Microbial update

air sampling

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Whatever foods we manufacture, however well we process them, the hygiene of the food production environment is of paramount importance. In modern chilled manufacturing plants the division of production into 'high care' and 'low care' areas signifies the hygienic care that has to be taken with the product.

Items entering high care areas must be 'clean' and in the case of foods and ingredients this usually means that they will have been through a process of some sort as they enter the area. That process could be a 'cook', or for some ingredients, for example salad items, a wash in water containing a suitable sanitiser will be used.

But of course other items also enter the high care area, people will enter through a changing area where clean protective clothing and footwear will be put on and hands will be washed.

Then of course there is the air supply, which will usually go through some form of filtration. But once inside the production area, it may become important to test the air to check on its hygienic status and whether it holds any form of micro-organism that could contaminate the product.

The air is one of the three transfer vectors of microbial contamination to foodstuffs; the other two being surface contact (for example by food contact surfaces, hands, utensils) and fluids (product washing, cooling, fluming or contact with cleaning rinses). As such, the role of this transfer vector should be understood if micro-organisms could lead to product spoilage or safety issues.

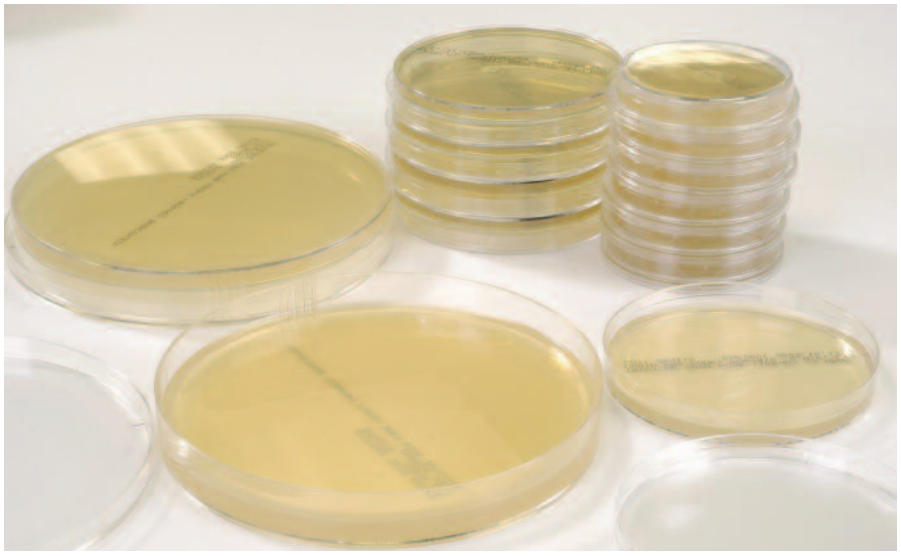
Air sampling is generally undertaken for one of three main reasons:

- As a validation of the risk of product contamination from ambient air at a particular site (for example a filling head).
- As a validation and verification of the general level of the effectiveness of room air supply systems.
- As a validation and verification of the general level of the effectiveness of process air being introduced directly (for example for aeration or transport) or indirectly (for example from compressed air pneumatics) into food products.

Passive air sampling

In ambient air, the number of micro-organisms coming into contact with the food will depend on the concentration of micro-organisms in the air, the size of the particle they are being carried on (settling velocity), the surface area of the product exposed and the time the product is exposed to the air.

This risk can be estimated by placing an opened Petri dish (or rehydrateable film), containing a suitable agar (referred to as a settle plate), at a point as close as possible to the product for a fixed sampling time.



Sedimentation techniques, referred to as passive air sampling, do not give an assessment of the number of micro-organisms in the air, only those that are of a sufficient size and weight to sediment to the surface in the exposure period.

The agar medium used should be chosen to enable the growth of whatever organisms are of concern, however, it should be ensured that items taken into the production area should not form a hazard to the food products.

Whilst settle plates will give an indication of the number of micro-organisms falling into product, they can only do this for a single time period and give no indication of the source of the airborne micro-organisms.

To understand the real risk to the product, the airflows in the processing area and the microbial sources need to be established.

Airflows can be assessed by smoke movements using smoke generators (as used in theatres) with a food safe smoke or, more sophisticatedly, with anemometers which record air direction and speed.

Airflows can be established under the likely range of environmental scenarios for example doors open/closed, air supply/evaporative condensers on/off, machinery on/off. Known microbial sources in food processing include cleaning (highest risk), traywashers, weighing, bandsaws/slicers, people, vehicle movements and general factory operations.

The external factory environment may also be a source of micro-organisms, partic-

ularly yeasts and moulds, whose numbers and diversity may be seasonal.

It is possible to gain information on sources of micro-organisms using settle plates close to exposed product for all air flow, process and external environmental scenarios, though the use of airborne samplers may be more useful.

Active air sampling

The general level of micro-organisms in ambient air can be assessed by actively capturing airborne micro-organisms onto agar, into fluids or into a filter matrix.

The most commonly used active air samplers, which are purpose built for food factory use, work by drawing a set volume of air through a perforated (or 'sieve') frontplate onto the surface of a 'Rodac' plate or Petri dish over which micro-organisms impact.

Alternatively, other samplers draw air over the surface of pre poured agar collection strips. Both passive and active air sampling should be undertaken using non-selective growth media as micro-organisms present in aerosols are physiologically different from those in suspension for which selective growth media have been developed.

Once a knowledge base has been established about air flows, microbial sources and settlement into product, i.e. the process has been validated for airborne microbial contamination risk, it is rare to verify airborne microbial levels.

Rather the knowledge gained from this exercise can be used to predict when the product is at greatest risk from an airborne microbial challenge and whether additional control actions are required (for example no wet cleaning during production).

The microbiological validation of the ambient room air, filtration systems is useful in chilled food, clean fill and aseptic food operations, primarily by active air samplers.

Along with other parameters such as pressure drop across the filters, the filtration system's performance can be occasionally verified by air sampling.

Sampling process air

Process air is more of a microbiological risk to product than ambient air, as rather than via sedimentation, micro-organisms can be directly injected into the product.

The performance of process air supply systems should thus be microbiologically validated and verified for microbiologically sensitive products. Process air can be sampled directly at the point of product contact by active air samplers, though the sampling of compressed air is more complex and is rarely undertaken in food factories.

The pressure of the compressed air must be reduced by a suitable in-line reducer to prevent damage to the sampler and to allow accurate sampling (relating to the velocity through the sampler and thus impingement).

Compressed air can also be fed into a large sterile bag or chamber, from which the air can be subsequently sampled at a lower pressure. Alternatively, a measure of the potential microbial contamination of compressed air can be obtained by swabbing the inside of the in-line water traps, i.e. anywhere in the compressed air line that micro-organisms could survive/grow following water condensation, though the compressed air should be switched off prior to sampling. The level of micro-organisms enumerated from the verification of filter performance should be very low and will be established during the validation trials to allow target levels to be set.

Conclusions

The level of micro-organisms enumerated from ambient air will be very variable and will be dependent on food product, process, factory design, production activities taking place at the sample time and sampling system used.

Total viable counts can range from 10^1-10^4/m^3 and yeasts and moulds can range from 10^1-10^3/m^3 in different food factories and even for RTE high risk environments, the count in the high risk area can be similar to that outside the factory – though the flora is likely to be different!

Verification standards for ambient air are thus very difficult to universally set and can only be established for a particular factory and then only if 'normal' conditions (no cleaning being undertaken, no open doors, fans working, no excessive people movements, no non-typical process conditions etc) can be guaranteed.

Ambient air sampling is thus best for thoroughly understanding the transfer vectors and sources of micro-organisms that could lead to the airborne contamination of microbiologically sensitive products. ■

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