FACT SHEET

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CHILLING AND ICING OF FRESH SEAFOOD PRODUCTS

Purpose:

To provide guidance and education to harvesters and processors of seafood products on best practices associated with chilling fresh seafood products.

Target Audience:

Anyone, directly or indirectly, involved in production and sale of seafood products.

What is chilling and why is it important?

Chilling is the process of cooling, but not freezing, fish and seafood products. Cooling occurs as heat is removed from these products by a provided refrigerant. In the commercial fisheries, chilling is performed using a variety of processes, but most often using ice.

To minimize the loss of freshness from boat-to-plate and maximize the shelf life, seafood products should be chilled to 0 °C (in most cases) immediately upon capture and maintained at this temperature throughout its entire supply chain.

Temperature abuse of seafood products is the primary factor driving a loss of freshness. Elevated temperatures accelerate bacterial and enzymatic spoilage mechanisms, and when abuse takes place over extended periods, it can significantly impact a products appearance, odour, flavour, and/or texture by the time it reaches the final consumer.

Chilling methods

Chilling methods used in seafood production are designed to remove heat from products into the surrounding environment. Depending on where within the seafood supply chain chilling is performed, different methods may be adopted.

Melting Ice

The best tool for chilling fish and seafood is melting ice.

Solid ice acts as the perfect temperature regulator for the storage of chilled fish and seafood because these products are made up of predominantly water. At temperatures < 0 °C, ice does not melt, but when combined with warm fish, ice begins to melt and the liquid water absorbs that heat, effectively cooling the product. If ice is available, in good contact with the product, and continuously melting, seafoods products will eventually equilibrate to the temperature of melting ice at 0 °C. Melting ice also performs a washing action to remove dirt and debris, prevents the drying out of skin and surfaces, and maintains a humid environment for live animal storage.

Chilling with dry ice (solid CO_2) or liquid N_2 are colder and theoretically capable of cooling seafood products more quickly than ice, however they are not reliable for any period of extended chilled storage of seafood products.

Chill Rooms

Chill rooms function by providing airflow in a refrigerated space that removes heat from the surfaces of food products in contact with the air. For products that are already chilled and well-iced, short-term storage in a chill room is recommended to limit environmental heat from melting the available ice.

Air has a much lower capacity to absorb heat from its environment than water, therefore chilling with cold air is not reliable for quickly cooling a large quantity of warm fish and seafood. The movement of chilled air over the surface of seafoods does not penetrate far below the surface layer, hence chilling can take hours or days to reach the target temperature. Without protection, these durations can lead to dehydration of the surface layer and adversely impact the product appearance.

Best Practices

Hygiene

In seafood production, ice used for chilling will come into direct contact with food surfaces. Water sources, facilities, personnel, and materials used in the production, distribution, and storage of ice for cooling seafood products must be clean. Ice supports the growth of bacteria that can very easily be transferred to products that accelerate spoilage. Containers storing ice should never be left exposed to the environment.

Seawater vs Freshwater

Seawater ice has a lower freezing temperature than freshwater ice and these lower storage temperatures can extend product shelf life. However, seawater ice can be challenging to maintain homogenous, and variable melting points and brine concentrations can be found throughout these mixtures. The inability to predictably self-regulate its temperature is the biggest drawback of seawater ice.

Types of Ice

Ice comes in many formats: crushed ice, flake/plate ice, tube/shell ice, and slush ice/chilled sea water. Each format has a unique geometry and surface area that influence each's overall performance, as well as different storage densities.

Ice Type	Weight (kg)	Volume (L)
Crushed	1000	1585.75
Flake	1000	2123.76
Tube	1000	1868.91

Importantly, the cooling capacity of ice is always the same, regardless of the type of ice or the source of water – 1 kg of ice of each style will perform identically. Differences between ice types are related to their unique stowage volumes and risks for product damage, such as skin indentations and tears, and scale loss.

Quantity of Ice

You can never use too much ice to keep fish fresh!

The minimum amount of ice needed to bring on a fishing trip however is based upon many factors:

1. the anticipated catch volume,
2. the initial product temperatures,
3. the type of fish being caught,
4. the ambient temperatures during harvesting,
5. the planned trip length
6. the stowage method (anticipated losses to heat)
7. the available space,
8. and end market expectations

The catch volume and planned trip length have the greatest overall impact on ice requirements. The rule of thumb for snow crab fisheries are ratios of 3:1 (crab:ice) during the winter season, and 2:1 in the summer season, but greater amounts may be necessary if uninsulated holds are used.

The rule of thumb to chill fresh fish to 0 °C and maintain that for the duration of the trip while also accounting for heat losses is nearly equivalent to the catch weight of fish – 1:1. In the winter season, less ice usage may be permissible, whereas in the summer season, upwards of 30 % more ice may be required. Once products are landed, processed, and transferred to chilled storage on land, a far lower ice requirement is needed to maintain the melting action.

The best indicator for adequate ice usage is the presence of lots of ice surrounding products when unloading fish holds or insulated containers.

Temperature Measurement

Delays in off-loading, during processing, and throughout distribution and storage are primary mechanisms of temperature abuse in fresh seafood supply chains. Maintaining the cold-chain from boat-to-plate is essential to preserve freshness, therefore verification of the effectiveness of practices and procedures adopted throughout the cold chain are critical for ensuring products with maximum freshness are being conveyed to market.

When measuring temperature of a batch of fish and seafood, it is important to target the highest risk segment of a batch in the warmest position of the product. Products deemed high-risk may be the largest fish, those stored at the centre or outside of a container, or those most recently captured.

A probe-type sensor with a digital display, such as a thermometer, is an accurate, portable, and quick method to record product temperatures. All probe sensors contain a temperature-sensitive element at the end of the probe that should be positioned where the temperature is to be measured. Heat can conduct along the temperature probe, so as great a length as possible of the probe should be inserted into the product.

Heat can also be conducted into the product by handling, so handling should be minimized, and recordings taken quickly. Instruments should be able to respond quickly to temperature changes, be accurate to within 0.5 °C, and give a read out to within 0.1 °C.

Infrared thermometers are not reliable for measuring the internal temperature of seafood products.

Key Take-Aways

9. Melting ice is the most effective tool for chilling large quantities of fresh fish and seafood.

10. Adequate quantities of ice must be used to ensure products are effectively chilled and maintained throughout the duration of the anticipated storage period.

11. Effectiveness of chilling must be verified periodically by measuring internal product temperatures with a probe-type sensor.

References

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