



Issue 14: December, 2014: This e-bulletin is aimed at personnel in fisheries & aquaculture, at fish packers, processors, distributors, retailers, and finally consumers.

'Hurdle' your way to seafood safety

Food quality is often separated into sensory quality and hidden quality. Sensory quality is that which is sensed by the human senses (appearance, colour, texture, taste, smell). Hidden quality is not sensed and embraces both positive and negative aspects. For example, the omega-3 oil content of two mackerel cannot be sensed and only laboratory tests will tell which contains most. A more sinister aspect of hidden quality is microbiological status. Nobody would get food poisoning if they could sense pathogenic bacteria in a food but they can't - - the bacteria remain hidden unless they are in huge quantities and the food is obviously spoiled. This is where hurdle technology comes into play and helps keep bacterial levels low.

What is hurdle technology?

The concept of hurdle technology was advanced in the late 1970s by Professor Lothar Leistner. The principle is that stability and safety of foods (including seafoods) depend on different parameters (hurdles = obstacles) of different intensity (Bøgh-Sørensen, 1989). The concept was featured as the cover page of the scientific journal *Trends in Food Science & Technology* (1995) and showed a picture of a 110m hurdle race in which the runners were pathogenic bacteria. The inference was that no bacteria reached the finishing line as they either fell at a hurdle or were unable to scale it. In the picture, all the hurdles were the same height but this is not the case in reality and different hurdles present different challenges for bacteria. The athletics parallel is that there are different types of jumps e.g. 100m hurdle, long jump, high jump, pole vault, steeple chase; these present different challenges to the athlete.

Common hurdles

Hurdles may slow bacterial growth, halt growth, or kill the bacteria. Examples of applications of hurdle technology to seafoods are given below. Hurdles can be classified as (i) physical, (ii) physico-chemical, (iii) microbially derived and (iv) combined. Physical hurdles include heat, cold and packaging. Blanching and pasteurisation (e.g. crab) kill the pathogenic bacteria present whereas canning gives a total kill (sardines). Chilling slows bacterial growth (fish fillets/darnes), freezing kills some of the bacteria but

some remain to grow again when the food warms up (frozen cod) while freeze-chilling lies in between. Vacuum packed seafood (smoked salmon) has no oxygen which limits growth of some bacteria but could encourage growth of anaerobic species. Aseptic packaging is putting sterilised food (e.g. seafood chowder) into sterilised packs with no ingress of outside air. Modified atmosphere packaging (MAP) involves injecting an atmosphere with reduced oxygen and high carbon dioxide (mildly anti-microbial) into trays (e.g. fish fillets/darnes) covered with a gas-impermeable film. MAP can increase shelf life by 33%. Physico-chemical hurdles include salt (salted fish), sugar (fish marinades), low water activity (dried or partly dried fish), acids (sardines canned in tomato sauce) and preservatives (some fish products). Microbially-derived hurdles embrace starter cultures that produce lactic acid and have applications in fermented fish, and also bacteriocins that produce proteinaceous materials that inhibit the growth of closely related harmful bacteria. Many seafoods have a combination of different hurdles and collectively these keep the products in good condition.

How many hurdles has my product got?

This is a key question for all in the seafood chain. For example, smoked mackerel has a least four hurdles i.e. salt, smoke, reduced moisture content and storage at cold temperature, and so is a relatively safe product. Canned sardines have been subjected to the high temperature of canning and some have a second hurdle (acid) if canned in tomato puree. Removal of a hurdle (e.g. a preservative) means remaining hurdles have to perform more strongly to maintain the same level of product safety, e.g. salt content may have to be raised (makes the salt hurdle 'higher'). Contrast smoked mackerel and canned sardines with products such as fresh fillets that have cold (2-4°C if a chilled product) as their only hurdle. This is why maintaining a continuous and unbroken cold chain is vitally important for chilled seafoods as temperature abuse can occur in as little as 20min if the chain is broken and the product is exposed to a warm environment (George, 2000). Frozen seafoods have a much higher level of safety than chilled as the former have ice and all the ice has to melt (this takes time) and the product then has to warm up before it begins to spoil.

References

- Bøgh-Sørensen, 1989. Proc. & Quality of Foods, Vol 3 (Chilled Foods), 3.42-3.52.
- George, 2000. Managing the cold chain for quality & safety. F-FE 378A, 32 pages.

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