



## Contamination in the food industry environment

by Enne de Boer, Chair of the Dutch Standardization Committee of Microbiology for food and animal feeding stuffs

Illness resulting from consumption of contaminated food continues to pose a serious worldwide public health problem. Consequently, there is a great interest in the collection of data that include contributing factors to foodborne outbreaks and the places where food was contaminated, mishandled or consumed.

It has been proven that a considerable number of foodborne diseases are attributable to improper hygienic practices and cross-contamination during the production and preparation of food. The importance of contaminated surfaces in relation to potential trans-

mission of pathogens to food is apparent in the food processing, catering and domestic environment. Exposure to pathogens on surfaces may take place either by direct contact with contaminated objects or indirectly through airborne particles. The hygiene of surfaces, instruments and equipment in the food industry essentially affect the quality and safety of the final product.

### Foodborne infection risk factors

The risk of foodborne infection associated with cross-contamination depends on two factors:

- level of contamination on the surfaces; and
- probability of its transfer to the food being consumed.

Pathogens, such as *Salmonella*, *Campylobacter* and *Staphylococcus aureus* may survive on stainless steel surfaces for hours or days, depending on the species, initial counts and the presence of food residues, and may become resistant

to chemical sanitizers. These bacteria are readily transmitted via hand or cloths to other surfaces, and from these surfaces to foods. In general, bacteria can adhere to many natural and man-made surfaces. Once attached and under favourable conditions, they can multiply, form colonies, elaborate hydrated exopolysaccharides and eventually develop into high complex, dynamic microbial ecosystems called biofilms. Many pathogenic and spoilage bacteria form biofilms on materials commonly used in food processing equipment. The retention of bacteria on food contact surfaces increases the risk of cross-contamination of these organisms to food.

The sanitation of food preparation surfaces is critical for the control of microbial contamination of foods and is of significant concern to the food preparation and processing industries and in the prevention of foodborne outbreaks.

Although food particles usually are cleaned from the surface when good hygienic practices are applied, bacteria attached to these surfaces are not visible to the eye and may therefore not be removed. Proper cleaning and sanitiz-



## From Farm to Fork

ing should prevent the spread of microorganisms and cross-contamination to ready-to-eat food.

The Hazard Analysis Critical Control Point (HACCP) system, as applied for food safety management, uses the approach of controlling critical points in food handling to prevent food safety problems. Risk assessment as part of the HACCP system of the food production process should identify and characterize the hazards in the process, assess the exposure and characterize the risks. Given the importance of risk assessment in determining the most vulnerable steps for contamination and growth in a food-processing operation, quantification of microbial contaminants on food contact surfaces has become important in establishing the degree of risk to the consumer. Quantifying microorganisms, including pathogens, on solid surfaces provides valuable data for modelling consumer exposure from cross-contamination in food manufacturing and food-service environments.

Testing surfaces after cleaning and disinfection gives information on the efficacy of the sanitation procedure applied.

### Monitoring the production environment

Several different techniques are used for monitoring the microbial contamination of the production environment and each technique can be applied differently and on different surfaces. Because of the many variables, it is essential to have a uniform approach or wrong conclusions can be drawn. For this reason, ISO technical committee ISO/TC 34, *Food products*, subcommittee SC 9, *Microbiology*, prepared ISO 18593:2004, *Microbiology of food and animal feeding stuffs – Horizontal methods for sampling techniques from surfaces using contact plates and swab*.

The horizontal methods described in this International Standard are specified with a view to detecting or enumerating viable microorganisms in the food industry environment. The term “environment” means any item in contact with the food product or likely to represent a

contamination or recontamination source, for example, materials, premises or operators. Two techniques described in the standard are the contact plate method and the swabbing method.

### Contact plate method

A contact plate is a small plastic dish, filled with a suitable agar<sup>1)</sup> medium made especially for the sampling of surfaces. The type of agar medium depends on the targeted microorganisms. For example, when enterobacteriaceae are assessed, the contact plates are filled with violet red bile glucose agar in accordance with ISO 21528, *Microbiology of food and animal feeding stuffs – Horizontal methods for the detection and enumeration of Enterobacteriaceae*. Dishes vary in diameter or area, depending on the type of surface being sampled. The RODAC® plates (Replicate Organism Detection And Counting) with a diameter of 55 mm, originally described by Hall and Hartnett in 1964<sup>2)</sup>, have found wide acceptance for microbiological sampling of a variety of surfaces in hospitals. In the past decade, other formats of contact plates have been made commercially available and the area of use of these plates has

### About the author



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expanded to a variety of places where sanitation and contamination levels are important, including the food industry and service facilities.

It is important that the agar medium in the plate has a convex surface, to enable good contact with the surface to be tested. Extreme care must be taken during sampling, so that fingers holding the plate do not touch the surface of items sampled.

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A special format of the contact plate method is the use of dipslides, originally developed for determining the microbial contamination of liquids, especially of urine for the diagnosis of urinary tract infections. Dipslides are synthetic slides (7 to 10 cm<sup>2</sup>), one or both sides of which are covered with a layer of an agar medium, and are suitable for assessing the microbial contamination of small surfaces.

The contact plate method is especially suitable for sampling flat, firm surfaces, is easy to use and saves time, because it is not necessary to transfer the microorganisms to a cultivation medium.

### Swab method

Agar contact plates are impractical for quantitative sampling of large and heavily contaminated surfaces and unsuitable for assessing the microbial contamination of flexible and uneven surfaces, such as cracks, narrow tubing, crevices, joints and any other difficult-to-sample areas on equipment. In these cases, the swab method should be used. Swabs usually consist of a breakable stick

1) Agar is a gelling agent extracted from red seaweed

2) Hall, L. B., and Hartnett, M. J. (1964), Measurement of the bacterial contamination on surfaces in hospitals. *Publ. Hlth Rep. (Wash.)*, 79, pp. 1021-1024

with cotton or synthetic material contained in a tube or envelope. The swabs are individually wrapped and sterilized. Using the swab method, a specified area of the surface to be examined is marked (e.g. using a template) and then wiped. The swab sticks are broken into a tube or bottle containing a sterile dilution fluid or neutralizing fluid and mixed by hand. For larger areas (> 100 cm<sup>2</sup>) sterile damp cloths or sponges are used. In the laboratory the initial suspension and, if necessary, further decimal dilutions, are used to determine the number of micro-organisms, using standard methods for the enumeration of the (groups of) micro-organisms to be investigated.

The results of testing surfaces for microbial contamination are often presented as hygiene scores based on the number of colony-forming units (CFU) per square centimetre present on the test surface.

There is no universal methodology that will recover all the organisms from a surface being sampled. Many factors may have a significant effect on the process, the most important being:

- types and numbers of micro-organisms on the surface;
- surface (material, roughness) to be tested;
- attachment strength of the micro-organisms on the materials;
- amount and type of soil present on the surface;
- sampling method used;
- the moisture content of the test material and the test surface (swab, surface of agar medium in contact plate) used;
- level of pressure applied in the use of contact plates or swabbing materials.

Because of the influence of all these factors on the result, techniques used for sampling surfaces mostly provide only indicative results and the value of these results is mainly the assessment of trends in the contamination of target surfaces. ISO 18593 specifies and standardizes sampling techniques, and consequently will help to obtain better repeatable results. ■