RECENT DEVELOPMENTS IN FOOD USES FOR ANTIBIOTICS

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The characteristics of antibiotic action and several practical applications of antibiotics in the preservation of foods are discussed. The present status of government regulatory measures and prospects for future developments complete the paper.

About two years ago the possible uses of antibiotics in food preservation were reviewed (3). Although not necessarily complete, that review cited some 34 references which dealt specifically with some aspect of food preservation. An annotated bibliography, Antibiotics in the Preservation of Foods, (1) covering 104 references has recently been prepared as a service to interested scientists. This rapid growth of the literature attests the great interest which is developing in the subject.

Since these reviews have been provided, it is not intended now to enter into a detailed discussion of experimental results. Rather, an attempt will be made to appraise the practical possibilities of antibiotics in food preservation and the implications of such use from the standpoint of food sanitation.

CHARACTERISTICS OF ANTIBIOTIC ACTION

Certain chemical compounds, known as antibiotics, derived from or produced by living organisms, are capable in minute concentrations of inhibiting the life processes of micro-organisms. Except in their origin and degree of activity, antibiotics do not differ radically from other chemical preservatives. In general, such compounds display considerable selectivity in their action; they may be highly effective against some species of micro-organisms yet practically without effect on others. The broad spectrum antibiotics, which are of particular interest in food applications, are so named because they are effective against a wide "spectrum" of bacterial species.

Again speaking generally, the antibiotics, at practical concentrations, are not lethal even to the susceptible organisms. They merely inhibit growth and development. Thus they do not sterilize, but merely slow up bacterial spoilage and thereby prolong normal storage life. To some degree they can substitute for refrigeration. Moreover their effect can be super imposed on that of refrigeration. When microbiological deterioration does occur it proclaims itself by common organoleptic signals of spoilage. Antibiotics cannot be used to cover up spoilage that has already occurred or to reclaim food that has become heavily contaminated.

Antibiotics as a class are relatively unstable compounds. Under the conditions of use in foods they lose potency gradually. They are destroyed by heat such as would be encountered in the process of cooking food.

From these considerations it may be seen that there is the prospect of using antibiotics in foods under controlled conditions such that there would be little or no problem from active antibiotic residues. Temporary preservation with antibiotics has the distinct advantage that it cannot be used to cover up damage or inferiority.

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1. Presented at the 42nd Annual Meeting of the International Association of Milk and Food Sanitarians, Inc., at Augusta, Georgia, October 3 - 6, 1955.

2. Copies of these papers are available upon request from the Technical Service Department of Chas. Pfizer & Co., Inc., Brooklyn 6, New York.
PRACTICAL APPLICATIONS

The numerous researches already reported in the literature demonstrate quite clearly that one can delay the microbiological deterioration of perishable food-stuffs by the application of a few parts per million of suitable antibiotics. This is true of animal products, such as meat and milk, and of vegetable products, such as salad mixes, spinach and potatoes. The evidence at hand indicates that such temporary preservation might be economically feasible for a number of products.

A few examples will serve to indicate the practical uses which are contemplated. A few parts per million of a broad spectrum antibiotic can inhibit the bacterial spoilage of fish. Used in conjunction with refrigeration or icing, antibiotic treatment can extend the fishing period by several days, without loss of the catch by spoilage. The antibiotic can be incorporated in the ice carried by the boat or even added to refrigerated sea water in which the fish are held. Antibiotic ice was used successfully in recent practical-scale tests by Canadian investigators (2).

The spoilage of chilled, unfrozen poultry is a serious distribution problem. Birds usually spoil in approximately one week at commercial storage temperatures. Birds are normally chilled in a slush-ice tank after killing, plucking, and evisceration. Adding 10 parts per million of a broad spectrum antibiotic to the slush-ice increases the time the birds can be held without spoilage by fifty to one hundred per cent.

Not only is it possible to delay bacterial spoilage of various cuts of meat and even comminuted meat by dipping or infusion with antibiotic solutions, but whole carasses can be successfully treated. This prevents deep spoilage and leads to the possibility of aging beef at higher temperatures, or of extending the safe handling period in the absence of refrigeration.

Much of the world is denied the use of fresh milk because of poor transportation facilities and lack of refrigeration equipment. If one part per million of a broad spectrum antibiotic is added to the raw milk at the time of milking, the onset of souring is delayed approximately one day at 37°C. If the milk is first pasteurized, antibiotics will preserve the milk for periods ranging from two days to several weeks depending on the storage conditions and concentrations of antibiotics used.

Some vegetables have protective coverings that are resistant to micro-organisms. Others, such as the leafy vegetables, are very vulnerable to bacterial attack. Thus the prepackaged salad mixes which have become increasingly popular in the past few years often deteriorate due to bacterial soft-rot. Dipping a salad mix for five minutes in a solution of oxytetracycline or in a streptomycin solution will double its shelf-life.

REGULATORY PROBLEMS

The above examples indicate that antibiotics are ready for immediate practical use in food preservation applications. However, there are certain regulatory problems that must be resolved. It is fairly widely known that the Food and Drug Administration has banned the use of antibiotic drugs as food preservatives. On the face of it this would appear to cut off any chance of developing this use of antibiotics, at least, in this country. This conservative attitude has been dictated by medical considerations, namely, the possibility of sensitization reactions and the possible emergence of resistant strains of pathogenic microorganisms. Indications have been obtained that the attitude of regulatory officials is not inflexible in this regard and it seems possible that the stand may be modified as additional information becomes available.

Antibiotics are already being used in two important areas closely related to food applications. Antibiotics are widely used in animal and poultry feeds. Recently there has been increasing use of high levels of antibiotics in so-called therapeutic feeds, as well as medication of the drinking water for poultry. Farm animals may at times be treated with repository forms of antibiotic-containing medications. As is well known to milk sanitarians, antibiotics are frequently used to treat mastitis and may on occasion appear in market milk in detectable amounts. Antibiotics have also been found to be practically effective in the control of certain plant diseases.

It has of course been demonstrated that, under proper conditions of use, such practices do not result in appreciable antibiotic levels in food. However, it must be admitted that we are approaching very close to food uses. In fact, there is no clear-cut line between present agricultural and proposed food uses.

It is interesting to note that most of the proposed food uses fall in the category of treatment of raw agricultural commodities. Therefore, these uses are believed to come under the Miller Pesticide Act and administratively under the jurisdiction of the Insecticide, Fungicide, and Rodenticide Division of the U. S. Dept. of Agriculture. No residue tolerances will be established for any antibiotic until suitable toxicity data have been made available to the Food and Drug Administration. Where it is established that no antibiotic residue will result, there is apparently no federal legal bar to the use of antibiotics in processing products shipped in interstate commerce.

In cases where an antibiotic is added to a processed food and retained during interstate shipment, the food would come directly under the jurisdiction of the
Food and Drug Administration. An example might be the use of an antibiotic to prevent the development of food poisoning organisms such as Salmonella species or enterococci. In such a situation it would seem proper to balance the public health advantage of preventing food poisoning against the possible hazard of including minute amounts of antibiotics in the diet. As matters stand now, however, all medical and legal questions will have to be satisfactorily answered before any antibiotics could be used as intentional food additives.

Considerable thought has been given to the possibility of using in food applications antibiotics which are not used as drugs. The trouble with this approach has been that only the antibiotics produced in large scale for drug use appear economically feasible in food applications. This is a situation which could well change in the future.

OUTLOOK FOR THE FUTURE

As the population continues to grow, not only in the United States but throughout the world, the efficient preservation of our available food supply becomes increasingly imperative. Even in the United States where storage and transportation are well developed, we are faced with monetary losses of 5 to 20 percent on most raw agricultural food products. These losses, due to quality deterioration or outright spoilage, may be significantly reduced by the use of antibiotics.

The average quality of beef animals is expected to fall because of the demands of an increasing population. Antibiotics can permit the economical upgrading of this meat by rapid tenderizing at higher storage temperatures than are now possible.

Food-poisoning organisms as well as other disease producing organisms carried by food may be reduced considerably by antibiotic treatment.

Because of better preservation by antibiotics, foods which have had only local distribution may be transported farther to give more variety and better nutrition to many peoples of the world. Antibiotics may help the armed forces solve some of their many logistics problems in supplying troops with suitable foods.

Antibiotics do not have to be used alone but may be used in combination with older methods of preservation such as pasteurization and refrigeration or with new methods just being developed such as atomic radiation. It seems likely that antibiotics could find important use in the processing of foods prior to final preservation by freezing or canning.

In short, there is good reason to believe that, although antibiotics are not a "cure-all" in food preservation, they will ultimately play an increasingly important role in preventing spoilage losses and giving the world population better, safer, and more varied nutrition at lower cost.

REFERENCES

