



## COLD STORAGE

### Purpose:

The purpose of this fact sheet is to provide guidance and education on cold storage requirements and best practices to support the production of safe, high-quality, innovative seafood products. For the purpose of this document, cold storage refers to frozen storage and does not address refrigerated storage.

### Target Audience:

Anyone, directly or indirectly, associated with the production and sale of seafood products in Nova Scotia. Individuals looking to better understand the Nova Scotia fish and seafood sector.

### Best Practices:

Cold storage of seafood products prevents the growth of microorganisms and minimizes enzymatic activity and chemical reactions. Proper cold storage is critical for maintaining the quality of seafood products. During cold storage, several processes contribute to the degradation of seafood products including protein crosslinking and denaturation, lipid oxidation, and dehydration, however measures can be implemented to limit their impact. These measures include the freshness of the raw material, storing product at the lowest achievable temperature, avoiding temperature fluctuations, allowing adequate air circulation, and protecting the product using packaging or glazing.

### Raw Material

The quality of frozen products will only be as good as the quality of the starting raw material. Processors should ensure their supplied raw materials meet their specification, and are handled, stored, transported, and processed in a manner that preserves quality throughout the supply chain, prior to cold storage.

### Storage Temperature

The optimal cold storage temperature for seafood products depends on the species and product presentation, as well as the intended storage period.

In general, cold stores maintained at  $-18\text{ }^{\circ}\text{C}$  are sufficient for lean fish, such as cod and haddock, and are effective for most seafood products intended to be stored over short periods ( $< 6$  months).

In contrast, fatty fish, such as herring and salmon, are recommended to be stored at temperatures  $< -24\text{ }^{\circ}\text{C}$ .

For long storage periods ( $> 6$  month) of any frozen seafood product, temperatures  $< -30\text{ }^{\circ}\text{C}$  are recommended to maximize the shelf life. Table 1 outlines recommended frozen storage temperatures and shelf life of various seafood products when held at different cold storage temperatures.

**Table 1.** Impact of cold storage temperature and time on the quality of seafood products (Kolbe, E., Kramer, D. and Junker, J. 2006).

Species	Product	For highest quality Maximum storage temperature (°C)		For good quality Storage life (months)	
		2-months to consumption	6-months to consumption	-18 °C	-29 °C
Albacore	HOG	-23.5	-29.0	6	12
	Steaks	-23.5	-29.0	7	16
	Loin	-23.5	-29.0	8	18
Yellowfin	HOG	-26.0	-31.5	6	12
Herring	Whole	-29.0	-34.5	2	6
	Roe	-23.5	-29.0	8	14
Snow Crab	Cluster	-26.0	-29.0	6	12
	Meat	-26.0	-34.5	4	7
Scallop	Raw Meat	-18.0	-23.5	10	18
Sea Cucumber	Raw	-18.0	-20.5	8	14
	Cooked	-18.0	-23.5	6	12
Oyster	In-shell	-23.5	-29.0	5	9
	Shucked Meat	-26.0	-31.5	4	7
Salmon	H&G	-23.5	-29.0	7	12
Pacific Cod	H&G	-23.5	-29.0	9	18
	IQF	-29.0	-34.5	7	12
	Fillet Blocks	-23.5	-29.0	8	15
Alaskan Pollock	H&G	-23.5	-29.0	8	14
	IQF	-26.0	-29.0	6	10
	Fillet Blocks	-23.5	-29.0	7	12

\*Highest Quality defined as minimal loss of quality where product at the end of frozen storage period is undetectable by trained sensory panel.  
 \*Good quality defined as an acceptable loss of quality that consumers will still purchase, but is not at the level the industry should be marketing.

## Temperature Fluctuations

Temperature fluctuations are critical to avoid during cold storage. To minimize them, keep storage doors closed as much as possible, install strip or air curtains, and only put product in cold storage when it has been completely frozen to or below the cold storage temperature. When there are fluctuations in temperature and the cold store becomes warmer than the product, the product temperature begins to rise. Rising product temperatures promotes higher rates of enzymatic and chemical reactions, and moisture loss. All cold storages must be equipped with a temperature recording device and monitored to control fluctuations. Ideally, continuous automatic temperature recording devices equipped with an alarm system are used.

## Product Arrangement

Proper organization within a cold store is also key. Product should be stored in a manner that leaves air space below and around the product to ensure proper circulation and that all content within the cold store is at the same temperature. Product should not be stored directly on the storage floor or against walls. Pallets or racking can be used to keep product up off the floor and allow for adequate air flow. Stock rotation should be followed to ensure that product stored first is being used before products stored last. Proper stock rotation reduces waste as quality deteriorates over time.

## Packaging

When selecting packaging material, it is important to select a material that will provide protection against the spoilage risks specific to the product. Barriers to oxygen limit lipid oxidation, and moisture barriers assist to prevent dehydration. Ideally, the packaging material is tightly fit to the product, such as vacuum packaging, to prevent as much moisture loss as possible. Lipid oxidation and dehydration can also be reduced through glazing, or by using chemical additives. For products that are unpackaged or unglazed, dehydration can be minimized by maintaining a relative humidity of at least 85% in cold storages.

## Regulatory

Regarding regulatory guidelines, the Safe Food for Canadian Regulations require that the storing of food must be conducted in a manner that does not present a risk of contamination to food and that frozen fish in storage is to be protected from dehydration and oxidation. Common methods outlined by CFIA used to prevent the dehydration and oxidation process of frozen fish include those mentioned above such as glazing, controlling relative humidity, using appropriate packaging materials or a combination of these methods.

## Key Take Aways:

1. Proper cold storage can preserve seafood product quality and maximize shelf-life.
2. Shelf-life during cold storage is limited by enzymatic activity, chemical reactions, and moisture migration which lead to protein denaturation, lipid oxidation, and dehydration of the product, respectively.
3. Quality deterioration during cold storage can be prevented by controlling raw material quality, the cold store temperature, the relative humidity, air circulation, and the use of packaging materials and glazing.

## References

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