Demonstrating the killing potency of thermal processes

In the feed and food industries a variety of thermal processes are applied in order to kill microorganisms and obtain safe products. Nofima Ingrediens can quantify the killing effect of thermal processes. Doseresponse studies demonstrating the effect of different temperatures, holding times, etc. are valuable in relation to design and optimization of thermal processes.

Feed and food manufacturers are imposed the responsibility for product safety. They have to ensure that the consumer is not exposed to injury or illness through adequate product control and quality assurance including HACCP (Hazard Analysis and Critical Control Points). In risk assessments according to the HACCP principles, thermal processes are often adopted as «critical control points». As those points are crucial to product safety theirkilling efficiency should be validated and documented.

Heat treatment has the potential to kill bacteria and other microorganisms. The effect is determined by temperature, moisture content and exposure time, but is also influenced by the nature of the product itself. In order to demonstrate the effect of a certain thermal process, microorgaisms with known heat resistance has to be exposed to the actual conditions.

In experimental studies, harmless organisms may be used in stead of pathogenic organisms with similar resistance. The enteric bacterium *Escherichia coli* is a suitable model for *Salmonella*, while spore suspensions with *Clostridium sporogenes* can replace more resistant species like *C.perfringens* (causing food poisoning and necrotic enteritis) and *C.botulinum* (causing botulism). According to its extreme heat resistance, *Geobacillus stearothermophilus* is suited for thermal processes involving particularly high temperatures, like steam sterilisation.

Nofima Ingrediens has studied survival of model microorganisms while drying protein powders in superheated steam (SHS) andhot air. For example, SHS at 300 °C killed more than 99% of heat resistant *C.sporogenes* spores in less than 1 minute, while hot air at the same temperature had negligible effect. Less resistant bacteria like *E.coli* were rapidly killed by both treatments.

Nofima Ingrediens can demonstrate the killing effect of a variety of thermal processes with the customers own processing equipment, or by simulating actual processingconditions in laboratory scale or pilot scale machinery. Fiskeriforskning has at its disposal a wide range of machines which can be adapted for such experiments.

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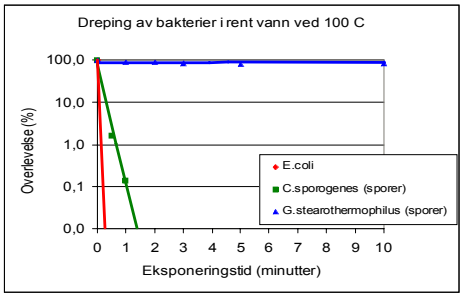
The extreme heat resistance of Geobacillus stearothermophilus spores makes it suitable as a survival indicator in thermal processes involving temperatures above 100 °C.



In order to quantify the killing effect of a thermal process, model organisms with a suitable heat resistance are chosen for the experiments. The figure shows killing rate of Escherichia coli, Clostridium sporogenes and Geobacillus stearothermophilus in pure water at 100 °C. No reduction in viability was registered for G.stearothermophilus spores, while C.sporogenes spores and E.coli had D-values of 0,3 minutes and <0,01 minutes, respectively. (D-value = decimal reduction time, i.e. time needed to kill 90% of the initial population)

The processing hall at Nofima Ingrediens contains a range of pilot scale processing equipment suitable for testing thermal processes. The figure shows a part of the drying hall which contains steam dryers, hot air dryers, spray dryers and a mill dryer.