

Good practices of seafoods handling and microbiological conditions in the pre-operational period in a fish market

Boas práticas de manipulação de pescados e condições microbiológicas no pré-operacional em um mercado de peixes

ABSTRACT

Simone Aparecida Lopes
Rodrigues* 

Vânia Loureiro 

Simone dos Anjos Caivano 

Introduction: Seafoods are very nutritious foods, but also highly susceptible to contamination. Once contaminated, they can be agents that transmit diseases to humans. Thus, the fish trade must pay great attention to hygienic-sanitary processes to ensure these foods safety and the consumers health. **Objective:** Evaluate the good practices of seafoods handling and the microbiological conditions in the pre-operational period in a fish market, located in the city of Santos-SP, Brazil, according to the requirements proposed in the ordinance of the Center for Sanitary Vigilance number 5 of 2013. **Method:** This cross-sectional study, with a quantitative approach, covered a total of 13 seafoods boxes. It was carried out through a technical visit where the “Route of Inspection of Good Practices in Commercial Establishments of Food and Food Services” was applied, imposed by the CVS-5 ordinance of 2013, and collections of samples on contact surfaces and handlers’ hands for analyses of mesophilic aerobic bacteria. **Results:** Good practices of seafoods handling were considered appropriate; food safety performance varied between 47.2% and 70.8%, and pre-operational hygiene conditions were considered satisfactory for contact surfaces and unsatisfactory for handlers’ hands. **Conclusions:** It can be concluded that good fish handling practices are appropriate, but the microbiological conditions in the pre-operational phase are satisfactory for contact surfaces and unsatisfactory for handlers’ hands.

KEYWORDS: Foodborne Diseases; Food Safety; Food Quality; Sanitary Inspection; Contamination Indicators

RESUMO

Introdução: Os pescados são alimentos muito nutritivos, mas também altamente passíveis de contaminação. Uma vez contaminados, podem ser agentes veiculadores de doenças ao homem. Dessa forma, o comércio de pescados deve possuir grande atenção quanto aos processos higiênico-sanitários para garantir a segurança destes alimentos e a saúde do consumidor. **Objetivo:** Avaliar as boas práticas de manipulação dos pescados e as condições microbiológicas no pré-operacional em um mercado de peixes, localizado na cidade de Santos-SP, Brasil, de acordo com os requisitos propostos na Portaria do Centro de Vigilância Sanitária (CVS) nº 5, de 9 de abril de 2013. **Método:** O estudo foi de caráter transversal, com abordagem quantitativa, e abrangeu um total de 13 boxes de pescados. Foi realizado por meio de visita técnica na qual foi aplicado o “Roteiro de Inspeção das Boas Práticas em Estabelecimentos Comerciais de Alimentos e Serviços de Alimentação”, imposto pela Portaria CVS no 5/2013, e foram coletadas amostras em superfícies de contato e nas mãos de manipuladores para análises de bactérias aeróbias mesófilas. **Resultados:** As boas práticas de manipulação dos pescados foram consideradas regulares, o desempenho em segurança dos alimentos variou entre 47,2% e 70,8% e as condições de higiene pré-

Curso de Nutrição, Faculdade de Educação e Ciências Humanas, Universidade Metropolitana de Santos, Santos, SP, Brasil

* E-mail: sirodrigues.nutri@gmail.com

Received: Jan 18, 2023

Approved: Nov 09, 2023

How to cite: Rodrigues SAL, Loureiro V, Caivano SA. Good practices of seafoods handling and microbiological conditions in the pre-operational period in a fish market. *Vigil Sanit Debate*, Rio de Janeiro, 2024, v.12: e02147. <https://doi.org/10.22239/2317-269X.02147>



operacional foram consideradas satisfatórias para as superfícies de contato e insatisfatórias para as mãos dos manipuladores. **Conclusões:** As boas práticas de manipulação de pescados estão regulares, porém as condições microbiológicas no pré-operacional são satisfatórias para as superfícies de contato e insatisfatórias para as mãos dos manipuladores.

PALAVRAS-CHAVE: Doenças Transmitidas por Alimentos; Inocuidade dos Alimentos; Qualidade dos Alimentos; Fiscalização Sanitária; Indicadores de Contaminação

INTRODUCTION

Fish consumption has increased considerably worldwide in recent decades, outstripping population growth and outstripping other animal proteins; in *per capita* terms, it rose from 9.0 kg in 1961 to 20.5 kg in 2018¹. Brazil has also seen a significant and growing increase in the production, professionalization of the sector, and domestic consumption of this food^{2,3}.

Among the factors responsible for the increase in fish consumption is consumer awareness of the health benefits it can bring¹. It is a very nutritious food but it is also highly susceptible to contamination throughout the production chain, causing damage when it deteriorates or becoming a carrier of diseases to humans⁴.

Waterborne and foodborne diseases (WFD) are caused by ingesting contaminated water or food and are responsible for a high number of morbidities and mortalities worldwide². According to data from the Ministry of Health's Health Surveillance Secretariat, the main etiological agents involved in WFD outbreaks are *Escherichia coli*, *Salmonella* spp., and *Staphylococcus aureus*⁵. In fish, the main bacteria identified are: *E. coli*, Coagulase Positive Staphylococcus (CPS), and *Salmonella* spp., and the main factors responsible for contamination with these microorganisms are inadequate conservation, lack of training for the handlers, and inadequate hygiene in the preparation areas⁶.

To reduce the risks of contamination and outbreaks of WFD, it is necessary to implement and control good hygiene practices throughout the production and commercial chain, as well as health education for all those involved in handling these foods⁷, as contamination can occur throughout the production process due to poor handling and inadequate hygiene of contact utensils and the hands of handlers^{8,9}.

Cross-contamination of food through contact surfaces is dangerous and high-risk, as the microorganism can remain viable for a long time due to the formation of biofilm in these places^{8,9}. As a form of control, the operational hygiene conditions of these surfaces can be checked by analyzing mesophilic aerobic bacteria, as this group includes the majority of pathogenic microorganisms of sanitary importance, making it an excellent indicator of unsatisfactory hygiene conditions¹⁰.

Public fish markets, due to the large circulation of people and the constant handling of fish, become places of great importance in the control and inspection of hygienic and sanitary conditions¹¹. In this sense, the marketing of fish in public markets should receive great attention from traders and the responsible

inspection bodies, in order to guarantee consumers the quality and safety of the food sold¹².

The municipality of Santos is located on the coast, 72 km from the capital of São Paulo (SP), and port activities, tourism services, and fishing in general are its main economic sources¹³. The city has a municipal fish market, responsible for selling a large part of the local fish production since 1982. Reopened in 2020, it has received new and modern facilities, aimed at improving hygiene and working conditions¹⁴.

Considering the above, this study aimed to evaluate the good practices of seafoods handling and the microbiological conditions in the pre-operational area of a fish market located in the city of Santos, in accordance with the requirements proposed in the ordinance of the Health Surveillance Center (CVS) No. 5 of April 9, 2013¹⁵.

METHOD

This is a cross-sectional study with a quantitative approach, carried out in a municipal fish market in Santos.

Thirteen of the market's 20 fish stalls took part in the survey. The remaining seven establishments did not agree to take part or their managers could not be found for authorization.

The data was obtained through a technical visit, carried out by a trained evaluator, to the 13 boxes participating in the municipal fish market between August 23 and 27, 2021, as detailed below.

Compliance analysis: application of the "Route of Inspection of Good Practices in Commercial Establishments of Food and Food Services" checklist¹⁵

This instrument was applied on a pre-established date and time with the managers of each establishment and the 55 items on the checklist were assessed, divided into six chapters, as shown in Chart 1. Following the protocol, to obtain the answers, a visual inspection and interview were carried out with those responsible for the fish stalls and supporting documents were requested for the items that required documentary analysis.

Scores were given for the conditions observed during the checklist. For each item considered "compliant", one point was awarded and "non-compliant" items received a score of zero. When the item was considered "not applicable", one point was subtracted from the total score to avoid bias in interpretation¹⁶. The boxes were identified by random letters from the alphabet,



different from the numbers identifying each establishment, to ensure confidentiality.

The data collected was double-entered to validate the information. For the analysis, the Microsoft Office Excel® program was used, in which the percentages of adequacies and inadequacies were calculated using the total number of points obtained (PO) divided by the total number of possible points (PP) multiplied by one hundred (PO/PPx100)¹⁶. The establishments assessed were classified according to the criteria shown in Chart 2.

To assess the risk to food safety, the checklist items were divided into four groups, according to the risk factors for WFD outbreaks, as shown in Chart 3. Food safety performance was determined based on the average percentage of adequacy of risks A and B, as these groups cover aspects of food handling and handler behavior, practice, and performance, while risks C and D deal with issues of structure and management and were therefore not assessed¹⁶.

Microbiological conditions

In order to assess the effectiveness of the sanitization carried out on the surfaces of utensils and equipment and on the hands of the handlers, a microbiological collection was carried out early in the morning and in a pre-operational environment, i.e., on sanitized surfaces and before starting work.

In each participating box, samples were taken from a randomly selected contact surface and from the dominant hand of a handler who had direct contact with the fish, totaling 26 samples. The samples were swabbed using a sterile swab soaked in 0.1% peptone water (Merck®), in an area delimited by sterile 20 cm²

molds (Laborclin®) on the contact surfaces and along the entire length of the palm, including the space between the fingers and nails.

After each point was collected, the part of the swab containing the sample was broken into a capped tube containing 40 mL of sterile 0.1% peptone water, duly identified. The tubes were sent under refrigeration to the microbiology laboratory at the Metropolitan University of Santos (Unimes).

In the laboratory, the samples were coded to facilitate their traceability and to guarantee the impartiality of the tests carried out, and analyzed using three decimal dilutions (10⁰, 10⁻¹, and 10⁻²), with the initial dilution (10⁰) corresponding to the suspension containing 40 mL of 0.1% peptone water plus the swab with the sample collected.

At the end of each dilution, 1 mL of the suspension was inoculated in duplicate, using a pipettor and sterile tips, into a sterile, empty Petri dish labeled for the point/dilution/duplicate. One tip was used for each sample and dilution. Next, approximately 15 mL of melted standard plate count agar (PCA) (Merck®) was poured into the inoculated plates and carefully mixed with the inoculum. After the PCA had solidified, the plates were incubated inverted in a heated, temperature-controlled oven at 35°C ± 1°C for 48 h ± 2h.

At the end of the incubation period, the Petri dishes were removed from the oven, sorted as recommended by Silva et al.¹⁸, and the colony-forming units (CFU) found on the plates were quantified. The numbers of colonies found in the duplicates of the decimal dilution selected were added together and the result of the sample is the arithmetic mean of the count of the two plates.

The results were expressed as CFU/cm² (surfaces) and CFU/hand (hands). For contact surfaces, the result obtained in CFU/mL was converted by multiplying by two (where: sampled area = 20 cm²; Diluent = 40 mL = 20/40 = 0.5 cm per mL = 0.5 x 2 = 1cm). For hands, the result was calculated by multiplying the result found by 40 (total volume of the initial diluent). The results were presented using exponential notation, with one decimal place after the comma and approximating upwards when the second decimal place was equal to or greater than five (e.g. 59.5 = 6.0 x 10¹).

Chart 1. Distribution of the chapters of the checklist "Route of Inspection of Good Practices in Commercial Establishments of Food and Food Services". Santos, SP, Brazil, 2021.

Chapter	Item
2	Employee hygiene and health, technical responsibility, and staff training
3	Sanitary quality of food production
4	Cleaning of facilities and the environment
5	Operational support
6	Sanitary quality of buildings and facilities
7	Documentation and recording of information

Source: CVS Ordinance No. 5/2013¹⁵.

Chart 2. Classification criteria according to the percentage of items met. Santos, SP, Brazil, 2021.

Score (%)	Classification
91-100	Excelent
76-90	Good
51-75	Regular
0-50	Bad

Source: Adapted from RDC No. 275/2002¹⁷.

Chart 3. Criteria for classifying types of food safety risks. Santos, SP, Brazil, 2021.

Risks	Criteria
A	Items related to time and temperature aspects
B	Items that affect direct contamination of food through the handler, equipment, and utensils
C	Items related to contaminated water and inappropriate ingredients
C	Items that affect indirect contamination, such as structure and facilities, and management

Source: Cunha, Rosso, and Stedefeldt¹⁶.



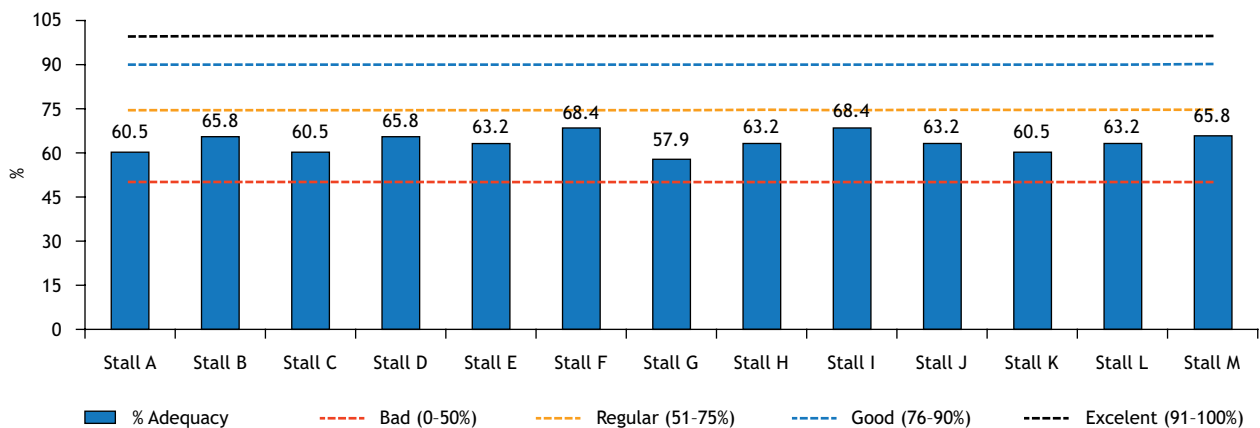
The samples were collected and analyzed as described by Silva et al.¹⁸. The results obtained were tabulated, considering the point and dilution, using the Microsoft Office Excel® program. The results from the contact surfaces were evaluated according to the standards established by Silva Júnior¹⁹ and the Pan American Health Organization (PAHO)²⁰, which classify points with results $\leq 5.0 \times 10^1$ CFU/cm² (≤ 50 CFU/cm²) as satisfactory and unsatisfactory $> 5.0 \times 10^1$ CFU/cm² (> 50 CFU/cm²), and hand results were assessed according to the standards set by the American Public Health Association (APHA)²¹, which establishes results $\leq 1.0 \times 10^2$ CFU/hand (100 CFU/hand) as satisfactory.

This project was approved by the Unimes Research Ethics Committee, under opinion No. 4.742.718.

RESULTS

Compliance analysis

In the analysis of compliance with good handling practices¹⁷, all the establishments assessed were classified as “Regular” (scores between 57.9% and 68.4%), as can be seen in Figure 1. The average percentage of compliance per chapter of the ordinance is shown in Chart 4.



Source: Adapted from RDC No. 275/2002¹⁷.

Figure 1. Percentage of adequacy in good handling practices per fish marketing stall at the Santos Municipal Fish Market. Santos, SP, Brazil, 2021.

Chart 4. Average percentage of adequacy by chapter of CVS Ordinance No. 5 of 2013¹⁵. Santos, SP, Brazil, 2021.

Chapter	Description	% adequacy average
2	Employee hygiene and health, technical responsibility, and staff training	43.3
3	Sanitary quality of food production	79.5
4	Cleaning of facilities and the environment	30.8
5	Operational support	66.7
6	Sanitary quality of buildings and facilities	78.6
7	Documentation and recording of information	0.0

Source: Adapted from RDC No. 275/2002¹⁷. CVS: Health Surveillance Center.

Hygiene and health of employees, technical responsibility, and staff training

Inadequate staff grooming was found in 100.0% of the establishments, where food handlers were seen wearing adornments, with long enameled nails, beards, and unprotected hair. As for uniforms and personal protective equipment (PPE), 53.8% of the handlers were found to be using knives without steel mesh gloves. During the handling activities evaluated, adequate and frequent hand asepsis procedures were not observed in 100.0% of the establishments, and there were no educational posters on correct hand hygiene in any of them, in the bathroom sinks or changing rooms.

All the establishments evaluated had a technical manager who was demonstrably qualified to implement good practices, however, none of them had a described program for training staff in good practices and there was no evidence that the training had been replicated for other employees.

Sanitary quality of food production

The fish is received in the establishment itself, in cool boxes with ice. Quantitative, qualitative, and sensory evaluation (color, smell, appearance, texture) of the products is carried out before they are released but the temperature is not checked



upon receipt in 100.0% of the establishments. It is worth noting that this item was assessed by interview, as it was not possible to monitor receipt during any of the technical visits.

Sanitizing the facilities and the environment

The facilities, equipment, furniture, and utensils in general were in a good state of repair and in good hygienic-sanitary condition in all the establishments evaluated, however, there is no standardized hygiene procedure in 84.6% of them. The sanitization stage is not carried out correctly, with household sodium hypochlorite being used without standardized dilution and application time. Only 15.4% used sanitizers suitable for commercial establishments, with standardized and automated dosing. As for the sanitizing products, 76.9% of the establishments had adequate labelling and storage, which were duly labelled, stored in a specific place, registered with the Brazilian National Health Surveillance Agency (Anvisa), and with all the mandatory labelling information.

Regarding staff training in hygiene procedures, 100.0% of the establishments had inadequate training.

Operational support

The water used in the establishments comes from the public supply network, controlled by the public administration of the fish market, and is stored in four reservoirs that are cleaned annually. However, at the time of the assessment, it was found that this procedure had not been carried out since the new market opened more than a year ago, and there are no records of any initial cleaning. This situation means that this item is inadequate for all the stalls.

The ice used by the establishments is purchased by third-party suppliers and it was not possible to confirm its origin in any of the establishments. In addition, the unloading of ice from a supplier was monitored and inadequate handling practices were observed, in which the boxes were placed directly on the floor and then stacked, creating a risk of contamination for the ice in the lower boxes.

The market's sewage system also belongs to the municipal public network, along with the collection, removal, and storage of organic materials, as well as the control of vectors and urban pests, and are in accordance with CVS Ordinance No. 5/2013¹⁵.

Sanitary quality of buildings and facilities

A few herons were observed in the outdoor area but even after being chased away by staff, they still remained in the area. No other sources of vectors, garbage, disused objects, rodents, or domestic animals were identified.

As for the facilities, 100.0% of the establishments did not have washbasins exclusively for hand hygiene. No other inadequacies were observed in this item.

Regarding the hygiene of cleaning materials, all the establishments did it properly. Regarding the materials used for equipment, utensils, and furniture, 100.0% of the establishments were inadequate, because the Styrofoam boxes used to package the fish are made of porous material and do not allow for proper hygiene, offering a risk of microorganisms proliferating and, consequently, contaminating the products.

No inadequacies were observed regarding the infrastructure of the boxes, changing rooms, toilets, sanitary facilities for customers, or the ventilation system of the premises.

Documentation and recording of information

None of the establishments evaluated had a good practices manual or documented standard operating procedures.

Food safety performance

The establishments' food safety performance was obtained from the average percentage of adequacy of the items covering the aspects of food handling and handler behavior, practice, and performance (risk groups A and B - Chart 3). There was a variation between 47.2% and 70.8%, as shown in Figure 2.

Microbiological conditions

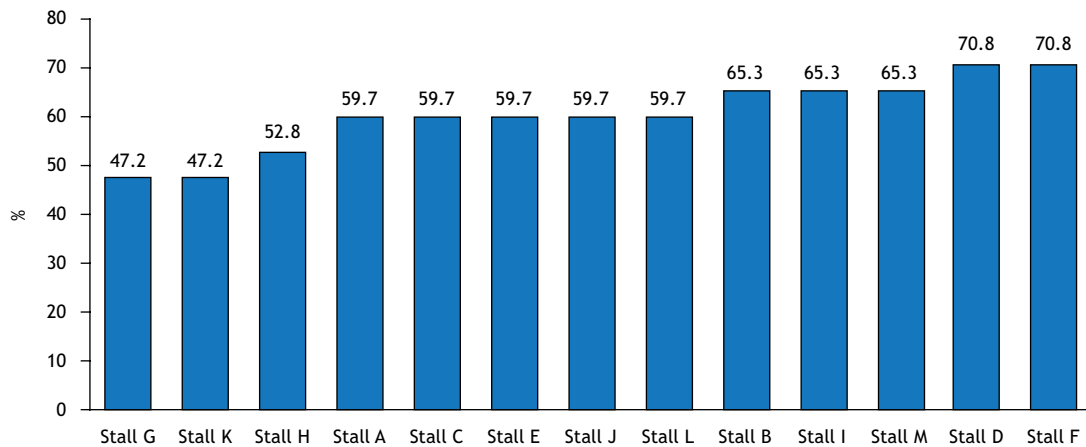
From the analysis of the contact surfaces, only one stall (7.7%) showed an unsatisfactory result for the total mesophilic aerobic count; however, all the handlers' hands analyzed showed unsatisfactory results, as shown in Chart 5.

DISCUSSION

Inadequate hygiene aspects on the part of the handlers are considered potential contamination risks during food handling and should be avoided¹⁵. Similar inadequacies were also found in other studies on hygienic-sanitary conditions in commercial food services^{22,23}. Handlers who are well trained in good practices use more efficient hygiene methods to ensure food safety, especially when they are under the supervision of qualified professionals.²⁴

Failures in the sanitizing process can also become potential risks of physical, chemical, or biological contamination. It is essential that, in addition to paying attention to the correct cleaning procedure, the recommended dilutions for chemical products used during pre-operational and operational processes are observed, so that there is no chemical contamination of food, bacterial resistance, or occupational accidents²⁵. A documented and implemented operating procedure and trained employees can minimize these risks.

Other sources of risk for food contamination in the fish production process are the water and ice used. Water tanks should be sanitized every six months or in the event of accidents that contaminate the water¹⁵, as water is essential in commercial food



Source: Adapted from Cunha, Rosso, and Stedefeldt¹⁶.

Figure 2. Percentage of food safety performance per fish marketing stall at the Santos Municipal Fish Market. Santos, SP, Brazil, 2021.

Chart 5. Results of total count of mesophilic aerobes on contact surfaces and handlers' hands in the fish sales stall at the Santos Municipal Fish Market. Santos, SP, Brazil, 2021.

Stall	Point identification	Result	Expression	Result classification
Stall A	Tray	0 CFU/cm ²	< 1 CFU/cm ² (est.)	Satisfactory
Stall A	Right hand	320 CFU/hand	3.2 x 10 ² CFU/ hand	Unsatisfactory
Stall B	Knife	2 CFU/cm ²	2.0 x 10 ⁰ CFU/cm ² (est.)	Satisfactory
Stall B	Right hand	1,400 CFU/ hand	1.4 x 10 ³ CFU/ hand	Unsatisfactory
Stall C	Tray	0 CFU/cm ²	< 1 CFU/cm ² (est.)	Satisfactory
Stall C	Right hand	160 CFU/ hand	1.6 x 10 ² CFU/ hand	Unsatisfactory
Stall D	Tray	7 CFU/cm ²	7.0 x 10 ⁰ CFU/cm ² (est.)	Satisfactory
Stall D	Right hand	1,640 CFU/ hand	1.6 x 10 ³ CFU/ hand	Unsatisfactory
Stall E	Tray	0 CFU/cm ²	< 1 CFU/cm ² (est.)	Satisfactory
Stall E	Right hand	1,740 CFU/ hand	1.7 x 10 ³ CFU/ hand	Unsatisfactory
Stall F	Knife	0 CFU/cm ²	< 1 CFU/cm ² (est.)	Satisfactory
Stall F	Right hand	900 CFU/ hand	9.0 x 10 ² CFU/ hand	Unsatisfactory
Stall G	Tray	5,230 CFU/cm ²	5.2 x 10 ³ CFU/cm ²	Unsatisfactory
Stall G	Right hand	296,000 CFU/ hand	3.0 x 10 ⁵ CFU/ hand	Unsatisfactory
Stall H	Knife	0 CFU/cm ²	< 1 CFU/cm ² (est.)	Satisfactory
Stall H	Right hand	620 CFU/ hand	6.2 x 10 ² CFU/ hand	Unsatisfactory
Stall I	Glove	3 CFU/cm ²	3.0 x 10 ⁰ CFU/cm ² (est.)	Satisfactory
Stall I	Right hand	10,400 CFU/ hand	1.0 x 10 ⁴ CFU/ hand	Unsatisfactory
Stall J	Tray	1 CFU/cm ²	1.0 x 10 ⁰ CFU/cm ² (est.)	Satisfactory
Stall J	Right hand	28,000 CFU/ hand	2.8 x 10 ⁴ CFU/ hand	Unsatisfactory
Stall K	Knife	13 CFU/cm ²	1.3 x 10 ¹ CFU/cm ² (est.)	Satisfactory
Stall K	Right hand	560 CFU/ hand	5.6 x 10 ² CFU/ hand	Unsatisfactory
Stall L	Cutting board	0 CFU/cm ²	< 1 CFU/cm ² (est.)	Satisfactory
Stall L	Left hand	16,800 CFU/ hand	1.7 x 10 ⁴ CFU/ hand	Unsatisfactory
Stall M	Tray	1 CFU/cm ²	1.0 x 10 ⁰ CFU/cm ² (est.)	Satisfactory
Stall M	Right hand	440 CFU/ hand	4.4 x 10 ² CFU/ hand	Unsatisfactory

Source: Adapted from Silva et al.¹⁸,
 CFU: colony-forming units; est.: Estimated.
 Reference: contact surfaces: ≤ 5.0 x 10¹ (50 CFU/cm²); hands: ≤ 1.0 x 10² (100 CFU/hand).



establishments and its quality is directly related to food safety²⁶. In the marketing of fish, ice has the same sanitary importance as water, as it comes into direct contact with the food to ensure its preservation. A study carried out microbiological analyses on ice used to preserve fish in a fish market in the state of Pará and confirmed the presence of *E. coli* and thermotolerant coliforms in all the samples analyzed²⁷, reinforcing the need for greater control of this input.

In order to guarantee control of all stages of the production process and avoid food contamination, documents and information records, such as the good practices manual and standard operating procedures, must be drawn up, updated, and implemented by the technical manager of the commercial food establishment¹⁵, however, in this study it was found that none of the establishments had these documents. Training for handlers should also be offered by the establishment's technical manager on admission and periodically, to ensure understanding and compliance with these documents^{15,28}.

The manual of good practices discusses the specific activities carried out by the commercial food establishment and includes, as a minimum, the basic hygiene and control requirements to guarantee the quality and safety of the food handled and marketed. Standard operating procedures are documents that establish systematic instructions for carrying out routine and specific activities in food handling¹⁵.

Fish market stalls are classified as commercial food establishments and are not required to have a professional technical manager. All that is required is proven training in good practices from an employee who actually works there, fully monitors the production/handling processes, and fully implements the parameters and criteria established in CVS Ordinance No. 5/2013¹⁵. This training is offered by the municipal health surveillance department, takes place every 36 months and there was no evidence of it being replicated for the other handlers.

CVS Ordinance No. 5/2013¹⁵ establishes that the technical manager (RT) of food services, whether professional or not, must have the authority and competence to draw up, implement, and maintain the manual of good practices and standard operating procedures; train employees in good practices; accompany inspections carried out by health authorities and provide the necessary information on the production process and procedures; notify epidemiological surveillance bodies of outbreaks of WFD.

Cunha, Rosso, and Stedefeldt¹⁶ evaluated food safety performance in different types of commercial food services and concluded that the presence of a professional technical manager in food safety management made a positive contribution.

Nutritionists are professionals with technical knowledge of food safety and food service management, and are qualified to implement good practices and ensure that they are maintained in commercial food establishments¹⁶, as are other professionals

qualified by their respective professional councils, such as biologists, veterinarians, and food engineers.

This study assessed the microbiological conditions of hands and contact surfaces in a pre-operational environment by counting mesophilic aerobic microorganisms. In Brazil, there is no legally established microbiological standard for this analysis, and the standards described in Brazilian literature and by international bodies were used. Based on these standards, the results obtained indicate that surfaces are being properly sanitized, however, they reveal a failure in hand hygiene, which puts the health of consumers at risk²⁹. The results found may be associated with the inadequacy observed in the items on the cleanliness of the handlers, the absence of both guidance posters on the hand hygiene procedure and effective training, as well as adequate sinks in the handling area for this function. A study carried out analyses of mesophilic aerobic bacteria on the hands of food handlers in a supermarket, before sanitizing and without training and after sanitizing and after training, and obtained results above the reference value in 94.44% and 55.55%, respectively, reinforcing that well-instructed handlers regarding good practice procedures reduce the risk of food contamination³⁰.

The satisfactory result obtained in the analysis of contact surfaces exceeded the expectations of the study, since unsatisfactory results are found in other similar studies^{29,31}. Most of the surfaces evaluated were clean, dry, and in a perfect state of repair, made of smooth material and easy to sanitize, reinforcing good pre-operational hygiene conditions.¹⁵

The study found some limiting aspects to data collection since the people responsible for the establishments were wary of receiving an evaluation of good handling practices, even though they were aware that it was not carried out legally. Everyone had been informed in advance of the dates and times of the checklist and sample collection, which may have influenced the scope of the results.

However, it also had positive points, since there are no records of studies evaluating the hygiene and sanitary conditions of the fish market, in new or old facilities, making this study unprecedented in this market. In addition, the evaluation was carried out with an educational purpose in mind, seeking to highlight the conformities found, provide guidance on the measures needed to adapt the non-conformities, and improve the hygienic-sanitary quality of the whole process, seeking to guarantee consumer health safety, a longer shelf life for the fish sold, and, consequently, greater credibility for the establishments.

CONCLUSIONS

The good handling practices with a regular rating, as well as the performance of the stalls in terms of food safety, did not meet expectations. The pre-operational microbiological conditions of the contact surfaces were mostly positive, however, the microbiological results of the handlers' hands reflect the need for intervention in education and implementation of the manual



of good practices and standard operating procedures, as well as the training of all handlers by a professional technical manager at the Santos Fish Market.

Although the new facilities at the Santos Municipal Fish Market have contributed to better hygiene and sanitation in the fish trade, this study has identified some opportunities for improvement,

especially regarding an adequate structure for hand sanitization during the commercial process in the establishments.

It is also necessary to continue this study by checking the microbiological quality of the water and ice used in the fish trade and by effectively implementing training and effectiveness assessments for all food handlers.

REFERENCES

1. Food and Agriculture Organization of the United Nations - FAO. The state of world fisheries and aquaculture 2020: sustainability in action. Rome: Food and Agriculture Organization of the United Nations; 2020[acesso 21 mar 2021]. Disponível em: <http://www.fao.org/3/ca9229en/CA9229EN.pdf>
2. Instituto Brasileiro de Geografia e Estatística - IBGE. Sidra: pesquisa da pecuária municipal. Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística; 2019[acesso 21 mar 2021]. Disponível em <https://sidra.ibge.gov.br/pesquisa/ppm/quadros/brasil/2018>
3. Empresa Brasileira de Pesquisa Agropecuária Pesca e Aquicultura - Embrapa. CIAqui Centro de Inteligência e Mercado da Aquicultura: comércio exterior: exportação. Brasília: Empresa Brasileira de Pesquisa Agropecuária; 2019[acesso 21 mar 2021]. Disponível em: <https://www.embrapa.br/cim-centro-de-inteligencia-e-mercado-em-aquicultura/comercio-exterior/exportacao>
4. Hernandez-Nava RG, Salgado-Cruz MDLP, Díaz-Ramírez M, Cortés-Sánchez ADJ. Food safety and fish production the case of *Staphylococcus aureus*: a review. *OnLine J Biol Sci.* 2020;20(4):291-306. <https://doi.org/10.3844/ojbsci.2020.291.306>
5. Ministério da Saúde (BR). Boletim epidemiológico 32. Brasília: Ministério da Saúde; 2020[acesso 22 jul 2023]. Disponível em: <https://www.gov.br/saude/pt-br/centrais-de-conteudo/publicacoes/boletins/epidemiologicos/edicoes/2020/boletim-epidemiologico-svs-32.pdf/view>
6. Aguiar AKR, Borba GID. Qualidade microbiológica e aspectos sanitários da comercialização de pescado e comida japonesa no Brasil. *Hig Alimentar.* 2018;32(280/281):52-6.
7. Cortés-Sánchez AJ, Espinosa-Chaurand LD, Díaz-Ramírez M, Torres-Ochoa E. *Plesiomonas*: a review on food safety, fish-borne diseases, and tilapia. *Sci World J.* 2021;2021:1-10. <https://doi.org/10.1155/2021/3119958>.
8. Fernandes DS, Castro VS, Cunha Neto A, Figueiredo ES. *Salmonella* spp. in the fish production chain: a review. *Cienc Rural.* 2018;48(8):1-11. <https://doi.org/10.1590/0103-8478cr20180141>
9. Getie M, Abebe W, Tessema B. Prevalence of enteric bacteria and their antimicrobial susceptibility patterns among food handlers in Gondar town, Northwest Ethiopia. *Antimicrob Resist Infect Control.* 2019;8:1-6. <https://doi.org/10.1186/s13756-019-0566-7>
10. Losito P, Visciano P, Genuardo M, Satalino R, Migailo M, Ostuni A et al. Evaluation of hygienic conditions of food contact surfaces in retail outlets: six years of monitoring. *LWT.* 2017;77:67-71. <https://doi.org/10.1016/j.lwt.2016.11.029>
11. Silva Junior AS, Barbosa FF, Monteiro JF. Aspectos higiênico-sanitários na comercialização no mercado de pescado Igarapé das Mulheres, Macapá-AP. *Biota Amaz.* 2016;6(4):1-19. <https://doi.org/10.18561/2179-5746/biotaamazonia.v6n4p15-19>
12. Evangelista-Barreto NS, Damascena SS, Cardoso LG, Marques VF, Silva IP. Condições de higiene-sanitária e grau de frescor do pescado comercializado na peixaria de Cachoeira, Bahia. *Rev Bras Higiene Saúde Anim.* 2017;11(1):60-75. <https://doi.org/10.5935/1981-2965.20170007>
13. Prefeitura de Santos. Uma metrópole em crescimento com a simplicidade caieira. Santos: Prefeitura Municipal; 2019[acesso 17 abr 2021]. Disponível em: <https://www.santos.sp.gov.br/?q=hotsite/conheca-santos>
14. Prefeitura de Santos. Novo mercado de peixes em Santos. Santos: Prefeitura Municipal; 2020[acesso 22 jul 2023]. Disponível em: <https://www.santos.sp.gov.br/?q=noticia/novo-mercado-de-peixes-em-santos-abre-neste-sabado>
15. Secretaria de Estado da Saúde de São Paulo - SES-SP. Portaria CVS N° 5, de 9 de abril de 2013. Aprova o regulamento técnico sobre boas práticas para estabelecimentos comerciais de alimentos e para serviços de alimentação, e o roteiro de inspeção. *Diário Oficial Estado.* 19 abr 2013.
16. Cunha DT, Rosso VV, Stedefeldt E. Desempenho em segurança alimentar e risco de serviços de alimentação de diferentes naturezas e o papel do nutricionista como líder em segurança alimentar. *Cienc Saúde Colet.* 2018;23(12):4033-42. <https://doi.org/10.1590/1413-812320182312.21042016>
17. Agência Nacional de Vigilância Sanitária - Anvisa. Resolução RDC N° 275, de 21 de outubro de 2002. Dispõe sobre o regulamento técnico de procedimentos operacionais padronizados aplicados aos estabelecimentos produtores/industrializadores de alimentos e a lista de verificação das boas práticas de fabricação em estabelecimentos produtores/industrializadores de alimentos. 2002. *Diário Oficial União.* 23 out 2002.
18. Silva N, Junqueira VA, Silveira NA, Taniwaki MH, Gomes RR, Okazaki MM. Manual de métodos de análises microbiológicas de alimentos e água. 5a ed. São Paulo: Blucher; 2017.



19. Silva Junior EA. Manual de controle higiênico-sanitário em alimentos. 4a ed. São Paulo: Varela; 2001.
20. Codex Alimentarius Commission. *Codex alimentarius*: higiene dos Alimentos: textos básicos. Rome: Codex Alimentarius Commission; 2020.
21. American Public Health Association - APHA. Compendium of methods for the microbiological examination of foods. Washington: American Public Health Association; 2001.
22. Souza LM, Amaral CAA, Liboredo JC. Conhecimento de manipuladores de alimentos sobre higiene e condições sanitárias na produção de comida japonesa. *Braz J Develop*. 2019;5(12):30684-96. <https://doi.org/10.34117/bjdv5n12-182>
23. Oliveira Rosa MY, Ferreira ACA, Ferreira LG, Lobato FHS. Avaliação higiênico-sanitária da comercialização de peixes no Mercado Municipal de Icoaraci, Belém (PA). *Diversitas J*. 2021;6(2):2877-99. Disponível em: <https://doi.org/10.17648/diversitas-journal-v6i2-1796>
24. Ferreira R, Franco N. A importância das boas práticas de manipulação dos alimentos ao combate de doenças: revisão de literatura. *Rev Interdis Saúde*. 2021;8(1):365-78. <https://doi.org/10.35621/23587490.v8.n1.p365-378>
25. Santos FF, Queiroz RCS, Almeida JA. Avaliação da aplicação das técnicas da Produção Mais Limpa em um laticínio no Sul da Bahia. *Gest Prod*. 2018;25(1):117-31. <https://doi.org/10.1590/0104-530X2234-16>
26. Macedo IME, Shinohara NKS, Oliveira FHPC. Bacteriological evaluation of drinking water in food services. *Res Soc Develop*. 2020;9(11):1-13. <https://doi.org/10.33448/rsd-v9i11.10253>
27. Penha ICS, Gonçalves CG, Rosa RMSS, Silva SER, Bichara CMG. Microbiologia do gelo utilizado na conservação do pescado em um mercado municipal de Belém, PA. *Braz J Develop*. 2020;6(9):66713-24. <https://doi.org/10.34117/bjdv6n9-200>
28. Agência Nacional de Vigilância Sanitária - Anvisa. Resolução RDC Nº 216, de 15 de setembro de 2004. Regulamento técnico de boas práticas para serviços de alimentação. *Diário Oficial União*. 16 set 2004.
29. Medeiros MGGA, Carvalho LRF, Robson M. Percepção sobre a higiene dos manipuladores de alimentos e perfil microbiológico em restaurante universitário. *Ciêns Saúde Colet*. 2017;22(2):383-92. <https://doi.org/10.1590/1413-81232017222.17282015>
30. Torres FPS, Gonçalves EV, Lopes MO, Galvão JA. Análise microbiológica das mãos de manipuladores de alimentos em supermercados. *Hig Alimentar*. 2020;34(291):1-10. <https://doi.org/10.37585/HA2020.02microbiologica>
31. Guimarães BS, Ferreira RS, Soares LS. Perfil microbiológico de utensílios em unidade de alimentação e nutrição comercial e institucional de Salvador, BA. *Hig Alimentar*. 2018;32(284/285):36-40.

Authors' Contribution

Rodrigues SAL, Loureiro V, Caivano SA - Conception, planning (study design), acquisition, analysis, data interpretation, and writing of the work. All the authors approved the final version of the work.

Conflict of Interest

The authors inform that there is no potential conflict of interest with peers and institutions, political or financial, in this study.



CC BY license. With this license, the articles are open access, which allows unrestricted use, distribution and reproduction in any medium as long as the original article is properly cited.