

handler is carrying salmonellae. Segregation of contaminated individuals is, therefore, impractical in commercial operations, and other control measures, such as heat treating the final product just before or after packaging, must be relied upon. Heat treatment of liquid egg products has, for example, been introduced recently with considerable success.

Improved farm practices and increased sanitation in the manufacture of commercial feed supplements will help to reduce the occurrence of salmonellae among poultry and meat animals but total exclusion of salmonellae from the animal environment is difficult to achieve. At present, the best prospects for control of foodborne salmonellosis in man appear to depend on the employment of processing systems that destroy the organisms and prevent their transfer from contaminated raw materials, equipment, or workmen to the finished product. Extensive laboratory work is necessary to monitor such systems, but no feasible amount of laboratory testing can, by itself, assure the absence of salmonellae from commercial lots of food.

The National Academy of Sciences has recently appointed a Committee on Salmonellosis that is now studying the control problem. Presumably it will make recommendations for minimizing human exposure through food and other routes of transmission.

Staphylococcal food poisoning

Some strains of Staphylococci produce heat-stable enterotoxins that cause severe vomiting and diarrhea within a few hours after ingestion of small doses. These toxins are not destroyed by cooking; therefore, food in which very large numbers of staphylococci have grown at any stage of production, processing, or distribution should be regarded as unfit for human consumption. About 2 or 3 years ago, 4.5 million pounds of cheese were placed under embargo by the Food and Drug Administration, because certain lots had caused Staphylococcal food poisoning. Fortunately, the owner was able to separate the few toxic cheeses from the rest by a serological method recently developed through the joint research efforts of the Food and Drug Administration, the Public Health Service, the Department of the Army, and the Food Research Institute. The toxic cheese was destroyed and the much larger nontoxic portion was returned to the market.

C. perfringens food poisoning

When *C. perfringens* is consumed in large numbers, it causes distressing abdominal pain and diarrhea. Outbreaks typically occur about 12 hours after the consumption of food that has been cooked insufficiently to destroy the heat-resistant spores of this organism and then held without adequate refrigeration for sufficient time to allow massive growth. Dishes containing meat or poultry products are particularly vulnerable to this type of contamination. In 1965, for example, frozen beef from Government surplus stocks, when served in a Georgia high school cafeteria, caused illness in 256 of the 447 persons who ate the meal. Similarly turkey a la king, prepared from USDA graded and inspected turkeys, caused 171 cases of *C. perfringens* food poisoning in two public schools in Little Rock, Ark.

Other microbial agents of foodborne disease

In the technical literature of the past 2 years, more than 30 infectious or toxin-producing organisms have been associated with food poisoning. They include a number of viruses, bacteria, molds, protozoa, animal parasites, and marine plankton organisms. In addition, there have been numerous illnesses associated with foods, for which no causative microbial or chemical agent could be identified. Discussion of the circumstances surrounding these incidents is beyond the scope of this paper, but it should be noted that each poses a health hazard relating to some part of the food industry for which further research is needed to improve food protection.

Impact of technological changes

As indicated earlier in this discussion, the rapidly changing commercial practices keep introducing new situations that need evaluation in terms of consumer protection. Sometimes competition or a shift in consumer preference may cause industry to make changes without investigating fully their public health implications. In addition, the ready availability of rapid transportation, increased use of refrigeration and freeze drying, and packaging in plastics or other new materials have encouraged marketing practices, with respect to nonsterile foods, that require special control to avoid trouble.