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Campden BRI
food and drink innovation

Microbiological aspects and considerations of a range of process technologies

The development, evaluation, commissioning and validation of new process technologies has one common goal, which is to ensure that the technology is capable of adequately reducing the number of microorganisms associated with the products.

This white paper looks in general at a very complex area – the interaction of product, packaging and process type and how they combine to enable microbial numbers to be adequately controlled.

We have a wealth of experience in this type of evaluation, so please contact us if you are considering developing new or modifying existing processes.

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Introduction

The type of processing technology will dictate the range of products likely to be preserved using this equipment. For example, drinks, ready meals, nuts and seeds or jams would all require processing using different technologies. Similarly the microbial loading of these different raw materials will vary considerably in terms of the range of microorganisms potentially present and the concentrations of each. These would in turn change considerably according to whether the raw materials were chilled and held individually or had a mix and hold stage.

The source of these raw materials will also have a potentially major impact on the level of microorganisms present and consequently on the level of the challenge to the processing technology. The lethal effect from the process could be from a combination of parameters, i.e. heat, pressure differentials, shear forces, moisture variation, oxygen availability. Some processes will achieve considerable lethality by one single treatment, whereas other will require the combined cumulative lethality of several during manufacture.

If the raw materials are handled or stored differently to the standard conditions this has the potential to more severely challenge the manufacturing system.

Food product formulation

This stage of all food manufacture is critically important from the microbiological perspective. Historical food poisoning issues have shown that even the most minor formulation changes have the potential to allow microorganisms to survive or grow when they would otherwise have been reduced or inhibited, e.g. changes to the types of sweeteners used.

This particular aspect has to be considered very carefully when developing new technologies because often the traditional preservation pathway is modified to incorporate the new concept.
Indeed on occasions the new technology has been developed to specifically change the eating qualities of the food, for example giving a milder treatment but incorporating more hurdles. In this example a clear knowledge of the combined effects would be essential to prevent survival and growth. The nature of how the treatment effectively destroys/reduces/inhibits the microorganism will be affected by cross contamination by materials affecting the product, such as the addition of extra water perhaps from condensation, or leakage into containers from untreated ingredients.

Microbiological cross contamination risks

These could change significantly throughout the manufacturing system. Any new technology should be evaluated in terms of the dynamics of the microbial population. For example, in a multi-phase manufacturing system the microbiological loading could contain 3 distinct groups of organisms at the raw material stage, one of which is sensitive to the first stage of manufacture and is consequently destroyed, while the remaining two are unaffected by the treatment and then become prime targets for the second stage of manufacture, e.g. multi component ready meals. If there is a risk from cross contamination, either by inadequate shielding of the product matrix or poor segregation of raw and processed product etc., then the integrity of the whole manufacturing system can be compromised.

Microbiological decontamination

This will be required at several stages of manufacture, and could involve the decontamination of suspensions, surfaces, couplings, junctions, and atmospheres. The combination of all of these areas in a new or modified processing technology would require evaluation and a clear understanding of how the reduction is achieved. What are the essential contact times, concentrations, temperatures, death kinetics etc?

Packaging

As the process technologies evolve, the packaging often changes at the same time. This in turn brings new challenges according to how the product is filled, as seen for example in soups/sauces that are manufactured in a number of different packaging formats including hot filled, cold filled, aseptically filled or clean filled. Similarly influential are the constituents of the product. It may have particulates, contain a very viscous fluid or indeed be a semi-solid product. All will have different filling criteria and different risks from microbiological issues, particularly in terms of pack integrity and stability during shelf life.

Shelf-life

The food product composition and process lethality applied during manufacture will play the strongest roles in terms of the length of shelf life according to microbiological stability. The type of technology may only stress certain microorganisms so that, during a longer shelf life, they may become resuscitated and then pose issues of both spoilage and food safety. Indeed historical data has demonstrated that the growth of one microorganism can change the conditions in the food, which may allow a previously inhibited organism to then start to grow during shelf life.

The assessment and validation of a new process technology will have a number of stages. Each should have microbiological data to support them until the final formulation/combination/full manufacturing scenario is confirmed.

We have found through our research that evaluating food manufacturing systems that are using traditional preservation techniques as well as those that are using novel or developed process technologies requires careful considerations of all potential microbiological issues. Each assessment is quite different and the key criteria used are unique to that particular manufacturing system. In our experience the hypothesis to be challenged at each stage requires an in-depth understanding of the full range of microorganisms that could be involved.

If you would like to discuss any aspect of this article or have developments you would like an opinion on please do not hesitate to contact

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