

The use of food additives has produced large public health benefits, primarily because such chemicals play a role in increasing food production, in conserving foods in storage, and by making foods continuously available in an acceptable form. Benefits and hazards are weighed and the need for future activities is stated.

HEALTH ASPECTS OF FOOD ADDITIVES

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A FOOD additive, in the general sense, is “. . . a substance or mixture of substances, other than a basic foodstuff, that is present in food as a result of any aspect of food production, processing, storage, or packaging. The term does not include chance contaminants.”¹ The term has in addition a legal meaning, as defined by the Federal Food, Drug, and Cosmetic Act, that is of little use in general considerations, and this meaning will not be implied in any of the following discussion.

A substance may be present in a food only as a consequence of its having been used as an aid to production or storage, as for example a pesticide residue or a substance derived from a packaging material. Such substances have been called incidental additives. Other substances are purposely added to foods to perform some function in processing, formulation, or preservation. These have been called intentional additives.

The chemicals or substances included in these classes of additives number many hundreds. A recent compilation lists about 1,700 intentional food additives alone, of which over 1,000 are used in flavors.² There are over 100 pesticide chemicals in use plus a variety of carriers, diluents, sticking agents, propellants, and other substances used

in conjunction with the active ingredients. And there are several hundred chemicals used in formulating food packaging materials which might become additives: the basic glass, film, paper, metal, cloth, or wood, plus the sizings and coating materials; the plasticizers, the adhesives, the dyes and printing inks, and the solvents, germicides, antioxidants, and other miscellaneous chemicals associated with them. Finally there are a few additives that result from use of feed adjuvants and drugs for domestic animals, plant growth regulators, and substances for maintenance and sanitation of food processing equipment.

It is obviously impossible in this presentation to discuss the public health aspects of this diverse and large list of substances in any but a general way: What are the benefits and what are the hazards to health associated with the use of chemicals in food production, processing, packaging, and storage? No attempt will be made to assess the safety and benefits from use of any particular additive.

Supplying foodstuffs for the United States and other urbanized, industrialized societies entails: (1) production, by a comparatively small part of the population, of the foods to be used in

consumption centers often distant from production areas; and (2) conservation of the foods during long periods of storage (particularly in temperate climates where seasonal shortages would otherwise occur) and through extended distribution chains. A great many applications of science and engineering have been made to this enterprise. Each of them is designed to enhance efficiency of production, conservation, distribution, or consumer protection or satisfaction; and each of them is associated with some degree of hazard, however small. Among them is the use of chemical aids.

The benefits to health resulting from use of chemical aids in food production, processing, and storage can be thought of in various ways. We shall consider them primarily as related to availability and conservation of food.

The nearly constant availability of a wide variety and abundance of foods in all parts of the country, at all seasons, and at reasonable costs is in part due to the use of these chemical aids. The contribution of insecticides, fungicides, herbicides, and other pest control chemicals to plant production, both in quantity and quality of product, has been extensively documented. Meat, milk, and egg production are benefited by chemical control of external and internal parasites. Pesticides contribute further to food availability by helping protect stored foods, and antisprouting agents help prolong the usability of some of them. Use of antibiotics, hormones, tranquilizers, enzymes, coccidiostats, and other drugs in animal rations increases efficiency of production and thus contributes to the availability of foods of animal origin.

Food otherwise not storable for long periods is always made available by preservation through processing of that which is not needed in the fresh state. Other foods, as cereals, generally are used as food for man only after proc-

essing. Still other processing is done primarily for the convenience of the consumer although preservation is an important added benefit in many such cases. Chemical additives perform many functions in these processes. Preservatives and antioxidants may be used to help inhibit deterioration of the processed food. Emulsifying, thickening, texturizing, and stabilizing agents are used in some foods to improve and maintain physical characteristics. Acids, alkalis, buffers, and neutralizing agents are added to obtain and preserve desired pH and for taste. Food color is influenced by adding chemical coloring agents, by bleaching, and by fixing colors. Flavor is added or enhanced. Sweetness may be contributed by non-caloric sweeteners. Nutrients may be added.

Packaging is nearly as varied as the food products contained and is formulated to meet specific functional needs. "The primary packaging materials, e.g., metals, glass, wood, fabric, paper, and synthetic films, are modified in many ways for particular purposes. They may be treated to withstand the solvent action of acidic, basic, neutral, alcoholic, or fatty foods they will contain, or the abrasive action of the foods; specially formulated to exclude or permit passage of gases and moisture; made shrinkable by heat or relatively heat-stable or cold-resistant, flexible or rigid, colored, transparent, or opaque."³ The packaging is expected to protect the food contained without itself contributing hazardous contamination to the food.

We tend to overlook, in our abundance, the great contribution of all these applications to maintenance of our food supply. We forget, for example, that the Irish potato has not been successfully produced commercially without pesticides for 100 years, that without pesticides our apples would be wormy or scabby, that some vegetables such as tomatoes would virtually disappear

from some markets in particularly bad blight years, and that more man-hours and more acres would be required to produce our needs, necessarily at greater costs, than at present. We forget the ravages of pests on stored products until we see, or are reminded of, the damage in other areas of the world. We are told that loss of stored food to pests in India is at least equal to that country's food deficit. We see in the markets of much of the world that half the grains or beans have weevil holes in them, with resulting loss in weight of 10 to 40 per cent. And we read that dermestid and other beetles consume half of the total weight and perhaps more than half of the protein of smoke-dried "preserved" fish during transport from Lake Chad to Lagos or Ibadan.⁴

The protection given our foods by packaging—at least the physical protection against attack from insect and microbiological pests—is evident, but the unseen protection afforded by gas or water barriers is less so. Perhaps even less evident is the role of functional chemical additives in the conservation of our food supply. This role is particularly important in the case of chemical preservatives that inhibit growth of spoilage organisms in or on foods and those that inhibit chemical (oxidative) deterioration. Other intentional additives, however, contribute to conservation and availability by enhancing or maintaining esthetic, physical, or convenience characteristics that promote consumer acceptance of foods.

Other and in some cases ancillary benefits to health stemming from use of food additives can be cited. The preservation of nutrients by inhibition of oxidative changes and the enhancement of nutritive value by purposeful addition of nutrients, or by addition of nutrient materials for some functional reason other than that of nutritional enhancement, are examples. Protection of the consumer from pathogenic micro-

organisms in foods is usually not entrusted to food additives alone; the antimicrobials used are primarily for control of spoilage organisms. Recent activity, however, has drawn attention to the toxic products produced by several common molds, and it may be that the fungistats we have so long used have contributed more to public health than just prevention of food wastage. Similarly, the nitrites used in curing hams may contribute more than just developing and fixing the color we associate with this food. It has been shown that salt and nitrites at levels used for curing meats also inhibit growth of some strains of *Clostridium botulinum*.⁵ These benefits to health are of secondary importance, however. The primary one remains the maintenance of an abundant food supply.

What are the hazards to health presented by the use of the many and diverse food additives? The possible adverse effects on health of each use of an additive will, in general, have been evaluated before the use is permitted and judged to be insignificant. What then is the source of the public anxiety about these substances? The proponent of the chemical or use and the regulatory agencies attempt to assure that the use will be safe. In the main the only methods available leave more or less justifiable doubts about actual safety for man, about possible effects from long-term ingestion, and about possible additive and synergistic relations among the host of additives and other chemical constituents of foods. Opponents play on these doubts and raise fears that current incidences of diseases are related to use of food chemicals or even that the future of the race is endangered by their use. Since it is impossible for proponents to demonstrate with complete finality that opponents are wrong, the public anxiety remains.

Aside from this anxiety, there has been no demonstrated adverse effect of

food additives on public health. This is not to say that the chemicals used as food additives are never hazardous. Even sodium chloride, perhaps the most common of food additives, has caused death when misused. The occupational hazards associated with manufacture and use of some chemicals, particularly pesticides, are important, but these are not hazards associated with the materials as food additives. With continued adequate assessment of toxicity and evaluation of safety before a usage is permitted and with review and reevaluation for any deleterious effect during usage, no significant hazard should be anticipated.

Since absolute safety of a use can never be demonstrated and present toxicologic methods are not adequate to assure that no long-term effect will be exerted by a chemical, it is mandatory that such reevaluation be done periodically. The reexamination might include animal experimentation designed to reveal a toxicologic action not suspected when the use was first permitted. It might entail a reevaluation of safety because usage becomes more widespread than originally anticipated. And it might include continued monitoring of the levels of additives occurring in the food supply as a result of permitted usages. Finally, studies of populations exposed to food additive chemicals during manufacture and use (or otherwise) might

reveal long-term hazards not demonstrable in the laboratory, and such studies should be, and frequently are, part of the continuing evaluation of safety of these chemicals.

Summary

The benefits to public health resulting from use of food additives are great and stem primarily from the role of these chemicals in increasing food production, in conserving foods in storage, and in making foods continuously available in acceptable form through processing. The benefits greatly outweigh any hazard detected by present methods of toxicology and safety evaluation. That hazards not detected by present methods might exist is recognized, and continuing reevaluation of the safety of each use in light of new information or new technology is necessary.

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