

Shelf life of Cold Smoked and Hot Smoked Salmon

(after removal from packaging and in sealed packaging)

The Food Code does not address shelf life. It addresses safety of the product. However, it has been included in this document to highlight the risks of ROP fish in the catering environment. The FDA's Fish and Fishery Products Hazards and Control Guide recommendations are discussed later in this document.

<http://www.fda.gov/downloads/Food/GuidanceRegulation/RetailFoodProtection/FoodCode/UCM374510.pdf>

3-502.12 Reduced Oxygen Packaging Without a Variance, Criteria.

Reduced oxygen packaging (ROP) encompasses a large variety of packaging methods * where the internal environment of the package contains less than the normal ambient oxygen level (typically 21% at sea level), including vacuum packaging (VP), modified atmosphere packaging (MAP), controlled atmosphere packaging (CAP), cook chill processing (CC), and sous vide (SV). Using ROP methods in food establishments has the advantage of providing extended shelf life to many foods because it inhibits spoilage organisms that are typically aerobic. ROP may also offer benefits related to time and labor savings, portion control and quality retention. However, ROP can also increase the potential for the growth of certain pathogens in the absence of the growth of competing spoilage organisms. For example, if certain controls are not in place, the formation of *C. botulinum* toxin may occur before spoilage renders the product unacceptable to the consumer.

ROP Fish

Retailers should be aware that when a manufacturer packages fish and fishery products a hazard analysis is required under 21 CFR Parts 123 and 1240, Procedures

for the Safe and Sanitary Processing and Importing of Fish and Fishery Products (the Seafood HACCP Rule) to provide for control for nonproteolytic *C. botulinum*. Factors that make formation of *C. botulinum* toxin reasonably likely to occur during finished product storage and distribution are those that may result from the use of a reduced oxygen packaging (ROP) environment in a food that does not contain barriers to growth of *C. botulinum*.

The processing control for *C. botulinum* can be either freezing, refrigeration alone or refrigeration in combination with chemical inhibitors, (e.g. salt, water activity control, nitrites).

The Fish and Fishery Products Hazards and Control Guidance, Fourth Edition, Chapter 13, describes freezing as a control strategy. This control is intended to prevent exposure of the product to conditions conducive to the production of toxin by nonproteolytic strains of *C. botulinum* in the closed ROP package.

Shelf Life Considerations for Smoked Salmon and other refrigerated ROP foods

The following excerpts are from a project conducted by the Institute of Food Research - Clostridium botulinum in vacuum packed (VP) and modified atmosphere packed (MAP) chilled foods. FINAL PROJECT REPORT (B13006) JULY 2006 M.W. Peck, K.E. Goodburn, R.P. Betts, and S.C. Stringer. The complete 225 page document can be found and downloaded in printed document format from http://www.ifr.ac.uk/safety/Final_project_report0707.pdf

The majority of commercially produced pre-packaged chilled/ refrigerated foods have a shelf life greater than 5 days, and some have a shelf life greater than 10 days without receiving any of the control measures specified by the ACMSF (1992). **The Advisory Committee for the Microbiological Safety of Foods, ACMSF (1995) recommendation of 10 days at 5°C/5 days at 10°C is not adhered to any significant extent in the UK or elsewhere.** The 10 day rule at 8°C specified in the 1996 industry code (UK) of practice is **only** adhered to by major producers in the UK and Benelux market. In some countries (e.g. France, Finland), chilled/refrigerated

products have been safely produced, over several decades, with shelf lives greater than 10 days. Many of these products will not have received a 6 log non-proteolytic *C. botulinum* process or any of the other control measures specified by the ACMSF (1992) and their shelf lives take account of lower temperature storage than 8°C.

It is not easy to determine the **maximum shelf-life of chilled foods at 8°C** (where other controlling factors are not known, e.g. water phase salt, other preservatives, microbiological control measures other than cooking) on only the data from 1307 independent challenge tests of toxin formation by inoculated non-proteolytic *C. botulinum* (**See Appendix 2 of the study cited above**).

It is clear that, given the correct environment, if present, non-proteolytic *C. botulinum* is able to form toxin in 10 days or less at 8°C. Also, predictive models indicate that toxin formation can occur in 10 days or less at 8°C (**the model in ComBase Predictor estimates toxin formation in 6 days at 8°C**). That toxin formation has not occurred in correctly stored short shelf-life chilled foods sold in the UK and internationally must be due to presence of one or more “unknown controlling factors”. The difficulty is that the magnitude, variability, and nature of these “unknown controlling factors” is not known, and it is suspected that the magnitude, variability, and nature are not the same for all chilled foods. Therefore that while short shelf-life foods have been produced safely in the UK and internationally for more than two decades, it is not known why they are safe with respect to foodborne botulism, or what the safety margins are.

It was noted in several studies that toxin formation by non-proteolytic *C. botulinum* was as rapid (or in some circumstances more rapid) in foods packed in air as under VP or low-oxygen MAP/ROP. This is presumably because there is no oxygen in the food, i.e. the food is reduced. Packaging under air or a similar oxygen-containing atmosphere is therefore not a guarantee that toxin formation by non-proteolytic *C. botulinum* will be prevented.

It was brought to the attention of researchers in the study that some chilled VP/MAP foods such as meat may be given a “rolling 10 day shelf-life”. That is, the product is opened during the initial 10 day shelf-life, some is used, and then the remainder is repacked and given a further 10 day shelf-life. Thus, the shelf-life is extended beyond 10 days without the identification of other factors that control toxin formation by non-proteolytic *C. botulinum*. While I am not aware of this practice leading to outbreaks of botulism, this represents a significant divergence from the guidance and would appear to be a **high risk practice**. **It is therefore proposed that for foods where no other controlling factor can be identified, the maximum shelf-life is 10 days, and that this commences once the product is first vacuum or modified atmosphere packed. The shelf-life must not be restarted if the product is subject to a further packing under vacuum or modified atmosphere, unless other controlling factors (as described by the ACMSF) are applied.**

For making risk assessments, determination of hazards and controls, and for information about specific products you may use.

ComBase: A database of response of foodborne bacteria (pathogens and spoilage bacteria) to environmental conditions in food. (website www.ComBase.cc)

ComBase Predictor: A predictive microbiology modelling package of response of foodborne bacteria (pathogens and spoilage bacteria) to environmental conditions in food. (website www.ComBase.cc)

The information below is from the Food and Agriculture Organization website.

<http://www.fao.org/wairdocs/tan/x5902e/x5902e01.htm> and

FDA’s Fish and Fishery Products Hazard and Controls Guide

<http://www.fda.gov/downloads/Food/GuidanceRegulation/UCM251970.pdf>

Smoked fish and botulism

Salmon flesh is either dry salted or brined before being cold smoked, the time of salting varying with the size of salmon being cured. The presence of salt in the product has a great effect on the growth of *Clostridium botulinum*, but the concentration of salt in smoked salmon is not usually high enough to prevent growth altogether; commercial smoked salmon usually contains 1 to 4 per cent salt. The concentration required to prevent growth at room temperature can vary from as low as 3 per cent to 5 per cent or more, so that the amount of salt present in smoked salmon is on its own no guarantee against the danger of botulism.

Trout and mackerel are brined and then hot smoked, either as gutted whole fish or as fillets. The range of salt concentration is similar to that found in salmon. Since neither the smoking nor the drying parts of present processes are particularly severe, *Clostridium botulinum* can survive and flourish in the finished product, unless it is kept sufficiently cool.

See the Fishery and Fishery Products Hazard and Controls Guide for product storage and control measures, beginning on page 245.

2D. REFRIGERATED FINISHED PRODUCT STORAGE

Follow the guidance for “Control Strategy Example 1 - Smoking (1d - Refrigerated Finished Product Storage),” except that where the critical limits list 40°F (4.4°C), they should list 38°F (3.3°C).

2E. RECEIPT OF PRODUCTS BY SECONDARY PROCESSOR

Follow the guidance for “Control Strategy Example 1 - Smoking (1e - Receipt of Products by Secondary Processor),” except that where the critical limits list 40°F (4.4°C), they should list 38°F (3.3°C).

Summary

Freezing of the product is always an option to extend shelf life of the smoked products that are opened and go beyond the manufacturers recommended shelf life or have been otherwise temperature abused. As discussed earlier in this document, refrigerated storage/chilled storage should be a CCP for these products. This is particularly important if refrigeration/chilled storage is the **sole source** of control for

the safety of the product. TTI (time temperature indicators are recommended in the Hazards and Controls Guide). Where permitted, **nitrites, water phase salt and other control measures** may allow less temperature control to maintain the safety of the product. While the focus of the discussion in this document is primarily, *C. botulinum*, *L. monocytogenes* growth is also a concern. You must follow the manufacturer's recommendations closely. The operational practice of removing the product from the original packaging, rewrapping and placing in secondary storage for later use is a high risk proposition and needs to be carefully monitored. Always remember that the product may not have the appearance of spoilage and still contain pathogens that may be harmful to the consumer if shelf life and refrigeration/chilled storage controls are not carefully monitored.