Food Science and Technology Notes

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There are often questions asked about added chemicals in our food supply. As an answer to some of these questions, this article offers an in-depth discussion of food additives, their functions, their development, and safety.
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FOOD ADDITIVES

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The topic of food additives is one of those which people are either against or for. We should try to be objective when we think about or discuss this subject. Are foods of natural origin o.k. and "synthetic" foods harmful? We cannot answer both questions affirmatively.

Foods are made up of a mixture of chemicals put together by nature, but we must remember not all foods produced by nature are harmless. Some foods contain toxic substances. One example is the presence of oxalic acid in spinach and rhubarb. The presence of other toxic substances in certain species of mushrooms and berries are other examples. Even the most innocent substances, salt for example, can be harmful when used to excess. Then, again we have strichnine and arsenic compounds which are extremely toxic substances, but in very small amounts that are used for medicinal purposes. The criterion used as a guide today is not whether a food is or is not of natural origin, but whether the particular food has or does not have toxicant characteristics in the amounts used. The burden of the proof today is on the food processing firms or on the additive manufacturers.

Let us now discuss and define what food additives are. To scientists and food technologists--and, practically speaking, to the general public--a food additive is "a substance or a mixture of substances, other than a basic foodstuff, which is present in a food as a result of any aspect of production, processing, storage or packaging". These substances are frequently divided into two classes, (1) intentional additives, which are added on purpose to perform specific functions, and (2) incidental additives which, though they have no function in the finished food, become part of a food through some

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phase of agricultural production, or of processing, packaging or storage. According to this definition, chemicals such as sodium bicarbonate, citric acid, ascorbic acid (Vitamin C), thiamine, gelatin, and even common spices are considered additives, along with many more formidable-sounding chemicals.

On the other hand, a lawyer must view the food additive as defined in the Food Additives Amendment to the Federal Food, Drug and Cosmetic Act. The definition of a food additive from the legislative point of view follows: "Any substance the intended use of which results, or may reasonably be expected to result, directly or indirectly in its becoming a component or otherwise affecting the characteristics of any food (including any substance intended for use in producing, manufacturing, packing, processing, preparing, treating, packaging, transporting, or holding food; and including any source of radiation intended for any such use), if such substance is not generally recognized, (GRAS substances) among experts qualified by scientific training and experience to evaluate its safety, as having been adequately shown through scientific procedures to be safe under the conditions of its intended use (or, in the case of a substance used in food prior to January 1, 1958, through either scientific procedures or experience based on common use in food)". In other words, the legal definition of food additives excludes most additives in common use because they are "generally recognized as safe" or because they have been previously approved for use. Other substances, such as pesticides and colors, are excluded because they are covered under other sections of the law. Today, however, the GRAS list of additives is being reviewed. Thus, a food additive (to scientists and laymen) is not a food additive (to lawyers and legislators) when its use in a food has been approved according to the specifications of the Food Additives Amendment. For the purposes of this article, we will use the laymen's definition.

Function of Food Preservatives

Some additives are added to perform specific functions in the food products, such as to improve nutritive value, preserve the quality of the food, or to flavor or color the food. Other additives become part of the food product through some phase of fresh food production, processing storage, or packaging. For example, an agricultural chemical applied to crops might be carried over into some processed foods, or a substance present in the food package might migrate into the food contained in that package. An example of the latter instance is calcium propionate used to control mold in bread or cheese by its activity in the bread wrapper. Additives such as agricultural chemicals, or substances that migrate from food packages may be present in foods, although usually only in minute amounts. Farmers and food processors, as well as federal and state public health authorities should all cooperate to make sure that these additives do not exceed safe limits. Food additives should be used in scientifically controlled amounts, not more than the amount necessary to perform the needed function, assuming that that amount has been found and declared safe by U.S. Food and Drug Administration.

Before we discuss uses or functions of additives, let us identify those instances when the use of additives is undesirable.

The use of additives is not in the best interest of the consumers and should not be permitted in the following situations:

1. To disguise the use of faulty processing and handling techniques, such as to reduce bacterial counts or to conceal off-odors.
2. To deceive the consumer, such as addition of color when its use has not been legally approved.
3. When the use of a food additive results in a substantial reduction of the nutritive value of the food.
4. When the desired effect can be obtained by good manufacturing practices which are economically feasible.

Additives perform nine distinct functions:

1. As Nutrition Supplements. Vitamins, minerals, and amino acids used to improve general nutrition. Rickets have been practically eliminated in this country due to the widespread availability of vitamin D-fortified milk. Incidence of goiter has been reduced by the use of iodized salt. And a general improvement in health standards can be traced to the supplementation of cereal products with thiamin, riboflavin, niacin, iron, and in some cases, with calcium and vitamin D. It has been estimated, for example, that enrichment of cereal foods alone provides 12% to 23% of our daily supply of thiamine, niacin, and iron, and 10% of our riboflavin. Breakfast cereals combined with milk are, according to nutrition experts, nutritionally good foods.
2. As Coloring Agents. The natural coloring materials in foods may be intensified, modified, or stabilized by the addition of neutral coloring materials, or certified food dyes. While these chemicals alter only the appearance of food, they are important for the esthetic value they add and the psychological effect they have on our food consumption habits.
3. As Preservatives. Chemicals may be used to help prevent or retard microbiological spoilage and chemical deterioration. However, they must not disguise spoilage, deceive the consumer, or permit unsanitary food handling.

4. As flavoring Agents. In number, flavor additives probably exceed all other intentional chemical food additives combined; in volume, their use is small. All natural as well as synthetic flavors used in foods must first be approved as safe for health. The similarity of synthetic flavors to those produced in nature permits both types to be used freely in combination, with results no different from either used alone. Flavor enhancers, which do not add flavors but instead intensify those already present, also require approval for use. Chemical enchancers were developed originally for commercial food processing. However, one such chemical--monosodium glutamate--has since found a market as a consumer product. The safety of MSG has very recently been reaffirmed by the National Academy of Sciences, National Research Council. However, since it was not found to benefit infants, NAC/NRC recommended that it not be used in infant foods.

5. As Agents to Improve Functional Properties. Chemicals in this classification act as thickening, firming, and maturing agents, or affect the colloidal properties of foods, such as in gelling, emulsifying, foaming, and suspending. Calcium salts, for example, help firm the texture of canned tomatoes.

6. As Processing Aids. Sanitizing agents, metal binding compounds, anti-foaming agents, chemicals that prevent fermentation and chemicals that remove extraneous materials are grouped in this classification. Examples are silicones to prevent foam formation in wine fermentation; citric acid to combine with metals and prevent oxidative rancidity; and sodium nitrite used as a curing agent for meats.

7. As Moisture-Content Controls. Chemicals sometimes are used to increase or decrease the moisture content in food products. For instance, glycerine is approved for use in marshmallows as a humectant to retain soft texture. Calcium silicate is frequently added to table salt to prevent caking due to moisture in the air.

8. As Acid-Alkaline Controls. Various acids, alkalies and salts may be added to food to establish a desired pH. Phosphoric acid

in soft drinks, and citrate salts in fruit jellies are examples of this chemical control of acid-alkaline balance.

9. As Physiologic Activity Controls. The additives in this group are usually added to fresh foods to serve as ripeners or antimetabolic agents. Examples of application for this purpose are ethylene, used to hasten the ripening of bananas; and maleic hydrazide, used to prevent potatoes from sprouting.

Development of Food Additives

In developing food additives, the modern chemist or food scientist often uses complex instruments, such as the spectrograph, to determine the chemical structures of certain components under investigation. However, not all research is carried on with help of multi-thousand dollar devices. In other instances, ordinary kitchen appliances and simple laboratory instruments are used, such as in determining whether a certain additive will help produce the desired consistency in a cake batter, so that a better baked product will result.

Safety of Additives

Simultaneously with development, the safety of additives is tested. One way this is done is through animal feeding experiments. These studies sometimes require two years or more, and may involve such experimental animals as rats, mice and guinea pigs.

When all the studies are completed and the proposers of the new additive are convinced the additive will perform the needed function in food and that it is safe for its intended use, the research data are submitted to the U.S. Food and Drug Administration. Government scientists make a thorough examination of the research data with regard to the proposed use and safety of the additive. They approve or disapprove the use of the additive for the application requested, or they may request added information.

The concept of safety involves the question of whether a substance is hazardous to the health of man or animal. Safety requires proof of reasonable certainty that no harm will result from the proposed use of the additive. It does not and cannot require proof beyond any possible doubt that no harm will result under any conceivable circumstances. In determining safety, we must consider: (1) the quantity consumed of the additive; (2) any substances formed in the food because of the presence of the additive; (3) the cumulative effect of such additive in the diet of man or animals, taking into account any chemically or pharmacologically related substances in the diet; and (4) safety factors which in the opinion of experts qualified by scientific training and experience to evaluate the safety of food additives, are generally recognized as appropriate for the use of animal experimentation data.