may occur naturally in food or may form inadvertently during processing. At present only tocopherol (vitamin-E) is used commercially as natural antioxidant, although a lot of such compounds occur primarily in plants (including fruits and vegetables).

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Biographical Sketch

Dr Natalia Cicic-Lásztity Ph.D. is a specialist in pediatrics at the Heim Pal Hospital in Budapest Hungary. She received her M.Sc. degree from the University of Belgrade (Faculty of Medicine).in 1990. Dr Cicic-Lasztiy worked till 1997 in the Pediatric Clinic of Semmelweis University of Medical Sciences in Budapest and obtained a degree of specialists in pediatrics. From 1998 to 2002 she takes part in research program of the Hungarian Institute of Health and Nutrition connected with clinical nutrition of patients with heavy pancreatitis. She received her Ph.D. degree in clinical nutrition in 2005. Dr Cicic-Lasztiy published several papers in scientific journals mainly in the field of clinical nutrition. She also participated in several national and international scientific events. Her present major interest is enteral and parenteral nutrition.