The Rationale of Microbiological Monitoring of Foods

Despite a most marked reduction in the morbidity of infectious diseases in general, the incidence of diseases of microbial etiology transmitted by foods and of food losses due to activities of microorganisms has not been reduced worldwide, including the highly developed countries. This is most certainly due to the fact that it has only recently become generally accepted that control of microbiological safety and quality of foods cannot be achieved by the approach so far followed in most instances. This approach relies, in essence, on monitoring end-product samples and using the results in a feedback manner to improve manufacturing practices. What is really required of course is intervention (Kayser and Mossel 1984). This includes: (1) identification of hazard points (Bauman 1974) in manufacture, distribution, storage, and culinary preparation; followed by (2) design of measures leading to improved practices throughout. These should be elaborated and validated, guided by the examination of line samples rather than end products. Obviously immediate feedback to manufacture or preparation should follow whenever and wherever required (Mossel et al. 1984).

Even after the introduction of these so-called good manufacturing practices, frequent and regular tests are necessary to check that these practices are being followed and are effective, or that further modifications are required. Methods of examination to be used for this purpose should be: (1) as simple and rapid as possible; (2) economically feasible; (3) accurate, repeatable, and reproducible.

Not too much progress has been made in this respect until recently. This is partly due to the relatively late start of analytical food microbiology as a branch of science (Buttiaux and Mossel 1957). The incentive of using mechanized and even fully automated methods of microbiological examination of foods consequently did not always lead to an adequate response.

In this paper, an attempt will be to summarize the present state of microbiological monitoring of line and food samples, particularly in the light of more recent molecular-microbiological data on the attributes of the most important microbial groups as they occur in foods. This should enable microbiologists called to advise on, or introduce, new (including facilitated) techniques into the laboratories of industry and government inspection services to arrive at an unbiased
evaluation of available technology, allowing a rational choice of procedures to be adopted.

Three general principles should always be adopted in this area of laboratory policy. First and foremost, the number of criteria to be used should be limited strictly to the minimum. The indispensable ones should be selected, guided by a careful study of the microbial ecology of every specific commodity, paying attention to health risks as well as to the food's so-called spoilage association (Mossel 1983). Furthermore, reference values should be available, against which the results of a given analysis can be gauged. This may sound trivial, but there exists a real problem here, i.e., in the assessment of such reference values. As in clinical medicine (Gräsbeck and Alström 1981), such reference values should be derived from surveys on specimens originating from production or catering lines previously inspected and noted for using correct practices, but modified before samples are drawn, if necessary (Mossel 1980). Finally and quite obviously, the methods used in assessing the conformity of production samples with reference values should be exactly the same as those used in determining reference values and rigorously standardized for that purpose. If this aspect of monitoring is neglected, the most embarrassing conflict of opinion can result between, e.g., production and quality assurance departments of the same factory, and worse, between manufacturer and buyer or government inspection services.

Analytical Essentials

Isolation and enumeration methods for specific groups of microorganisms in foods and drinking water invariably rely on the use of selective culture media. This entails two types of problem which require the permanent attention of the food microbiologist.

Limitations of Selective Media

In view of the intensive genetic flux observed in almost all niches of significance in food microbiology (Altherr and Kasweck 1982) no selective medium will exclusively grow the sought after microorganism for which it was designed. Even if it did initially, there is no guarantee that it will continue to do so (Dijkmann 1982). Consequently, most selective media are either insufficiently selective or else are inhibitory for the group of organisms they are supposed to enumerate. Every formula, whether made up in the laboratory or purchased in some form, therefore represents a compromise. This is in itself unavoidable and can in principle lead to workable situations provided the performance of a medium is "constant," i.e., does not vary too much from lot to lot.

This clearly calls for checking the functioning of media, both upon purchase and in the course of time when a given batch number is used for, say, more than 1 of 2 weeks. It goes without saying that such monitoring will soon be abandoned when testing methods become too complicated or time-consuming. Nonetheless, a medium should always be challenged by a selection of test strains that should