Comparison between different ice media for chilling fish

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Figure 1. Agar cylinder used in the model studies.

Figure 2. Styrofoam box in a cooling chamber used for cooling experiments with the agar cylinder.

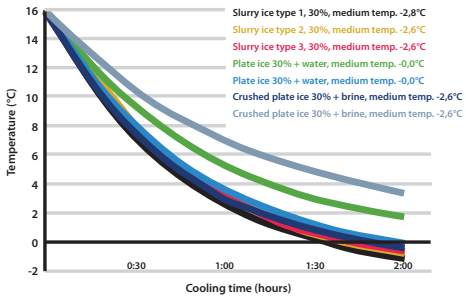

Figure 3. Cooling of agar cylinder using different types of ice media. Temperature is measured in the centre of the cylinder.

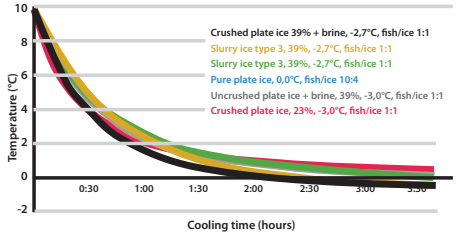

Figure 4. Cooling of saithe using different types of ice media specimen distributed in three layers in each tub., average temperature for twelve fish specimen in each tub.

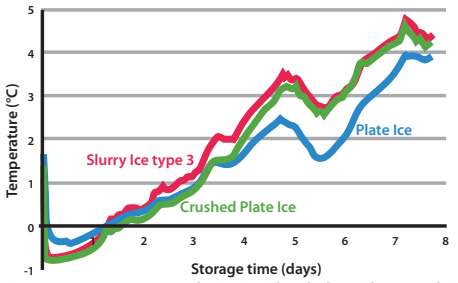

Figure 5. Temperature evolution inside whole saithe stored in different ice media, average temperature for twelve fish specimen in each tub.

Introduction

Various studies have shown that two-phase slurry ice is more efficient than ordinary plate ice for chilling fresh fish. In most of the studies only one type of slurry ice has been applied, most often prepared in commercial ice-machines. The objective of this work was to investigate both chilling and maintenance of low temperature utilising plate ice and different kinds of ice slurries. Both saithe and a cylinder made of agar were used as specimen in the experiments.

Materials and Methods

Model studies were performed in controlled consistent conditions. The different ice media under consideration were the following:

1. Three types of slurry ice – made with three different types of ice machines.

The slurry ice types were made of brine, ranging from 1.5 to 4.0 wt. % in salt concentration, but in most cases from 3.0 to 3.5 wt. %. The ice concentration ranged from 14 to 39 wt. % and the medium initial temperature ranged from -3.0 to -1.1 °C. The ice particle size was in the interval from 5 - 500 µm according to the ice machine producers.

2. Plate ice with particle size of ca. 1 – 3 cm.

3. Mixture of plate ice and brine.

4. Mixture of crushed plate ice and brine. The plate ice was crushed to a particle size of ca. 0.5 – 3 mm.

The cylinder's (Fig. 1) weight was 1.6 kg, its length 30 cm and diameter 8.0 cm and the initial temperature of it was ca. 16 °C. During chilling it was kept in a styrofoam box (Fig. 2) immersed in 38 kg of chilling medium. The whole, gutted saithe used both for investigating chilling and maintenance of low temperature during storage weighed ca. 1.5 – 2.0 kg. A ratio of 1:1 between fish and slurry ice was used when chilling saithe. In the storage experiments 54 kg of both slurry ice and crushed plate ice were packed evenly in insulated tubs along with 100 kg of saithe in each tub. The initial medium temperature was -2.2 °C and the ice ratio 37.1 wt. % which equates to the 20.0 kg of uncrushed plate ice used in the third insulated tub.

Results and Discussion

Chilling of agar cylinder and saithe

Unsalted plate ice (temperature 0.0°C with/without water) is the only chilling medium that shows significantly worse chilling performance than the others (Fig. 3). The influence of particle size does not seem to be as important as the temperature of the medium. The same can be stated by comparing results from two different cases in Fig. 4; one with crushed flake ice (approximate particle size 1 mm), the other machine made slurry ice with finer particles. In both of these cases the initial temperature of the medium was -2.7 °C and the ice ratio 39 %.

Storage of whole saithe

The results presented in Fig. 5 show that both crushed plate ice and the other slurry ice type maintain lower temperature in fish during storage for the first 2 – 4 days than the plate ice. This fact is mainly explained by the lower initial temperature of the cooling medium in these two cases. However, because of the small particle size of the two slurry ice media it melts faster than the plate ice resulting in higher temperature for the slurry ice media after the aforementioned 2 – 4 days of storage.

Concluding remarks

1. The cooling rate of all of the different slurry ice types was superior compared to plate ice.

2. The most important property of the chilling medium is the temperature since the size of the ice particles seems to have only minor influence on the cooling rate. The importance of distributing the ice medium evenly when packing fish and ice medium in fish tubs became evident in this work.

3. After a few days the faster melting of the ice slurries results in inferior cooling capacity so the plate ice, in general, maintains lower temperature in fish through long storage.

Acknowledgement

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