Microbiological Criteria for Food\(^1,2\)

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ABSTRACT

Microbiological criteria can be separated into standards, guidelines and specifications. These criteria are applied to reduce potential health hazards associated with foods and to evaluate food quality. Microbiological criteria must be realistic, enforceable and consistently applied. In fulfillment of their responsibilities to consumers, both regulators and food purveyors will continue to improve and to establish new microbiological criteria for food.

Since the discovery by Pasteur and others of the role of microorganisms in disease, man has taken strides to preclude, destroy and/or prevent multiplication of microorganisms in food supplies. The dramatic reduction, since the turn of the century, in foodborne diseases resulting from pasteurization of dairy products and establishment of microbiological criteria for dairy products has stimulated interest in microbial criteria for other food items. This interest has been stimulated in part by increased consumer awareness, the desire by regulatory agencies to insure wholesomeness and quality of food and industry efforts to market consistently high quality wholesome food with a long shelf-life. Controversy among consumer groups, regulatory agencies and industry exists regarding several issues. To what foods should criteria be applied? What organisms or groups of organisms should be used as indicators? What maximum number of microorganisms can be accepted? Are enumeration methods suitably precise and do the prescribed criteria fulfill the intended purpose? This report is intended to present an update on the current status and philosophy of microbiological criteria for foods.

TYPES OF CRITERIA

Microbiological criteria include standards, specifications and guidelines which are defined as follows: (a) A microbiological standard is a law or administrative regulation designating the maximum number of microorganisms acceptable and/or the types of microorganisms present in a food as determined by prescribed methods. A microbiological standard is enforceable through civil or criminal courts. (b) A microbiological specification is a contractual agreement, usually between a buyer and a seller, which defines acceptable products from a bacteriological standpoint. Specifications should address the maximum number of microorganisms or type of microorganisms as determined by prescribed methods. (c) A microbiological guideline designates the same requirements as a standard but has no legal status; hence it is not enforceable. Federal regulatory agencies generally prefer the use of standards as criteria because of the provisions for enforcement. They view guidelines as useful only as a transitional step toward establishment of standards (4). State and local regulatory agencies generally prefer the guideline approach and look to Federal agencies for establishment of information upon which to base criteria (5). In addition, state and local agencies usually lack the resources and jurisdiction to properly develop and enforce national standards. Industry lacks the authority to impose legal standards, thus to protect economic interests and reputation, industry frequently relies on microbiological criteria in the form of specifications for food items purchased.

FOODS THAT NEED CRITERIA

Food classes requiring microbiological criteria can be separated into two categories: (a) items that present a potential health hazard, and (b) items that may suffer a reduced shelf-life and lower quality but present no health hazard. The International Commission on Microbiological Specifications for Foods (ICMSF) (7) has devised a scheme in which the type of health hazard and the conditions of use associated with a product are evaluated.
into 15 levels of health hazard severity. Conditions of use are considered from the standpoint of whether the degree of hazard is reduced, unchanged, or increased. For instance, dried whole-egg used in food to be cooked before consumption would result in reduced hazard. If consumed immediately after reconstitution, dried whole-egg would not alter the risk; however, the hazard would increase for foods that were reconstituted and not cooked within a significant period before consumption.

The types of health hazards considered by the ICMSF (1) are: (a) None - Reduced shelf-life, i.e., aerobic plate count (APC) (levels 1-3); (b) Low - Non-pathogenic indicator organisms - i.e., coliforms (levels 4-6); (c) Moderate - Limited potential for secondary transmission - i.e., *Clostridium perfringens, Staphylococcus aureus* (levels 7-9); (d) Moderate - High potential for secondary transmission - i.e., *Salmonella* (levels 10-12); and (e) Severe - Possible death - i.e., *Clostridium botulinum* (levels 13-15).

By using this method for classifying the degree of health hazard, an agency or industry can establish criteria consistent with its needs. Obviously, more stringent microbiological criteria are applied to foods with a high potential to present moderate or severe health hazards than applied for the purposes of ensuring an ideal product shelf-life.

**ESTABLISHING CRITERIA**

Whether or not microbiological criteria are intended to ensure consumers of either shelf-stability or wholesomeness of a product, factors involved in the establishment of criteria are similar. Sampling, storage, shipment of samples and laboratory methodology must be standardized and give reproducible results. There must be a positive correlation between shelf-life and wholesomeness for microbiological criteria to be relevant. For example, a high aerobic plate count (APC) of a cured salami does not adversely affect shelf-life, whereas a high APC of freshly ground beef probably indicates limited shelf-life. Similarly, in certain food items, high fecal coliform counts correlate with poor sanitary conditions, thus increasing the possibility of the food being unwholesome.

Criteria in general, and standards in particular, must be administratively feasible. In other words, can an agency enforce the standard effectively? The penalty for noncompliance with microbiological standards also must be realistic and relevant to the offense. Producers suffer economic and adverse publicity for violations and penalties considered too severe may contribute to standards being rescinded (2).

Considerable criticism has been voiced, particularly from industry, of the use of pass/fail microbiological criteria. The question is often posed, "Why is a product with an APC of 9,999,999 acceptable but one with 10,000,001 unacceptable?" Criteria recently have been devised to eliminate this criticism (I). Rather than a product being judged either acceptable or unacceptable, a third category, marginally acceptable, has been added. A sampling plan is established that specifies the following: (a) number of samples to be examined — n; (b) maximum number of microorganisms that are tolerable — m; (c) maximum number of samples that can exceed m without declaring the lot unacceptable — C; and (d) maximum number of microorganisms any one sample can contain without causing the lot to be unacceptable — M. Any lot having one or more, but fewer than C, samples exceeding m is considered marginally acceptable. The marginally acceptable category alerts regulatory and quality control personnel to investigate and rectify the cause of the high microbial counts. This scheme provides for rejection of a product if the microbial count from one sample is excessively high, the sample contains potentially hazardous microorganisms, or if the number of samples with counts exceeding m is greater than C. The ICMSF and Canadian authorities are developing microbiological criteria utilizing this three class acceptance system (1,3). It is likely that many regulatory agencies also will adopt this type of microbiological acceptance system (5).

In addition to consumer, economic and health considerations, microbiological criteria also must consider the capability of industry to consistently produce products in compliance. A basic knowledge of food production, food microbiology and statistics, supplemented with extensive data relative to the normal microbial content and load of the food are required to establish realistic criteria.

Microbiological criteria must be routinely and consistently enforced. Periodic enforcement is ineffective in improving either shelf-life or wholesomeness and tends to be viewed as harassment by producers. Collection of samples should be coordinated with sanitary inspections of the processing and handling facilities. A deliberate effort to provide sanitary handling at every step of production is necessary to produce food of minimal microbiological populations.

**REFERENCES**

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