Food additives—an unending controversy[1,2]

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ABSTRACT The use of food additives originated in ancient times but did not engender controversy until the early 1800s, when intentional food adulteration became appallingly common in some countries. Problems with intentional food adulteration continued until about 1920, when regulatory pressures and effective methods of food analysis reduced the frequency and seriousness of food adulteration to acceptable levels in the United States. Since 1920 the use of legally sanctioned food additives has become common. However, for the last several decades the regulation of food additives has been a matter of controversy. Explanations for this controversy, which is likely to continue, are not difficult to identify and are discussed in the text. *Am J Clin Nutr* 1987;46:201–3.

KEY WORDS Food additives, food adulteration

The practice of adding chemicals to foods originated thousands of years ago and involved, for example, the use of flavors, spices, preservatives, and ripening agents. Patterns of the addition of chemicals to foods have changed dramatically during the course of history. From ancient times to about 1820—phase I of the history of the usage of food additives—the addition of chemicals to foods was done primarily for respectable reasons. Intentional chemical adulteration during this period was generally not a significant problem, probably because food was procured personally, from friends, or from small businesses, all modes that involve a large measure of personal accountability.

Beginning in the early 1800s—phase II of the history of food additives—intentional food adulteration in the United States and several other countries of the world increased greatly in frequency and seriousness. This has been attributed to *1*) increased centralization of food processing and distribution along with a corresponding decline in personal accountability; *2*) the rise of analytical chemistry, which allowed unscrupulous purveyors of foods to replace older, less effective, empirical approaches to food adulteration with more efficient approaches based on new scientific knowledge about the composition and properties of foods; and *3*) inadequate government regulations (1). The early 1800s was also a period during which the public developed a greatly increased concern about the quality of the food supply. This concern, or more properly indignation, was aroused in England by Frederick Accum's 1820 publication on the subject of food adulteration (2) and by an anonymous publication entitled *Death in the Pot* (1). Accum (2) claimed that "indeed, it would be difficult to mention a single article of food which is not to be met with in an adulterated state; and there are some substances which are scarcely ever to be produced genuine." He further remarked: "It is not less lamentable that the extensive application of chemistry to the useful purposes of life, should have been perverted into an auxiliary to this nefarious traffic."

Intentional adulteration of food remained a serious problem until about 1920, at which time (the beginning of phase III) regulatory pressures and effective methods of analysis reduced the frequency and seriousness of this problem to acceptable levels. Most knowledgeable individuals believe that the safety of the food supply has steadily improved since that time. However, some argue that new problems began about 1950 (beginning of phase IV?), when foods containing legal chemical additives became increasingly prevalent, when the use of highly processed foods increased to a point where they comprised a predominant portion of the diet in industrialized countries, and when contamination of some foods with the by-products of industrial activities became more common. Although the great majority of concerned individuals believe that authorized practices of food additive use in the United States since 1950 have not posed a significant threat to public health (3), those holding contrary views have made this an issue of continual debate and this debate has aroused apprehension among consumers. The apprehension was unintentionally heightened by the US Food and Drug Administration (FDA) when it removed from

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the list of allowed substances several chemical additives (eg, cyclamates and a few colors).

Evidence that consumers are apprehensive about chemicals added to foods is provided by the results of a survey conducted in 1985 by the Good Housekeeping Institute (4). When 200 women were asked "do women believe that chemicals are ever good for us?", 19% responded "no, never good" and another 43% replied "I don't know." The history of the use of chemicals in foods has been a turbulent one and controversy continues to shroud many current-day practices.

Some effort is currently being made to market *natural* foods, ie, those that are relatively free of chemicals not put there by mother nature, and thereby cater to the desires of consumers who have apprehensions about food additives. However, two forces provide powerful incentives for increased use of food additives. First, urbanization is extensive and continues to increase, separating areas of food production from primary sites of consumption and encouraging the use of food preservatives to avoid excessive spoilage. Second, women continue to enter the work force in increasing numbers, creating a powerful demand for convenience foods in which food additives are common.

The responsible course of action in dealing with food additives is to monitor and evaluate continually the safety and wholesomeness of the food supply and to effect improvements when warranted. Few would disagree with this general statement. The government is following this course of action but not to the satisfaction of everyone.

Governmental authorization to add selected chemicals to foods is controversial because regulatory decisions often contain a large judgmental component. Lingering problems include the following:

1) Testing for the safety of food additives (5–7). The potential hazard of food additives to humans is usually assessed by means of animal feeding studies. This is necessary because obvious constraints exist on using humans as test subjects. Animal studies are quite effective for assessing acute toxicity of various chemicals, but are far less effective for assessing carcinogenic and sublethal effects that may arise from ingestion of food additives over intermediate to long periods of time.

The animal approach involves at least two formidable shortcomings. First, assessment of sublethal adverse effects in animals is an inexact science. Second, toxicity data for animals can be extrapolated to humans only with considerable uncertainty even under the best of circumstances. This uncertainty increases when a test substance is fed to animals at levels far in excess of those normally encountered in human diets. It is possible that massive doses in animals produce a metabolic overload resulting in the formation of metabolites that would not occur at lower doses.

Interactions among dietary components may also increase the difficulty of extrapolating animal data to humans. Interactions may lessen or intensify the effect of a given test substance and the response direction is not always known. Even when the direction of the response is known, interactions are difficult to quantify.

Furthermore, thorough testing of a food additive by an accepted protocol is time consuming and expensive, making it unreasonable (and in some instances almost impossible) to rigorously test all chemicals that are sanctioned for use. For example, the amounts of some infrequently used flavors required for a rigorous test of safety would exceed the total annual usage of these chemicals in the US food supply.

Largely for reasons of expense, many chemicals, especially those having GRAS (generally recognized as safe) status and many of the naturally occurring chemicals found in foods, have not been rigorously tested. These chemicals have received a low priority for testing primarily because they have long histories of use without evidence of harm and, in some instances, because their chemical structures are unlike those of substances which are known to be harmful.

2) Absolute safety of a food additive can never be proven, nor is absolute safety ever likely to occur (8).

3) Assessing amounts of food additives consumed. It may seem strange to some, but accurate information on the intake of specific food additives by individuals in the US population is not available. The reason is that this information is very difficult to obtain. Committees of the National Research Council, under contract from the FDA, have devised and administered two herculean surveys to gather information of this kind, but limitations in the survey approach, complexity of the survey instrument, and the variable quality of the raw data have resulted in estimates of additive use and additive intake that are less accurate than desired, especially for individuals at the highest percentiles of consumption (9, 10). Despite their shortcomings, these surveys have provided the best available estimates of food additive use and consumption. Furthermore, the experiences gained by the committees responsible for designing these surveys have already resulted in improved procedures for determining food additive use and consumption. Information required for an exercise of this kind includes the concentration of the relevant food additive in every type of food produced, the portion size for each food for each sex and age group, and the frequency with which each food is consumed by each individual. Obtaining accurate information for men, women, and all age groups in the US population is obviously not easy.

4) Many regulatory decisions regarding the use of food additives can not be made solely on the basis of scientific facts. The following are examples of this: How many and what kinds of adverse sublethal incidences traceable to a given food additive should be tolerated annually in the US population before use of the additive is disallowed or restricted? In judging the regulatory status of a food additive, should the risks of use be balanced against the benefits of use and the risks of nonuse (if any such risk exists)? Should different standards of safety be applied to those

additives that have nutritive properties as opposed to those that are used solely for aesthetic or economic reasons?

The addition of chemicals to foods has been a matter of controversy since the early 1800s. Whereas informed individuals generally acknowledge that the quality, wholesomeness, and safety of the US food supply has improved during the past 150 years and that the present day food supply is remarkably free of hazards, some individuals disagree with the latter part of the statement and a few disagree vigorously. Continuing governmental surveillance of the food supply, with regulatory judgements made on the basis of emerging scientific information, has resulted in the occasional banning of a previously allowed food additive or the imposition of new restrictions on its use. Such actions typically are based on results from animal feeding studies indicating that the margin of safety, which is required to be generous for all food additives, is less than formerly believed. To most individuals this is a reasonable course of events as our already good food supply is continually scrutinized to determine where further improvements can be made. Critics view new regulations banning or limiting the use of a specific food additive as conclusive evidence that our food supply has been unhealthful and improperly regulated all along.

This controversy will never end. As a result, public anxieties about the safety of the food supply will continue and will result in elaborate sparring over regulatory issues. Fortunately, this controversy embodies an element of good by assuring continual vigilance, which, in turn, leads to continued research on food safety and development of better regulations governing the handling and processing of foods.

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