

# Implementation of a HACCP management plan in a marinated fish processing unit

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**Abstract:** Fish is considered a valuable food product, due to its content rich in lipids, proteins, vitamins, minerals, and especially in omega 3, which has a digestibility coefficient of about 97%. Nutritionists believe this type of meat should not be missing from the consumer's daily diet, especially for children and the elderly, as it constitutes a third and a half of the daily protein requirement. Consumers prefer eating fish meat instead of other types of meat. Nowadays, fresh fish is preferred, followed by frozen fish, and then fish products are preserved by salting and smoking. To obtain marinated fish, frozen fish is used, especially mackerel. The purpose of this work is to identify and monitor the critical points in the technological flow in a fish processing unit and to identify pathogens with the potential risk that can affect the final product, implicitly the health of the consumer (E.coli, L.monocytogenes, Salmonella, Staphylococci, coagulase-positive, Anisakis). Implementing a HACCP plan in the units obtaining fish products has proven to be beneficial, both for the economic operator and the final consumers (4,5). By applying this food safety system, the consumer's trust in products in this category increases, considering the fact that fish is a perishable product with a risk of contamination during the technological flow, regardless of the way it is marketed.

**Keywords:** marinated fish, CCP, Anisakis, HACCP plan, food safety

## 1. Introduction

Food safety is an essential branch in the field of the food industry, starting from the transport, storage of products, their production, and preparation until their sale in supermarkets, each of the listed stages emphasizing a well-prepared HACCP plan for the finished marketed product. This food safety system offers numerous solutions to economic operators to be able to offer quality and safe products on the market for the final consumer.

A basic product that is part of the diet of consumers of all ages is fish, which through its consumption provides a rich supply of omega-3, proteins, lipids, minerals, and vitamins. In general, consumers prefer both freshwater and oceanic fish.

In general, in fish processing units, mackerel is used either fresh or frozen to obtain marinated fish. Unlike other fish, mackerel is a rich source of digestible proteins, its preparations is

recommended for athletes, people involved in severe mental and physical work, people suffering from serious illnesses or people recovering from surgery. Regular consumption of mackerel meat reduces the occurrence of rheumatoid diseases, prevents the occurrence of cancer, and increases immunity, but is contraindicated in people with kidney and liver diseases, hypertension, and gastrointestinal diseases [3]. Due to the fact that it is a fish that accumulates a lot of heavy metals, it is not recommended for vulnerable people such as children and pregnant women. Another risk for this type of fish is the presence of the Anisakis parasite, which can be a danger for the final consumer if this parasite is present in the fish meat, and the meat is consumed raw.

For this reason, the implementation of a HACCP plan in a marinated fish production unit is beneficial in order to control the dangers in certain stages of the technological flow and in the end to offer a safe product for consumption for the final consumer [1].

## **2. Methods**

### **Product description**

Mackerel is the most consumed fish in Romania and one of the most consumed fish in the world. It is found in several areas on the world map and is of particular importance for the fish industry. Mackerel has a typical aroma is very succulent and has a delicious taste. Its aromatic and tender meat has a red-brown color, and the amount of fat can vary depending on the harvesting period, between 3 and 30%.

### **Organoleptic characteristics:**

- ✓ Appearance: the smoked mackerel is packed in a polypropylene bag by vacuuming. Smoked mackerel trunks have a smooth surface, without spots, without skin breaks; in section, the color is yellowish-white, without traces of blood or viscera, and the muscles are compact. The weight of the packaged product can vary between 200 and 500 grams.
- ✓ Consistency: the texture of the muscles is compact, without fat agglomerations.
- ✓ The color of the skin after smoking is golden, and uniform and the muscles have a reddish-brown color.
- ✓ Taste and aroma of the product - by smoking the product acquires a pleasant taste and smell

### **Chemical composition**

- ✓ Mineral salts: maximum 1.2%;
- ✓ Lipids: 8%;
- ✓ Water: 69.8%;
- ✓ Protein min 21%;

### **Technological flow diagram**

Quantitative and qualitative reception of fish: to obtain the marinated mackerel product, generally frozen fish or fresh fish is used. The documentation of each batch of fish is checked, freshness is visually assessed, and the existence of parasites. The result of the reception is entered in the "Reception of raw materials" and "Aquaculture reception form" registers, the quantity and organoleptic characteristics being recorded by entering the appropriate/inappropriate qualification and assigning the batch number. Thawing the fish is done in pools where a saturated brine is prepared with a high temperature and a fish/brine ratio of 1:2 or 1:3. The period of the thawing-salting process depends on the size of the fish and can last from 8 to 24 hours. Fish storage is an intermediate stage and aims to preserve the quality characteristics of the product during storage at a temperature of -1 to +2 °C. The storage is done in PVC valves, in alternate layers of ice.

The primary processing of fish consists of manual operations: removal of scales, head, tail removal, evisceration, milk, and roe collection.

The removal of scales is performed manually, and the temperature in the room where these operations are carried out must be a maximum of 10 °C. Technological waste is collected in shuttles lined with household bags, which are periodically evacuated, through the waste evacuation installation equipped with a shredder and transport pump, in the waste warehouse, at a temperature of +2...+8°C.

The head is removed by making a V-shaped incision, next to the operculum, the resulting head is collected in PVC shuttles lined with household bags that are placed under the work table, on a shelf specially designed for this stage, and the mackerel trunks are collected in plastic shuttles, at the evisceration table.

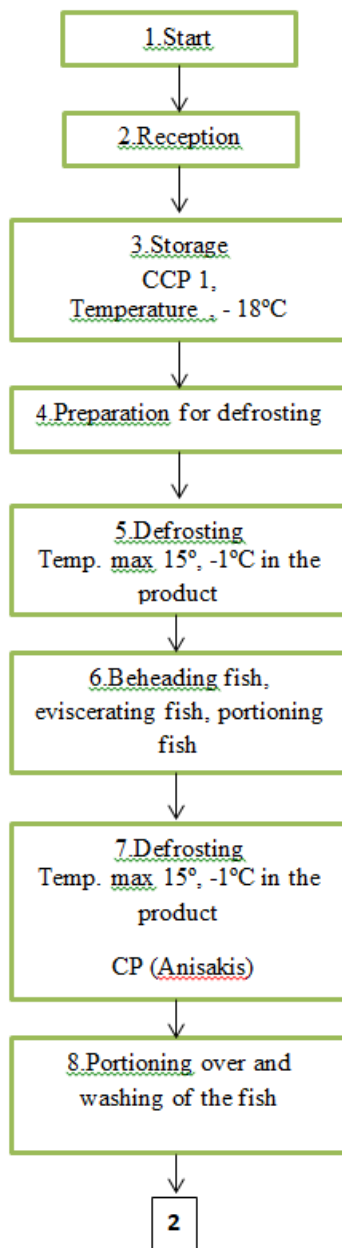
Evisceration is done by cutting the abdomen, along the fish, from the head to the anal hole, and the collected waste is evacuated in the same way as the scales. During evisceration, the visual inspection of parasites is done continuously, and at the same time the removal of fish contaminated with Anisakis.

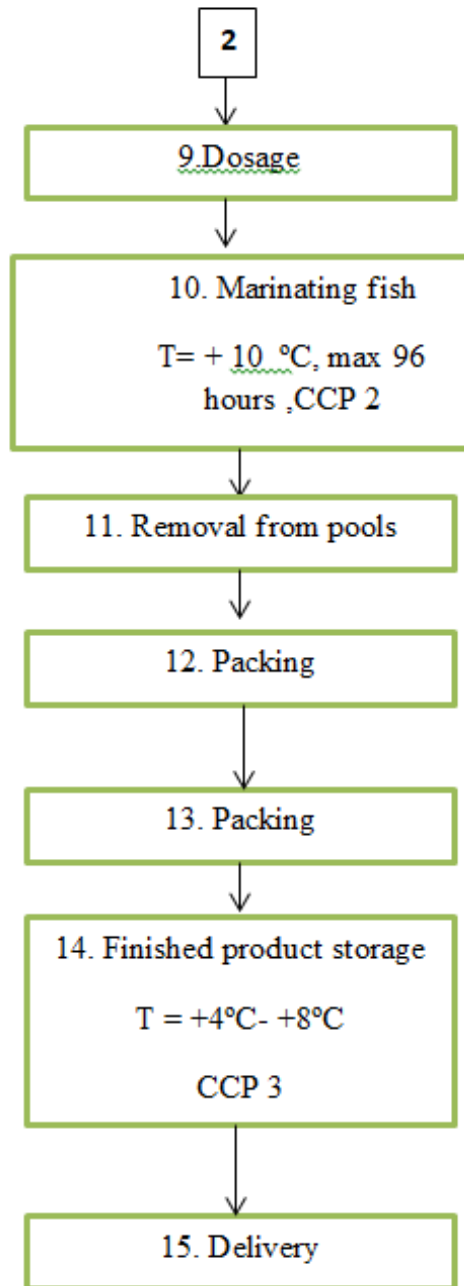
Rinsing the fish - after gutting, the resulting fish carcass is rinsed with a mixture of water and ice flakes and collected in plastic shuttles and each layer is covered with ice flakes.

After defrosting, the mackerel trunk is checked against the Anisakis parasite, portioned, washed, and prepared for marinating in the pools, in which the marinating solution is found according to the network. The product is marinated for 72 hours at a maximum temperature of 15 degrees. After marinating, the mackerel pieces together with the vegetables are packed in plastic

containers, glass, or plastic bags and vacuumed for 2 hours at a pressure of a minimum of 570 MB. Storage of the finished product is carried out at temperatures between +4 - +10 degrees Celsius, a maximum of 10 days (Figure 1).

Figure 1 Technological flow over marinade





Sources: own contribution

### 3. Results and discussion

Marinated mackerel is a product that is generally obtained from fresh fish, or frozen by hot or cold smoking. Marinating, as a preservation method, is the oldest method used to increase shelf life and improve the taste of food products. The processed products "ready for consumption" will be carefully controlled because they must not contain any risk for public health (Table 1). In the case of mackerel, the danger is represented in particular by Anisakis, a parasite frequently

found in oceanic fish and which lives in the digestive tract of marine mammals, from where it is eliminated in the aquatic environment, together with the faeces, from which the larvae emerge which, after passing through the body to some small crustaceans, fish and cephalopods, they reach the human digestive tract causing illness (2,6). Regarding processed products, we note that some processes ensure the death of Anisakis larvae, others do not. Insufficient processes that do not kill the larvae are:

- cold smoking which ensures a temperature in depth of 20 °C – 25 °C, always below 40 °C, and the prior salting of 3-7% in depth is also harmless to the larvae;
- marinating, salting, brining and smoking the products found, as a rule, on the market are not insurance, therefore these processes should only be applied to previously frozen products;
- irradiation is ineffective, the larvae being resistant to high doses (>6 Gray), which, moreover, cause serious organoleptic damage.

Processes that ensure the death of Anisakis larvae consist of processing or cooking the fish that ensures deep temperatures above 60 °C. Thus, for a 3 cm thick fillet, boiling for 7 minutes at 70 °C or 10 minutes at 60 °C is insufficient, cooking "red to the bone" is insufficient (Table 1).

Table 1 HACCP PLAN FOR MARINATED FISH

Stage	Important hazards	Control measures	CCP/CP	Critical limits	Monitoring procedures		Correction/Corrective Actions	Documents/ Records
					Method	Frequency		
<b>Frozen fish reception</b>	Salmonella E.coli Anisachis	Verification of supplier analysis bulletins	CP1	Salmonella 25/g absent E coli-abs	Verification of supplier quality certificates	To each batch	Batch rejection Selection of suppliers reception committee training	Registers of raw materials, auxiliaries and packaging
<b>Storage</b>	Salmonella E.coli	Temperature monitoring	CCP1	-18 °C +/- 3°C max 1 year	Temp monitoring freezer	Continuously	Partial defrosting - immediate processing Switching to own generating set Maintenance Personal training	Computer memory
<b>Defrosting</b>	Salmonella E. coli	Temperature monitoring	CP2	max + 15 °C	Temperature monitoring freezer	2 times/lot	Temperature adjustment Immediate processing over Maintenance	Temperature sheet
<b>Decapitation Evisceration</b>	Anisachis	Anisakis visual control	CCP2	Absent	Visual control	Continuously	Confiscation of infested fish or parts Personal training Supplier selection	Evisceration sheet
<b>Dosing marinating solution</b>	Sorbic acid	Correct dosage	CCP3	According to the recipe	Weighing	To each batch	Marine solution correction Weighing metrological check Personal training	Seaman's file/register
<b>Marinating fish</b>	Salmonella Ecoli	Temperature monitoring	CCP4	Minimum 72 hours Max. 15 °C	Emperature and duration monitoring	For each batch	Process resumption Personal training Maintenance	Register of marinated fish
<b>Vacuum</b>	Salmonella E. coli	Pressure monitoring Correct programming	CP3	min.pressure 570 mb Time - 2 sec	Visual control	For each packaging unit	Repackaging, Revision Adjustment of vacuuming device Personal inheritance maintenance	Blank sheet
<b>Finished product storage</b>	Salmonella E. coli	Temperature monitoring	CCP5	T = + 4°C - +10°C, Max 10 days.	Temperature monitoring	Continuously	Immediate intervention by adjusting the refrigeration installations Own generator set Maintenance Personal training	Computer memory Temperature diagram

Sources: own contribution

#### 4. Conclusions

The implementation of the HACCP system in fish processing units proves to be a necessary "tool" to improve the quality of food products and provide the final consumer with a safe product without hazards.

The establishment of the PCC on the technological flow was carried out following the analysis of the dangers, and for smoked fish they must be: when storing the fish after receiving the goods, when eviscerating, when salting, smoking, and storing the finished product.

The application of the HACCP system is not a stand-alone system but should be seen as a basic element of the food safety management system. It thus completes the good hygiene practices, which are the basis of the HACCP plan, targeting the product-specific hazards, thus elaborating the necessary control measures for their management and the corrective measures that must be applied to reduce the risk

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