



BC Centre for Disease Control
An agency of the Provincial Health Services Authority

Environmental Health Services

Food Issue

Notes from the Field

Raw fish in refrigerated reduced oxygen packaging

Request received from:	Regional Health Authority
Date of request:	March 18, 2015
Issue (brief description):	Is it safe to allow refrigerated raw fish in cryovak (ROP-reduced oxygen packaging) for one week?

Disclaimer: The information provided in this document is based on the judgement of BCCDC's Environmental Health Services Food Safety Specialists and represents our knowledge at the time of the request. It has not been peer-reviewed and is not comprehensive.

Summary of search information

1. Contacted CFIA and Health Canada, and consulted 2013 FDA food code
2. Reviewed articles and information in provincial fish inspection manual, and previous responses

Background information

An operator is thawing frozen fish, then cryovaking fresh raw fish at a large facility. Is there any guidance on safety of this practice and shelf-life storage under refrigerated conditions?

What are the risks associated with ROP packaging and fish?

Reduced oxygen packaging (ROP) includes vacuum packaging (absence of air in packaging), modified atmosphere packaging (MAP, gas mixtures of O₂, N₂, CO₂ in a ratio other than normal atmospheric air are used to prevent spoilage) and controlled atmosphere packaging (CAP).¹ MAP is an uncontrolled process, the gas mixture composition may change over time versus CAP, where the gas composition does not change.^{1,2} Cryovak is the name of a process when plastic film is shrink-wrapped over food, this would be equivalent to vacuum packaging.³

The principal hazards with anaerobic environments are the formation of *C. botulinum* toxin. Many other bacteria able to grow in reduced oxygen atmospheres can also be of concern, such as *L. monocytogenes* and *S. aureus*.^{2,4} *C. botulinum* growth and toxin formation can be prevented by controlling refrigeration to temperatures below 3.3°C.⁴

Previous guidance on ROP packaging of raw fresh fish from British Columbia and Canada

The BCCDC has provided information on packaging, including cryovak in the past in the Fish Inspection Reference Manual (FIRM) in section 4.2 on Labelling and Packaging.² Under vacuum packaging controlling temperatures to below 3.0°C is recommended to prevent the risk of *C. botulinum*. Cryovak products are recommended to be stored frozen (pg. 4-125).

Regarding refrigerated raw fish in ROP, one study noted that in both vacuum packaged and MAP salmon fillets that were inoculated with *C. botulinum* spores, sensory spoilage occurred before botulinum toxin detection (see Table 12 pg. 4-126 FIRM).^{2,5} This was used as the basis for the advice provided on previous inquiries on this subject, that is, as long as refrigerated ROP raw fish was held at temperatures at or below 3°C, this practice should be acceptable for a maximum time of one week.

Current guidance on this practice also exists from federal authorities. Of note, neither the CFIA nor Health Canada prohibits the activity of ROP packaging of refrigerated raw fish. The CFIA has 3 basic requirements for processors who package raw fish (personal communication, W. Louie, Mar 18, 2015):

1. Compliance with the Food and Drugs Regulation B.01.007 on best before date labelling⁶;
2. Include controls for the hazard of concern in the PCP (preventive control plan), or QMP (quality management program); and
3. Validation of the controls described in the PCP or QMP, including validation of best before dating.

Health Canada also addresses this issue in their *Code of Practice for MAP Fresh Fish* (Jan 23, 1996).⁷ They have several control points to address receipt, handling and processing. These are summarized in the table below.

Control Points	Rationale and monitoring records
Purchase and pack only hygienically handled fresh fish of good quality. Do not accept raw materials known to contain micro-organisms, toxins or parasites.	<ul style="list-style-type: none"> • Autolytic decomposition and bacterial growth can occur from elevated temperatures • Tainted, decomposed, or unwholesome products cannot not be controlled during plant sorting, preparation, or processing.
Fish should be transported to the factory under refrigeration on ice ($\leq -1^{\circ}\text{C}$)	
On receipt, fish should be $\leq -1^{\circ}\text{C}$; max temp acceptable is 5°C.	<ul style="list-style-type: none"> • Records establishing quality and temperature on receipt should be available
Fresh fish should be caught within ≤ 2 days before packaging	
During MAP processing, temp must be maintained at -2°C to 3°C through out process Temperature must not exceed 10°C	<ul style="list-style-type: none"> • Temp control will limit spoilage • Records verifying temperature during process should be available
Washing must be performed with potable water. Following evisceration, fish must be washed, or they are not suitable for MAP	<ul style="list-style-type: none"> • Minimum 20% CO_2 is recommended for MAP. Deviations from gas mix $\geq 5\%$ must be corrected. • Verify gas composition at beginning and end of runs
Shelf-life must be determined, and a “use by” date and “refrigeration date” must be applied to every package	<ul style="list-style-type: none"> • The use by date should account for actual conditions of production, distribution and retail storage • Challenge testing is required, and data made available

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Guidance on ROP refrigerated raw fish from US

There is mixed advice in the US. It appears that the retail code prohibits this activity; however, the guidance provided to processors allows this activity, with some conditions. A summary of these positions is provided.

According to the retail food code, this activity is not permitted for raw fresh fish (2013 FDA retail code 3-502.12 C)⁸

<i>Fish</i>	(C) Except for FISH that is frozen before, during, and after PACKAGING, a FOOD ESTABLISHMENT may not PACKAGE FISH using a REDUCED OXYGEN PACKAGING method. ^P
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While raw meats and vegetables are permitted to be in ROP packaging while under refrigeration, fish and seafood is excluded.

Guidance on the practice of raw refrigerated ROP management of fish products are also addressed in the latest (4th edition) of the “*Fish and Fisheries Hazard Guidance*” document.⁹ In Chapter 13 which addresses *C. botulinum* toxin formation a section on “Refrigerated (not frozen), reduced oxygen packaged raw, unpreserved fish and unpasteurized, cooked fishery products” recommends keeping raw fish fillets below 3.3°C to prevent formation of *C. botulinum* toxin, and to use a time-temperature indicator (TTI) device to ascertain a reasonable shelf-life for the product once it leaves temperature control conditions of the processor, and enters the distribution system. This device changes colour once temperature and time limits are exceeded, alerting the consumer to not purchase or eat this product.

Recommendations from BCCDC

This risk of *C. botulinum* requires careful handling and precise refrigerated temperature control of all fish and seafood products to temperatures below 3.3°C when in placed into any type of ROP packaging. We recommend that the guidance from CFIA and Health Canada be followed. Specifically;

- During receipt, handling and processing of raw fish into ROP, temperature control must achieve 3°C or lower at all times;
- Temperature control must be monitored with logs;
- Labelling must comply with federal regulations (B.01.007) and all packaging must have a “best before/use by” date and a label that states “keep refrigerated”;
- Processors must verify the shelf-life of their product through testing and make the data available to the regulator and this data must take into account storage temperatures from catch through to retail holding of the product;
- Processors should have a food safety or HACCP or PCP (preventive control program) in place;
- Control plans must describe how hazards of concern will be addressed in the plan, specifically for *C. botulinum*;

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- The use of additional consumer labelling, such as with TTI devices is recommended; and
- Maximum recommended holding time for refrigerated raw fresh fish should be limited to one week, if conditions above are met.

Note: this is based on spoilage organisms occurring in less than 10 days under an 8°C temperature abuse condition; however, new evidence may result in a change in recommendations

References

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3. Wikipedia. Sealed Air. 2015 [cited 2015 Mar 20, 2015]; Available from: http://en.wikipedia.org/wiki/Sealed_Air.
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8. Food and Drug Administration. Food Code 2013. College Park, MD 2013 [cited 2015 Mar 18]; Available from: <http://www.fda.gov/Food/GuidanceRegulation/RetailFoodProtection/FoodCode/ucm374275.htm>
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