Effects of chilling technologies on developing microbial populations during storage of whole, gutted haddock

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Effective cooling of newly caught fish is of great importance for increased quality, safety and shelf life of the product. In this study, microbial developments during cooling of whole, gutted haddock were documented using cultivation for enumeration and molecular screening methods to determine the dominating microflora without cultivation. This methodology is relatively new in the field of food microbiology.

The results show a divergent dominating microflora influenced by the cooling methods. Furthermore, the study demonstrates that the dynamics of microbial populations during storage are susceptible to major population shifts as a result of storage conditions.

Cooling media

Cooling technologies have been improving in recent years with development and commercialization of ice machines of different kinds where water, ice, salt and gases have been used to increase cooling rate and reduce temperature during storage and transportation. All these developments aim at reducing bacterial growth and thereby extending shelf life and increasing product quality. Information on how these new techniques affect the succession of the bacterial flora on the fish is limited at present.

Four different cooling applications were compared and the temperature profiles recorded during the storage experiment (Table).

Measured parameters of each cooling medium used for the chilled storage experiment.

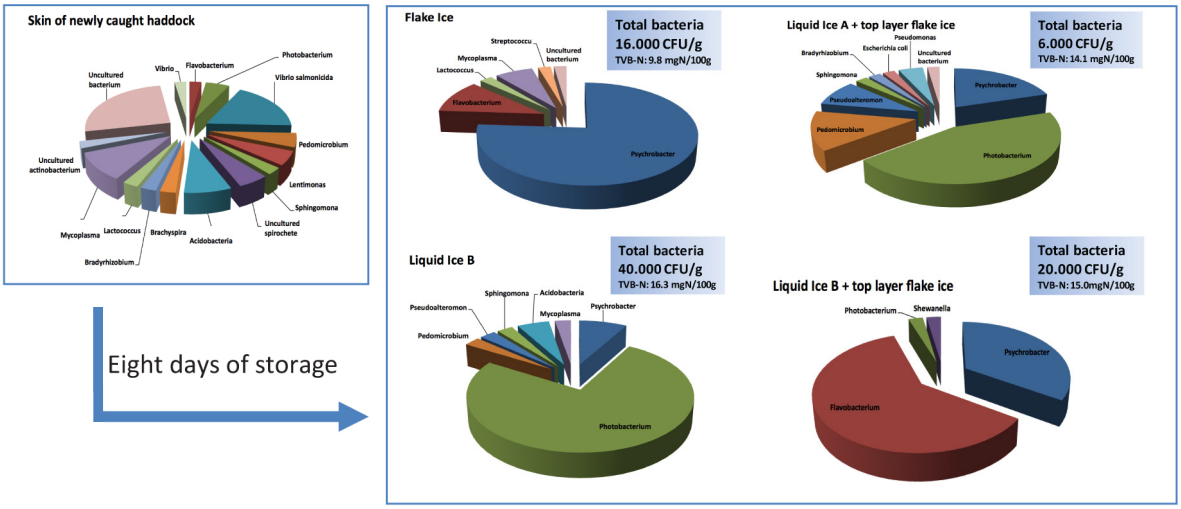
Cooling media	Mean temperature	Salt content
Flake Ice + Top Ice	-0,09 (±0,31)	0%
Liquid Ice A + Top Ice	-0,64 (±0,24)	2,9%
Liquid Ice B No Top Ice	-0,39 (±0,33)	2,1%
Liquid Ice B + Top Ice	-0,47 (±0,34)	2,1%

Bacterial developments

Cultivation of total viable psychrotrophic bacteria and pseudomonads showed no significant differences as time progressed between cooling methods. *Photobacterium phosphoreum* growth was delayed by all cooling methods at early storage but increased rapidly during late storage, mostly in Liquid Ice group B.

Molecular screening of the skin and flesh microflora revealed the dynamics of bacterial populations establishing during chilled storage and how different cooling methods can revolutionise the microflora in this environment (Figure). The results were in agreement with cultivation and spoilage indicator analysis (TMA and TVBN). *Photobacterium phosphoreum* was in highest dominance in haddock flesh when stored in Liquid Ice B and Liquid Ice A with ice on top. The other groups showed that *Psychrobacter* and *Flavobacterium* were dominating.

Surprisingly, the better cooling efficiency of the liquid ices was not supported by the bacterial growth behaviour. The brine used in the liquid ice may create an environment favourable to the active fish spoiler *Photobacterium phosphoreum*.



Bacterial species composition on the skin of newly caught haddock (left) and in the flesh of haddock after 8 days of storage in different cooling media (right) as analysed by cultivation independent molecular analysis (16S rRNA clone analysis).

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