MONITORING THE CLEANLINESS OF FOOD PROCESSING ENVIRONMENTS

Good hygiene, cleaning and disinfection procedures should ensure that the food processing environment is free from unacceptable levels of microbial contaminants. However, we cannot be sure that these measures are effective just by looking. The measurement of microbial cleanliness goes beyond what can be seen by the naked eye. There are a number of ways in which the food processing environment can be monitored to ensure that the highest standards of cleanliness are maintained.

Minimising risks
Food companies are obliged to ensure that their products are safe and in good condition when they reach the market place and, in so doing, to minimise the risks of the products becoming contaminated along the way.

There are a number of potential vectors for food products to become contaminated, including:

- Raw materials – added before or after cooking.
- People – for example, food handlers and equipment operators.
- The environment – during processing, storage or distribution.

Also, contamination can be chemical (for example, lubricants or cleaning fluids from equipment), physical (foreign objects that have inadvertently been incorporated into the product) or microbial (microorganisms that can cause the product to deteriorate or pathogens that can cause illness in the consumer).

This article will concentrate on monitoring for microbial contamination in the environment. Foodborne microorganisms may pose a health risk for consumers, if they are pathogens such as Salmonella, Listeria or Campylobacter, or they may cause food to spoil prematurely, thus reducing shelf-life and saleability.

Precautions can be taken to minimise the risk of microbial contamination from the environment, such as good hygiene, cleaning and disinfection procedures, but the only way to ensure that these precautions are effective is to sample the environment at key places in order to demonstrate that the levels of microorganisms present fall within acceptable limits. The Campden and Chorleywood Food Research Association (CCFRA), in the UK, has published guidelines for effective microbiological sampling of food processing environments. Identification of key sampling locations could, also, be performed as part of a Hazard Analysis and Critical Control Points (HACCP) exercise, internationally accepted guidelines for which are available from the Food and Agriculture Organisation of the United Nations.

Where to monitor
The food processing environment can become contaminated from a variety of sources, including doors, windows and vents. Alternatively, microorganisms can be carried in on raw materials or personnel and transferred to equipment and surfaces. Careful and strategic sampling and monitoring should help to identify problem areas and allow appropriate action to be taken before products can become contaminated.

An environmental monitoring programme should include the regular screening of surfaces, such as worktops, sinks, drains, utensils, equipment, walls, floors and ceilings, and of air quality within the food processing environment.
**Surface sampling**

Once a surface has been cleaned, the effectiveness of the cleaning procedure can be tested using a Contact Plate (Figure 1). In a Contact Plate, the surface of the culture medium is above the side of the plate. An area is sampled by gently pressing the agar onto the test surface.

Alternatively, a Dip Slide can be used. This is a plastic slide, coated on both sides with a layer of culture medium. Different media can be applied to either side, allowing 2 tests to be performed in one. A flexible hinge between the handle and the slide allows the entire surface of the medium to be pressed gently onto the area to be tested (Figure 2). Dip slides can also be dipped into a liquid to test its microbial load, hence the name.

Figure 1. A Contact Plate (surface of the agar above the side of the plate)

Figure 2. A Dip Slide allows two tests to be performed on one slide.

Inaccessible or uneven surfaces and equipment can be sampled using swabs or sponges. The swab or sponge is moistened and then wiped across the test surface. This can then be
used to directly inoculate an agar plate, or put into a transport medium and taken back to the laboratory for testing. Alternatively, if testing for pathogens, the samples can be placed in an enrichment broth to recover any microorganisms present, prior to plating.

If any microbial contaminants are present, they will grow on the culture medium to form distinct colonies. These can then be counted and identified, if required, allowing invisible dangers to be visualised easily.

**Air Sampling**

Some microbial contaminants may be carried in the air. They can originate from external sources (via doors and windows, or if air filters are not properly cleaned and maintained) or they can be derived from internal sources (for example from personnel, dust particles or aerosols created during production). It is, therefore, important that the quality of air in the food processing environment is monitored routinely. This can be achieved by placing Settle Plates in positions around the processing area considered to provide the greatest risk. Settle plates are simply culture plates that are left exposed to the atmosphere for a specified time and then incubated in the laboratory to grow any air-borne microorganisms that settle on the agar surface.

**Figure 3. Air sampler**

![Air sampler](image)

Alternatively, automated Air Samplers (Figure 3) can be used. These devices draw in measured volumes of air, which pass over the surface of a culture plate, depositing any air-borne contaminants on the medium.

Whether sampling is passive, using Settle Plates, or active, using Air Samplers, air quality is a good index of the overall sanitary condition of an area. The records from the routine monitoring of air quality can build a picture of the general standard of hygiene in a food processing environment. This data is a valuable tool for the detection of potential hazards in critical areas or lapses in hygiene standards.
Laboratory Analysis
Once samples have been inoculated onto an appropriate culture medium, the plates or slides should be covered, incubated appropriately and examined for growth. A wide range of culture media is available, from general-purpose media (such as Nutrient Agar, Plate Count Agar and Tryptone Soya Agar for total viable counts [TVCs] or Sabouraud Dextrose Agar and Malt Extract Agar for yeast and mould counts) to more selective media, designed to only grow certain types of organism. Some media may contain neutralisers to counteract the activity of any residual disinfectants that may be present in the sample. Each colony that grows represents one microorganism recovered from the area sampled. The overall colony count gives a good indication of the microbial cleanliness of the environment tested. The laboratory is, then, able to report back whether the results fall within pre-defined acceptable limits.

In some cases, the laboratory may perform an investigation for a particular problem microorganism, such as Salmonella, Listeria or Campylobacter. In such instances, media with selective and diagnostic properties are used to isolate and identify the target organism. The presence of such organisms in the food processing environment may lead to factory down time and delays in product release. Speed and reliability are critical, therefore, and many new tests are available that offer valuable reassurance to food manufacturers in less than half the time of traditional methods.

Measuring the cost
Undoubtedly, environmental monitoring involves a commitment of time and resources. However, the potential cost of NOT monitoring is far greater.

Should unacceptable microbial contamination reach the final product, then, hopefully, end product testing would detect this. However, this can not be guaranteed as contamination is often sporadic rather than spread evenly through-out a batch. If detected, production would have to cease while a full-scale investigation was carried out, and whole batches of product may have to be destroyed. In the case of perishable products that may already have been released, product recalls may be required, with subsequent damage to the Company's reputation. If missed, the costs to the company of such contamination could be enormous.

Food manufactures must be able to demonstrate Due Diligence, to ensure that such scenarios are avoided. This entails demonstrating that every precaution is taken to avoid microbial contamination and that these precautions are reliable and effective. Environmental monitoring is a valuable tool available to food manufactures for this purpose.

References:
1. Campden and Chorleywood Food Research Association (1999). Effective microbiological sampling of food processing environments. CCFRA Guideline No. 20