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Agenda 8 **FFP/34 CRD/18**

JOINT FAO/WHO FOOD STANDARDS PROGRAMME
CODEX COMMITTEE ON FISH AND FISHERY PRODUCTS

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Comments by Norway

APPENDIX I, MODIFIED ATMOSPHERE PACKAGING

[MODIFIED ATMOSPHERE PACKAGING **OF RAW FRESH OR PREVIOSULY FROZEN FILLETS AND MINCED RAW FISH]**

We have tried to facilitate further discussion. :Below please find a summary of all comments submitted to this agenda item. Some issues are placed in square brackets.

Specific comments:

- New comment: One country wants this Appendix to be used for all products within the Code.
- One country wants to revise the title of the Appendix.
- One country would like to move this sentence "Good process controls are essential when packing fillets and similar products in a modified atmosphere" to the first paragraph as an introduction in paragraph 1.

This Appendix is a general guidance to all packaging of fish and seafood in modified atmosphere (MAP) and can be used for all products within the scope of the Code. For some production processes, the current section of the Code gives further guidance.

[MODIFIED ATMOSPHERE PACKAGING **OF RAW FRESH OR PREVIOSULY FROZEN FILLETS AND MINCED RAW FISH]**

~~GOOD PROCESS CONTROLS ARE ESSENTIAL WHEN PACKING FILLETS AND SIMILAR PRODUCTS IN A MODIFIED ATMOSPHERE~~

Comments to paragraph 1:

- One country: New first sentence, to be consistent with the definition adopted in the "*CODE OF HYGIENIC PRACTICE FOR REFRIGERATED PACKAGED FOODS WITH EXTENDED SHELF LIFE*" CAC/RCP 46-(1999) (*CAC/RCP 46*).
- One country refers to the definition of MAP.

~~Modified atmosphere packing (MAP),~~ **The atmosphere in a modified atmosphere packaged product (vacuum or gas) differs from the ambient atmosphere which** ~~in which the composition of the atmosphere surrounding the fillet is different from the normal composition of air~~ can be an effective technique for delaying microbial spoilage and oxidative rancidity in **[raw]** fish. **It also introduces the serious food safety hazard of *Clostridium botulinum* growth and toxin formation. However, when packing fish and seafood in modified atmosphere packaging to extend the shelf life of refrigerated products, good process controls are essential. The composition of the atmosphere can be changed either by adding a specific gas mixture or by removing the air by vacuum packaging or skin packaging. By skin packaging a film is sealed on top of the tray or the bottom web obtaining a similar condition as vacuum packaging.**

Comments to paragraph 2:

- Comment from one country that the following guidance should be considered as supplemental to the guidance already outlined in this code.
- Countries suggest change white fish to lean fish in which the latter one should be used as it covers a wider range of fish species.
- Several comments to gas mixtures.
- Several comments related to rancidity inhibition.
- Comment to red fish and discoloration.
- Several comments to bacterial inhibition and growth of other types of bacteria when use of MAP.
- One country has comment to improved sentence about gas/product ratio.
- One country has comment on use of CO_2 emitter.

The following guidance should be considered as supplemental to the guidance already outlined in section 8.2 of this code. Note that the guidance below does not apply to raw or cooked *smoked* products. For MAP of smoked fish and smoke flavoured fish, please refer to section 12.1.14 of this code.

For **lean** ~~white~~ fish gas mixtures containing **CO_2 added O_2 and/or N_2 are recommended.** ~~35-45% CO_2, 25-35% O_2 and 25-35% N_2 are recommended~~. **The composition of the gas mixture may vary a lot (the ranges may be, but not limited to 35-60 % CO_2, 25-60 % O_2 and 25-40 % N_2). Sometimes gas mixtures containing 50 % CO_2 + 50 % O_2 or 50% CO_2 + 50 % N_2 or 100 % CO_2 are used. Gas mixtures containing up to 60- 80 % CO_2 in combination solely with N_2 are recommended for oily fish. Only these two gases can also be used for lean fish. To inhibit oxidative rancidity of oily fish, oxygen gas may be excluded.** ~~Gas mixtures containing up to 60% CO2 in combination solely with N_2 are recommended for oily fish.~~ **Moreover, the concentration of CO_2 above 25 % in the atmosphere may cause brown discolorations of**

[red fish or fish species containing myoglobin]

due to oxidation myoglobin to metmyoglobin at low partial pressure of oxygen. For fresh shrimp or prawns packed in ice the atmosphere of up to 100 % CO_2 is recommended. For cooked shrimps lower levels of CO_2 (for example 60 %) are common. The inclusion of CO_2 is necessary for inhibiting common aerobic spoilage bacteria such as *Pseudomonas* species and *Acinetobacter/Moraxella* species, **however it can results in dominance of more resistant organisms, such as Lactobacillus and Alteromonas in cooled fish. By use of MAP spoilage bacteria like Photobacterium can grow. As an effect of their development some metabolites are formed, which can cause abnormal sensory characteristics of stale fish. Generally the Gram negative bacteria are more sensitive to CO_2 inhibition than Gram-positive, with pseudomonas being among the most sensitive and clostridia the most resistant.** However, **for** retail packs of fillets or similar products**, with** a too high a proportion of **CO_2** ~~CO_2~~ ~~in~~ **of** the internal gas mixture can induce pack collapse **and** excessive drip. **Too long storage** time ~~and~~ may cause bleaching. Other gases, **N_2 and O_2,** ~~N_2 and O_2~~, are included as diluents to prevent these effects. ~~O_2 is preferentially excluded from oily fish in MA packs so as to inhibit oxidative rancidity.~~ A gas/product ratio~~n~~ of 3:1 is ~~commonly~~ recommended. Any reductions in this ratio can ~~result in an impaired~~ **impact** the **duration of the extended** shelf life ~~extension.~~ **Use of for example CO_2 emitter (a liquid absorber that develops CO_2 gas inside the package) allows for increasing the amount of product and can also prevent pack collapse.**

Comments to paragraph 3:

- Comments to effect of CO_2 related to decreased temperature and pH, and to *Clostridium botulinum*.
- Comment from several countries to technologist or microbiologist. One country comments to delete suitably and such as a food technologist or microbiologist, but to add by use of recommended methods.
- New comment: *Listeria monocytogenes* is reported to be inhibited by high levels of CO_2.
- Several comments to temperature control and *Clostridium botulinum* type E.
- Comments to other controls of *Clostridium botulinum.*

The extent to which the shelf-life of the product can be extended by MAP will depend on the species, fat content, initial bacterial load, gas mixture, gas/product ratio, type of packaging material and, especially important, the temperature of storage. **The inhibitory activity of CO_2 increases with the decreasing of incubation and storage temperatures as well as the decreasing of pH into the acid range.** Determination of the shelf life of a particular product should be **performed** by a ~~suitably~~ qualified person

[such as a food **technologist** ~~technologies~~ or microbiologist]

and by use of recommended methods.

***Listeria monocytogenes* is reported to be inhibited by high levels of CO_2.**

Since fish can be contaminated with *Clostridium botulinum* type E great care has to be exercised when determining the shelf life. **Type E does not break down protein and can grow at a minimum of 3°C. This allows toxin production before spoilage makes the product unacceptable to consumers. Storage of fish in an oxygen free atmosphere increases possibility of development of Clostridium botulinum, if the raw material is not completely free from these anaerobes. Fish packed in such an atmosphere should not be kept in a temperature higher than 3 C, below which Clostridium botulinum type E does not develop. Moreover the packaging should be made of the material of low permeability of water vapor and gases (e.g. O_2 ~~O2~~ barrier and CO_2 ~~CO2~~ barrier.** ~~Although it is generally accepted that *Clostridium botulinum* does not grow at temperatures below +3°C other factors, e.g. salt content or pH etc. can also have an inhibitory effect.~~ Thus when determining the shelf life of MAP fresh fish it is advisable to do challenge tests on the product which accurately reflect the product conditions and storage and distribution environment.

If temperature is the sole control, processors need to store and distribute MA packs below 3°C with an appropriate time temperature indicator (TTI) on each individual package.[1] TTIs alert the end user or consumer when the package has been exposed to unsafe time-temperature exposures for toxin production. The TTI should be designed and validated for Clostridium botulinum toxin production using the Skinner-Larkin curve.[2]

Reduced oxygen packaging (ROP) encompasses a large variety of packaging methods including MAP, vacuum packaging, hermetically sealed containers, heat sealed plastic or laminated packaging, and packing in oil. By reducing or preventing the exchange of air, a processor can create a reduced oxygen environment and introduce the hazard of Clostridium botulinum. MA packs can become ROP from spoilage organisms depleting the O_2.

It is very important to note that the inclusion of **O_2** ~~O2~~ **even at levels above air** does not preclude the growth of *Clostridium botulinum* type E ~~and~~.**Since this pathogen can grow and produce toxin at temperatures of 3.0 - 3.3 °C, strict** temperature control **is required** throughout **the production chain and specially throughout** the shelf life of the product i~~s very important and. In many circumstances it is considered undesirable to use ice to cool these packs and~~ Therefore mechanical refrigeration ~~methods are preferred~~ **should be used.**

[The MAP product should be kept in chilled condition maintaining a temperature og 0-3 °C].

Comments to new paragraph 4:

- Comments to additional controls for *C. botulinum* are provided in case processors do not want to use temperatures below 3°C and TTIs. Also a reminder is added for processors to create a HACCP plan that includes *C. botulinum* as a hazard for ROP fish.

***Clostridium botulinum* can also be controlled through formulation and processing controls[3] such as:**

- **Freezing the finished packaged product and using labeling with instructions to keep the product frozen until used and to thaw under refrigeration immediately before use.**
- **Controlling the level of acidity or pH of the food to be 4.6 or below for shelf stability or to 5.0 or below with refrigeration at 4.4°C or below.**
- **Controlling the amount of moisture in the food to be 0.85 or below for shelf stability or to below 0.97 with refrigeration at 4.4°C or below.**
- **Controlling the amount of salt in the product to a minimum of 5% water phase salt with refrigeration at 4.4°C or below.**
- **Using a combination of salting, smoking and refrigeration. Controls for smoked fish can be found in Annex II of *Standard for smoked fish, smoke-flavoured fish and smoke-dried fish* (CODEX STAN 311-2013).**

All ROP seafood products should have a hazard analysis critical control point (HACCP) plan that addresses *Clostridium botulinum* and all of the food safety hazards associated with the product.

References:

1. National Advisory Committee on Microbiological Criteria for Foods (March 20, 1992) Vacuum or Modified Packaging for Refrigerated Raw Fishery Products.

2. 2. Skinner, G.E. and Larkin, J.W. (1998) Conservative prediction of time to *Clostridium botulinum* toxin formation for use with time-temperature indicators to ensure the safety of foods. *Journal of Food Protection* 61, 1154-1160.

3. 3. USFDA (April 2011) Fish and Fishery Product Hazards and Controls Guidance, 4th edition, Chapter 13, Clostridium botulinum Toxin Formation.

Comments to paragraph 4 (new 5):

- One country comments: "Seal integrity, GMP and GHP should be adhered to, of MA packs etc.
- One country suggests changes to three sentences about Seal integrity of MA packs etc.
- One country comments "only film with a clearly defined specification from reputable manufacturers and approved for use by the relevant health authority should be used".

Seal integrity, **with GHP and GMP** of MA packs is ~~a critical control point since it determines whether a MA pack is susceptible to external microbial contamination and air dilution of~~ **essential in maintaining** the gas mixture **and product quality for the duration of the shelf life**.Essential checks on heat sealing should include proper alignment of the sealing heads or jaws, dwell time, temperature, pressure and machine speed. **To obtain and maintain a proper seal, great** ~~Great~~ care should be taken to ensure that the seal area is ~~not contaminated with~~ **free of** product, product drip or moisture~~ since seal integrity may be reduced~~. In addition, ~~the quality of the film used is important, particularly with regard to gas permeability, and~~ **the specifications and quality of the film used for the MAP should be suitable for maintaining or achieving the modified atmosphere desired within the package. O**~~o~~nly film with clearly defined specification**s** from reputable manufacturers

[approved for use by the relevant health authority]

should be used.

No comments to paragraph 5 (new 6):

Maintenance of the correct gas mixture injected into MA packs is essential to ensure product quality, appearance and shelf life extension. For these reasons routine gas analysis of MA packs should be included as part of the process control. Analysis of the gases within MA packs can indicate faults with seal integrity, MA materials, MAP machinery or gas mixing prior to flushing. The use of continuous gas analysers is recommended. Immediate gas analysis following packing is necessary as CO_2 absorption takes place rapidly.