

# DETERMINING THE SHELF LIFE OF SEAFOOD PRODUCTS

## Purpose:

The purpose of this fact sheet is to assist the interpretation of the CFIA guidelines for completing shelf life studies as they apply to seafood products.

## Target Audience:

Anyone, directly or indirectly, associated with the production and sale of seafood products.

## What is shelf life?

Safe Food for Canadians Regulations (SFCR) require that all pre-packaged foods are labeled with a durable life date, often referred to as the products shelf life, and is commonly expressed in the form of a best-before date. SFCR outlines those foods considered filthy, putrid, rotten, decomposed, or diseased are not permitted for inter-provincial trade or international export. To evaluate the durable life of a seafood product and determine a best before date, shelf life studies are performed.

The handling, processing, packaging, and storage conditions all influence the durable life of seafood products. Shelf life studies should be completed on individual products due to the variation that can be observed between similar products handled slightly differently. A product's durable life expires when it no longer maintains its wholesomeness, palatability, nutritional value, and any other qualities claimed for it by the manufacturer.

A shelf life study will supply the documented evidence required to show retailers, customers, and regulators that the food will maintain its safety and quality when stored under recommended conditions.

## Types of shelf life studies

Both real-time and accelerated shelf life studies may be completed with seafood products. Accelerated studies may only be performed independently of real-time studies when an appropriate relative rate of spoilage (RRS) model has been established for that product. If this model has not been established, real-time studies must be performed in parallel to an accelerated study to validate the changes under the accelerated condition. For these reasons, real-time shelf life studies, where a food is stored under recommended conditions (or at the high-end of a stated range) and in the final product packaging, are straightforward to be completed by producers, and are most applicable for seafood products.

## How to conduct a shelf life study

### Step 1: Estimate the shelf life of the product with information available from trusted sources

Seafood products classified as fresh, frozen, or ready-to-eat (RTE) each have unique food safety risks and spoilage processes that influence the end of their durable life. Seek out reliable sources that accurately represent your product, and propose a duration greater than this window to be used for your shelf life study.

### Step 2: Select the properties used to determine the end of the durable life

The spoilage process of any seafood product is affected by both characteristics of the product itself, as well as by

the environment it encounters. The properties that affect durable life may be critical control points (CFIA, 2018). In unfrozen fish, spoilage is dominated by bacterial growth causing the development of off-odours and off-flavours. In frozen seafood, spoilage can occur because of lipid oxidation.

### Step 3: Develop a testing approach to determine the durable life

Sensory evaluation is commonly used to assess changes in the sensory attributes (appearance, odour, flavour, texture) and alone can often be sufficient to determine the durable life of seafood products. Post-harvest changes in seafood products are mediated by enzymatic, bacterial, and oxidative processes that create chemicals readily detectable by the human senses and are reliable indicators of the degree of spoilage. **See the Seafood Spoilage fact sheet for more information.**

A combination of testing strategies may be required to determine the durable life should your product need to comply with specific food safety/quality standards, or if there are specific claims or product specifications made on the product. For instance, a declaration of omega-3 content on a product label must be within the range of allowable variation throughout the duration of its durable life.

### Sensory Evaluation

Sensory evaluations are completed to monitor and record changes in the product occurring over time (CFIA). Guidelines for the Sensory Evaluation of Fish and Shellfish (CXG 31-1999, Codex Alimentarius) outline the operational procedures that should be followed by food enforcement agencies to assess seafood products by sensory evaluation.

Key considerations include the procedures for sample collection, the preparation and handling of samples, the evaluation area where samples are assessed, and the evaluation scheme. Seafood products should always be evaluated at room temperature with sufficient light and ventilation.

An evaluation scheme specific to the unique attributes of the seafood product is recommended.

### Non-Sensory Methods

Non-sensory testing methods can support sensory evaluations when determining the durable life of seafood products. Examples of measurable quality characteristics of seafood products that may be targeted by analytical testing are shown below in Table 1.

**Table 1.** Analytical testing opportunities to characterize changes in seafood products.

Product Attribute	Quality Factors		
<b>Microbiological</b>	<ul style="list-style-type: none"> <li>Total Aerobics</li> <li>Total Anaerobes</li> <li>Total Coliforms</li> <li>Faecal Coliforms</li> </ul>	<ul style="list-style-type: none"> <li>Yeast</li> <li>Molds</li> <li><i>C. botulinum</i></li> <li><i>E. coli</i></li> </ul>	<ul style="list-style-type: none"> <li><i>L. monocytogenes</i></li> <li><i>Salmonella spp.</i></li> <li><i>S. aureus</i></li> <li><i>Vibrio spp.</i></li> </ul>
<b>Chemical</b>	<ul style="list-style-type: none"> <li>pH</li> <li>Total Volatile Basic Nitrogen (TVB-N), i.e., Trimethylamine, ammonia</li> <li>Free Fatty Acids; Omega-3/6/9 Content, i.e. DHA/EPA/DPA</li> </ul>	<ul style="list-style-type: none"> <li>Peroxide Value; p-anisidine</li> <li>Water Activity (Aw)</li> <li>Proximate Composition</li> <li>Salt-Soluble Protein</li> </ul>	<ul style="list-style-type: none"> <li>Histamine</li> <li>Micronutrients</li> <li>% Salt / Water-phase salt</li> <li>E-nose; E-tongue</li> </ul>
<b>Physical</b>	<ul style="list-style-type: none"> <li>Texture analysis</li> <li>Water holding capacity</li> </ul>	<ul style="list-style-type: none"> <li>Glaze %</li> <li>Colour</li> </ul>	<ul style="list-style-type: none"> <li>Cold Chain</li> <li>Gas Composition</li> </ul>

## Step 4: Plan the shelf life study

### Number of panelists

In a seafood production environment, the availability and experience of panelists can be a limiting factor for completing sensory evaluations for determining the durable life. Where inexperienced and untrained panelists are available, the greatest number of individuals that can commit and are recruited for the study is recommended.

### Sample Collection

Product to be used in shelf life studies must be identical to the product sold to market. Samples are to be taken directly off the processing line after final packaging during regular processing hours rather than prepared specifically for the shelf life study.

### Frequency of Sampling

The durable life of a product is defined based upon the evidence collected during the shelf life study. This means that daily sampling or sampling on alternate days may be necessary for perishable seafood products. When a sample is determined to be unacceptable, the durable life is the previous sampling interval when the sample was determined to be acceptable by the assessors.

### Sample Numbers

Sufficient samples should be provided to support the proposed analytical and sensory testing schedule, while accounting for the need to complete repeated measurements for certain analyses. When completing a sensory assessment on whole fish, multiple fish should be evaluated.

## Defining the Storage Conditions

Real-time studies are conducted at the recommended storage condition. If a range of temperatures is recommended, i.e., 2 °C – 8 °C, 20 °C – 25 °C, < 4 °C, or -18 °C, the least favourable condition should be used.

## Step 5: Conduct the study

Execute what you have defined and document the whole process.

## Step 6: Evaluate data and determine the actual durable life of the food

The end point of a shelf life study is reached when the product no longer meets the specifications that it must comply with as defined by regulations or set by the customer.

## Step 7: Establish conditions for verifying the declared durable life

If any changes are made to the product (i.e., formulation, packaging, processing methods), the durable life must be re-evaluated to ensure that it remains accurate.

Using the information gathered through sensory, microbial, chemical, and physical analysis, quality control programs should be established to monitor for product specifications which can be used to define the durable life and quality attributes of seafood products. Table 2 shows product specifications which may be targeted for different seafood products.

**Table 2.** Product features relevant for evaluation of various seafood products (Connell, 2001).

Specification	Whole Fish	Wet Fillets	Smoked White Fish	Smoked Fatty Fish	Frozen Fish	Frozen Block	Canned Fish	Live Crustacean	Raw Crustacean	Cooked Crustacean
Freshness	x	x	x	x	x	x	x	x	x	x
Species Labelling	x	x	x	x	x	x	x	x	x	x
Net Weight	x	x	x	x	x	x	x	x	x	x
Condition	x	x	x	x	x	x	x	x	x	x
Blemishes	x	x	x	x	x	x	x	x	x	x
Skin, Bone, Belly	x	x	x	x	x	x	x	x	x	x
Odour, Flavour	x	x	x	x	x	x	x	x	x	x
Temperature, Ice Usage	x	x	x	x	x	x		x	x	x
Packaging	x	x	x	x	x	x	x	x	x	x
Counts	x	x	x	x	x	x	x	x	x	x
Bacterial Count	x	x	x	x	x	x	x	x	x	x
Salt Content			x	x			x			
Smoke Flavour			x	x						
Additives		x	x	x	x	x	x		x	x
Colour		x	x	x	x	x	x		x	x
Freeze / Cold Storage Condition					x	x			x	x
Glaze					x	x			x	x
Voice, Ice Lumps						x				
Shape/Size						x				
Amount of Mince						x				
Fish Content							x			
Degree of fill/drained weight							x			
Arrangement of Fill							x			
Heat Processing			x	x			x			x

## Key Take Aways:

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1. Shelf life studies of seafood products are critical for manufacturers to complete to understand how their product quality attributes are changing throughout the recommended storage period of their product.
2. Sensory evaluation alone can be sufficient to determine the shelf life of most seafood products.
3. Any changes made to the manufacturing of the product (change of suppliers, packaging, equipment used in processing), may require a re-evaluation of the stated shelf life for the product.

## References

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- Connell, J.J. 2001. **Quality Control in the Fish Industry.** Torry Advisory Note No. 58. Torrey Research Station.