

# Octopus vulgaris Fishing Industry Staff Hands and Equipment Surfaces Microbiological Contamination Study

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## Abstract

The contamination in the industries of treatment and transformation of halieutic products in particular the common octopus leads to an awareness of their impact on the quality of common octopus. Cleaning and disinfection are fundamental methods in the industry of treatment and conditioning of common octopus because they allow limiting contamination of products. The method of swabbing allowed realizing samples of surfaces of 25 cm<sup>2</sup> (5 cm of length and 5 cm of width) which are determined with a sterile and wet swab, bearing on 54 samples and 18 smears on the three studied technological stages: Reception, Plating, and Threshing. The rates obtained of the total aerobic mesophilic flora on the technological surfaces studied upstream is 0.175 colony-forming units per square centimeter which represents 97.9% and fecal coliforms are present in the order of 71%. These results show that the degree of efficiency is not satisfactory, the high rate of contamination by total aerobic mesophilic flora and fecal coliforms are due to the inefficiency of the cleaning and disinfection protocols used. On the other hand, the results obtained by the Total Aerobic Mesophilic Flora and fecal coliforms downstream which are respectively 2.3.10<sup>4</sup> colony-forming units per square centimeter representing 38.6% and 3.9.10<sup>4</sup> colony-forming units per square centimeter which represents 0.08%, these results reveal that the degree of effectiveness is satisfactory because the values are lower than the standards established by the committee of microbial contamination of surfaces of the laboratory section "committee of microbial contamination of surfaces of the laboratory".

## Keywords

Bio contamination • Disinfection • Hygiene • Cleaning • Surface

## Introduction

The equipment for processing and packaging of food products are likely to be the source of bio-contamination of certain microorganisms that are attached to *Listeria monocytogenes* [1]. The safety of food is currently a major concern, not only of all those who assume, at different levels, responsibilities in public health [2], but also consumers who make it one of the important criteria of their choice of purchase [3]. If the microbiological risk often appears in the public as the most worrying microbiologists and hygienists agree that it is the microbiological contamination that remains the most difficult to control today [4]. Operators of the fishing industry sector are careful to ensure the microbiological quality of food delivered to the consumer because the error is intolerable in this area [5]. Operators in the fish industry sector are obliged to implement a quality approach based on the principles of hygiene and quality control throughout the production process of common octopus [6]. The effectiveness of the cleaning depends on the training and commitment of the staff, both those who work on the production lines and those who are responsible for the cleaning process itself [7,8]. In a well-managed company, sufficient time is essential to ensure complete and effective cleaning, and the entire process is properly documented, using appropriate checklists and is specially trained, which ensures maximum efficiency [9]. The method of cleaning and disinfection has been applied

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empirically for a long time, currently, the problem of hygiene in the fishing industries is very closely related to the ineffectiveness of method cleaning and disinfection implemented). The HACCP approach (Hazard Analysis for Control Critical Point), is systematic, structured, and rationale for the control of hygiene (control of microbiological hazards to ensure quality and well adapted to the control of critical points. The advantage of cleaning and disinfection in the practice of HACCP is not to demonstrate. The objective of this study is to develop objective and efficient analytical tools to characterize the germs likely to contaminate the surfaces of equipment and the hands of staff and to assess the progress made in the fishing industry in the field of quality policy and sanitary safety of products through the approach of cleaning and disinfection.

## Materials and Methods

### Selection of equipment surfaces and personnel hands

Samples were taken from the three different sections of the plant, namely receiving, setting, and threshing. The objective of the analysis of these stages is to verify the impact of the work equipment and the hygiene of the personnel on the microbiological quality of the product. The study was carried out based on three essential questions that revolve around the principle of good hygiene and manufacturing practice:

- Is there a separation between the healthy and the dirty sectors?
- Is the principle of forwarding motion respected?
- Is there any respect for the cold chain?

These three main questions were submitted to a dozen people who are part of the team of hygiene and handling products.

### Sample preparation and enumeration of microorganisms

A total of 54 samples and 18 smears on the three technological stages studied (Reception, Plating, and Threshing) and upstream and downstream of cleaning and disinfection and hands of the staff from July 7, 2019, to August 20, 2020, at the level of the establishment of processing and packaging of octopus. The smears and samples are made on the surfaces of equipment upstream and downstream of three stages are the reception, flattening, and beating from manufacturing diagrams of frozen octopus from

a sterile swab. Swabs of 1 ml made are placed in a test tube containing 5 milliliters of the sterile diluent water-peptone buffer allowing to revive the germs at adequate conditions of time and temperature. Then 1 milliliter of this liquid is plated in a petri dish covered with Violet Red Bile Agar to look for coliforms and total aerobic mesophilic flora on agar for enumeration on plates [10-12]. The enumeration of total aerobic mesophilic flora is performed by taking 1 ml of suspension from each of the dilution tubes  $10^{-1}$  to  $10^{-4}$ , transferring them to sterile petri dishes of plate count Agar and then homogenizing by rotary movements in both directions. These plates after a few moments of solidification are incubated in the oven at 30°C for 48 hours-72 hours. Only the whitish colonies growing in depth are counted. To test and count coliforms, petri dishes are plated with  $10^{-1}$  dilution and then poured with Violet Red Bile Agar and incubated at 44°C for 24 hours-48 hours. Fecal coliforms appear dark red with a diameter greater than 0.5 mm [11].

## Results and Discussion

### Results of the enumeration of the total aerobic mesophilic flora

Currently, there are no international and national standards available regarding microbiological surface contamination available. Each laboratory makes its internal monitoring program. In our study, we were interested and referred to the standards established by the "committee of microbial contamination of surfaces of the laboratory section" for surface control in the food industry and which stipulate that [13], for 25 cm<sup>2</sup> of surface, if the number of colonies counted on agar is less than 100, the disinfection is satisfactory; if the number of colonies on agar is more than 100, the disinfection is not satisfactory; nevertheless, coliforms and others should be absent.

Table 1 represents the results of the enumeration of the total aerobic mesophilic flora on the surfaces of equipment and at the level of the hands to evaluate the hygiene of the personnel as well as the validation of the plan of cleaning and disinfection [14]. Concerning the enumeration of the total aerobic mesophilic flora, it is observed that out of 161 samples carried out at the level of the hands, there are 57 positive samples, that is to say, 35, 41%. This high rate of non-compliance is expressed by a deviation from the hygiene rules. The corrective measures taken are sensitization and training of personnel [15]. As for the samples taken on the surfaces of equipment, there are 12 positive samples, i.e. 12.24% of 98 samples taken [4]. The diagnosis of the microbiological quality of surfaces and hands reveal measures for improvement concerning the cleaning plan and disinfection, these measures are well oriented towards the control of the

**Table 1.** Results of total aerobic mesophilic flora enumeration on equipment surfaces and staff hands

Sampling	Sampling	Sampling of positive	Percentage (%)	Preventive measures
Hands	161	57	35.4	Staff training
Equipment surfaces	98	12	12.24	Training and process review

**Table 2.** Represents the levels of contamination of surfaces by the Total Aerobic Mesophilic Flora at 30°C according to the technological stages upstream.

Technological steps	Average microbial load (in colony-forming units per square centimeter)	Level of contamination	Number of samples	Percentage (%)
Reception	$8.1 \cdot 10^4$	30<F<100	198	91.9
Flattening	$7.3 \cdot 10^4$	30<F<10	178	98.3
Threshing machine	$5.6 \cdot 10^4$	30<F<10	162	89.8

**Table 3.** Levels of fecal coliform contamination (*E. coli*) at 44°C

Technological steps	Average microbial load (in colony-forming units per square centimeter)	Level of contamination	Number of samples	Percentage (%)
Reception Flattening	$6.5 \cdot 10^4$	F<10 10<F<30	46	41.3
	$5.2 \cdot 10^4$		72	22.2
Threshing machine	$1.9 \cdot 10^4$	10<F<30	61	19.6

quality of products and the hygiene of staff. The personnel of the company must not present a disease being able to contaminate the food product from where the importance to require a medical certificate to the hiring and to proceed to annual planning of the medical visit, thus it is capital to implement a program of sensitization and training on the hygiene of the internal personnel and respect of the good practice of hygiene as for the enumerations of the coliforms, the analyzed products are absent [16]. Record the results of microbiological control of the surfaces according to the technological stages of treatment upstream (Table 1).

The studied sections are reception, flattening, and threshing. These results clearly illustrate on the samples taken (Table 2), with the average microbial load which is  $1.72 \cdot 10^3$  colony-forming unit per square centimeter of germ whose level of contamination is between 10 and 30, which represents 197.9%, compared to the standard we can conclude that the cleaning and disinfection at this stage are not satisfactory [17].

### Result of the enumeration of coliforms

The following results in Table 3 represent the levels of contamination of surfaces by Fecal Coliforms (*E. coli*) at 44°C according to the technological stages upstream.

It is important that in each level of production of a fishing industry according to know precisely the fundamental characteristics to be from the reception of the raw materials to the packaging of the finished product [18,19]. The enumeration of *Escherichia coli* and other coliforms are usually considered indicators of fecal contamination. Their presence in food, therefore, raises the suspicion of possible contamination by pathogenic bacteria such as *Salmonella*. The results show the average microbial load of fecal coliforms to be  $1.2 \cdot 10^5$  colony-forming units per square centimeter, which represents 71% germ content [20]. This reflects the operation of cleaning and disinfection according to the technological steps upstream is inefficient compared to the standard (Table 3).

### Record of the results of microbiological control of the surfaces according to the technological stages of treatment downstream

The average microbial load of the mesophilic flora is  $2.3 \cdot 10^4$  colony-forming units per square centimeter which represents 38.6% of germs (Table 4); compared to the standard we can conclude that the cleaning and disinfection are satisfactory.

The average microbial load of coliform is  $3.9 \cdot 10^4$  colony-forming units per square centimeter on the 10 samples taken at three technological stages, representing 0.08%, which means that the cleaning and disinfection operation is effective compared to the standard (Table 5).

**Table 4.** Represents levels of contamination of surfaces by the total aerobic mesophilic flora at 30°C according to the technological stages downstream

Technological steps	Average microbial load (in colony- forming units per square centimeter)	Level of contamination	Number of samples	Percentage (%)
Réception	3.7.10 <sup>4</sup>	F<10	198	21.2
Mise en plat	1.8.10 <sup>4</sup>	10<F<30	172	10.46
Batteuse	1.4.10 <sup>4</sup>	F<10	62	19.3

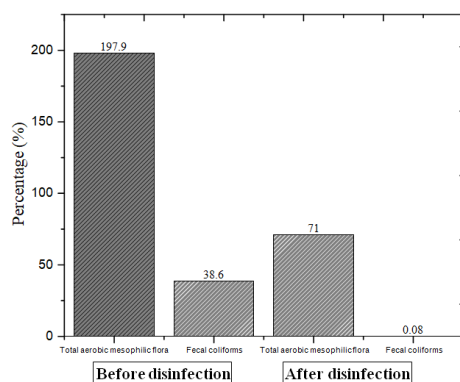
**Table 5.** Represents levels of contamination of surfaces by coliforms at 44 °C according to the technological steps downstream

Technological steps	Average microbial load (in colony- forming units per square centimeter)	Level of contamination	Number of samples	Percentage (%)
Réception	2.1.10 <sup>4</sup>	F<10	5	0.05
Mise en plat	1.4.10 <sup>4</sup>	10<F<30	3	0.03
Batteuse	1.3.10 <sup>4</sup>	F<10	2	0.02

## Comparison of satisfactory and unsatisfactory results

The comparison of the satisfactory and unsatisfactory results according to the technological stages before and after studied has to say the reception, the flattening, and the threshing stage by the Total Aerobic Mesophilic Flora and the fecal coliforms.

The enumeration of the Total Aerobic Mesophilic Flora at the level of these stages upstream and downstream allowed us to appreciate the hygienic qualities at the levels of these various technological stages and to estimate the cleanliness of the equipment and the degree of control of the good practices of hygiene and manufacture (Figure 1). These results show the values of the total microbial flora and fecal coliforms before are not satisfactory compared to the standard against the analysis of the total aerobic mesophilic flora and fecal coliforms after showing the degree of efficiency of cleaning and disinfection. The cleaning and disinfection operations are important means available to ensure compliance with the rules of hygiene in the fishing industries because the industrialist must offer the consumer food of satisfactory hygienic quality.

**Figure 1.** Demonstrate comparison the results before disinfection and after disinfection

## Conclusion

The presence of microorganisms on production surfaces in the industry of processing and packaging of environment. Indeed, the cleaning and disinfection procedures can significantly reduce the contamination of surfaces. It is, therefore, necessary that these operations are effectively conducted by the staff of the institution; each must limit the spread of germs on surfaces and maintain equipment in a good hygienic condition. Thus, all personnel must be properly qualified and trained on the tasks to be performed in the plant. The treatment of fishery products, in this case, octopus, undergoes manipulations that are a source of bacterial contamination that can threaten the health of the consumer. It is necessary to control the parameter that acts on the contamination of products including refrigeration. This last being considered as a permanent concern

of the industry of treatment and conditioning because the technique of cold must allow adequately minimizing to see blocking the contamination. This study was conducted in an octopus processing and packaging industry and consisted of a survey that allowed us to assess the level of hygiene of staff and equipment and microbiological analysis of surfaces upstream and downstream. This research opens the way to many perspectives, in particular the constitution of a team of cleaning and disinfection, the training of the personnel of the establishment to the good procedures of hygiene and manufacture, and the permanent respect of the principles of forwarding March and cold chain. Common octopus requires taking preventive measures to limit their impact on the working.

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