

## Evaluation of the manipulation that is given to the fishery product in terms of quality and safety at the time of its capture by the artisanal fisherman of the Gulf of Nicoya, Costa Rica

Fabián Chavarría<sup>1\*</sup>, Cristian Fonseca<sup>2</sup>, Diana Chinchilla<sup>1</sup>, Ma. Andrea Herrera<sup>1</sup>

<sup>1</sup> *UNA-Campus Sostenible Program, Vicerrectoría de Administración. Universidad Nacional de Costa Rica. Heredia, Costa Rica.*

<sup>2</sup> *Laboratory of Technology and Quality of Fish Products. Marine Biology Station, Biological Sciences School, Universidad Nacional de Costa Rica. Puntarenas, Costa Rica.*

\*fabian.chavarria.solera@una.cr. Telephone number: (506) 2277-3554

### Abstract

The research evaluated the handling and storage type that is given to the fish product in terms of quality and safety at the time of its capture by the fisherman. The methodological tool for obtaining the primary information was a close type survey and a checklist, both addressed to artisanal fishermen of the Gulf of Nicoya, Costa Rica. According to the results obtained in the investigation, it was determined that manipulation is not on its best, due to the considerations evaluated and observed such as cleaning of boats, implements used, gutted, type of storage and use of ice.

**Keywords:** manipulation, storage, icing, fishery product, Gulf of Nicoya, fisherman

### 1. Introduction

Fish is one of the most perishable foods, due to its chemical composition and the low acid pH of its meat (Massa 2006), due to those reasons, it needs to be handled and treated properly from its capture until it is consumed or industrialized; the management that is given from the beginning of the commercialization is one of the factors that determine the quality of the product (González and others 2006).

Gonzalez and others (2006) define quality as the integration of properties of a product that influence its acceptability when buying or consuming. The concept includes many meanings, such as: safety, nutrition, freshness, gastronomic delights, purity, consistency, size and product excellence, as well as honesty, for example in labeling.

Generally, in the fishery product the term "quality" refers to the aesthetic

appearance and freshness, or the deterioration degree that the fish has suffered from the moment of its capture. It can also involve safety aspects such as: absence of dangerous bacteria, parasites or chemical compounds. It is important to remember that "quality" implies something different for each person and is a term that must be defined in association with a single type of product (Huss 1998).

Based on the above, it is said that the quality of the fish is a synonym of its appearance and freshness (Ramírez and others 2006). Freshness is a fundamental factor to consider for the opinion of fitness for human consumption; however, the fishery product may be fresh but not suitable for consumption. In addition to freshness, there are involved other factors that have to do with hygiene and sanitation. In this sense, it is said that in order for a fishery product to be considered of high quality and to be fit for human consumption, it must fulfill with three premises: Freshness - Hygiene - Health, these conditions can be summarized as Safety. (González and others 2006)

According to Gonzales and others (2006), hygiene has to do with the product of external factors that can cause damage to the consumer, for example chemical contaminants such as the motor fuel of the boat or cleaning products like detergents, as well as microbiological contaminants: fecal coliforms, staphylococci, virus, etc. On the health aspect, it has to do

with internal factors of the fish that can also affect the consumer, for example: parasites in the musculature, zoonoses and biotoxins.

There are two definitions of "fresh": a) freshly produced, without preservatives or storing; B) exhibits its original qualities intact, without alterations in any way (Jiménez 1981). It is said that the absolute freshness of the fish is when it is in the stage of *rigor mortis*. A good state of freshness according to Ramírez and others (2006) is what is closest to the state when it was alive, it is the opposite state to rotten, that is to say, when there have been no changes in the product that prevent its consumption.

Therefore, the level of freshness is another way to express the quality of the fishery product, it can be said that from the point of view of consuming fish, if the level of freshness is good: it has a high and exquisite nutritional level, and based on human health has a high level of security (Ramírez and others 2006).

Due to the nature of the fishery products, it is indispensable to give it a good manipulation, as a guarantee to obtain a safe food, that also possess good commercial appearance and nutritional quality. This is achieved only by having good handling practices with the product and maintaining an appropriate temperature. Only in this way is it possible to prevent alteration and increase the quality level. The alteration is essentially due to microbial development, so preserving

that fish quality is an issue that is closely related to hygiene (Galán and others 2011).

Since its capture, fish is a food destined to be consumed by the buyer, so it has to be manipulated, prepared and preserved with all the care that food needs. For example, during the handling on the ship it is necessary to clean the storage tanks of the food. Among the undesirable practices during storage of the fishery product are: boxes of wood (because are hard to clean); stacking, causing the product to crush; contact with dirty floor; exposure to the sun, which generates heating, lack of cooling. (Galán and others 2011).

It is necessary to apply hygiene rules, however, it is not enough, as there will still be bacteria whose multiplication must be avoided through refrigeration as close as possible to 0 °C (Méndez 2007). Temperature is a primary factor that must be taken care of to avoid the decomposition of the fish products, for which reason, a suitable chain of cold must be maintained from the capture until its consumption.

In that sense, the use of ice is very important in good handling practices because it ensures and maintains quality. Whole products should be surrounded and covered with ice, to maintain adequate temperatures. The optimal temperature to keep the freshness and quality of the product, is not greater to the 4 °C. In this respect, for the optimal conditions of a fast and

good cooling it is necessary to know the influencing factors, such as: amount of ice, temperature of the environment, isolation of the storage container and initial temperature of the fish. (González and others 2006).

The use of ice is the most simple and inexpensive method of cooling according to different authors, to maintain the freshness of the product. If the cold chain is maintained, that is to say, it is given appropriate treatment to the fishing products, using the appropriate amounts of ice and the products are not allowed to suffer ups and downs in their temperature, it is sure to extend its useful life (Ramírez and others 2006). However, it is necessary to pay attention to the fact that although the products are stored on ice, the loss of freshness continues to advance, so that storage time is another important factor to take into account (UNA and others 2007). Fish should be kept refrigerated at the lowest possible temperature, close to 0 °C, but for a short period of time (Connell 1978).

Temperature and storage time, along with the type of handling and the way fish are sacrificed, are the most important factors to reduce loss of freshness. Taking into account those factors will cause the deterioration or decomposition processes to slow down or become slower and the product has a good commercial appearance for longer, which implies that the product retains a high degree

of freshness. Regarding nutritional quality, it should be taken into account that fish and seafood maintain their nutritional properties (Ramírez and others 2006).

On the basis of the above, it can be clarified that the speed of decomposition and the possibility of prolonging conservation in the best possible state, depends on many factors that intervene from the very moment the fish is being caught, before its death. In this respect, in order to achieve good quality and safety, the handling and conservation

of the fishery product must be ensured from the moment it is captured.

## 2. Materials and Methods

### Study Area

Surveys were conducted in the fishing communities located on the east coast of the Gulf: Puerto Nispero, Costa de Pájaros, Chomes, Puntarenas and Tárcoles. Regarding to the inspections with checklists, were carried out in the zones: around Isla Caballo and off the coast between Chacarita and Caldera, Puntarenas (Fig. 1).

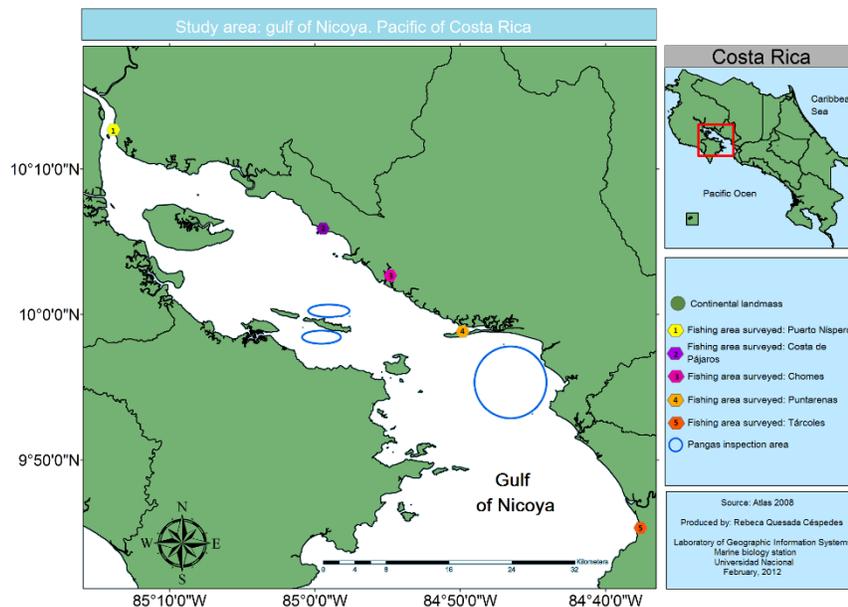


Fig. 1. Geographical location of surveyed fishing communities and inspections of fishermen in the Gulf of Nicoya, Costa Rica.

Collaboration: Laboratory of Geographic Information Systems, Station of Marine Biology, Universidad Nacional de Costa Rica.

### **Field work**

Surveys were aimed to the artisanal fishing sector, the purpose of these was to make an evaluation to make an evaluation and analysis of the management that is given to the fishery product at the time of capture in terms of quality and safety. Random fishermen were surveyed who were fishing at the moment, as well as visiting several fishing communities on the east coast of the Gulf. To counter-validate survey data, the treatment of the product during the fishery was inspected and documented through the use of a checklist and photographs. In this way, the fishermen were visited while they were in their work and in the moment that they had product stored in the boat, being able to check by observation the manipulation and handling that is given to the product on board of the boat right after is captured.

### **Statistical Analysis**

The statistical treatment of the data was performed using the statistical package SPSS Statistics 17.0 in order to codify the surveys and checklists, obtaining the percentages of trends with respect to the type of on-board manipulation performed by artisanal fishermen in the Gulf of Nicoya.

### **3. Results**

Regarding the time it takes for a fisherman on a fishing trip, all the surveyed replied that it was highly variable and depended on many factors such as: the tide, the amount of fish, and the type of fishing gear they

used. However, the majority, 73.3% said they last more than 6 hours, in times ranging from 6 to 16 hours. The 15.0% of fishermen responded they lasted from 5 to 6 hours, followed by 5.0% who claimed to last from 4 to 5 hours. 3.3% reported lasting only 3 to 4 hours, while the remaining 3.4% reported less than 2 to 3 hours.

On the other hand, in inspections of boats, more than half (66.7%) were found to be dirty, with dirty water deposited on the surface, as well as organic matter such as dry leaves, porous wood surfaces, blackened surfaces. However, only 33.3% of the vessels were clean as regards the contact surfaces with the fishery product, without any of the characteristics previously described.

As for the implements used for a good manipulation of the fishery product on board the boat, it was found through the inspection that 70.0% of the artisanal fishermen use an apron, consequently, the remaining 30.0% do not use it. These percentages are very similar to those reported by the survey, where it was obtained that 76.7% use an apron and the remaining 23.3% do not use it.

Regarding to the use of boots on board the boat during the fishing operation, it was observed in the inspections that a little less than half, 43.3% use them, while 56.7% do not carry this type of implement with them. In contrast, the survey reported that

51.7% did use boots while 48.3% did not use it.

Another tool evaluated according to its use or non-use on board the boat were gloves. It was found through checklists and surveys that 93.3% and 78.3% respectively, use fabric gloves. During inspections it was found that very few (6.7%) did not use them. On the other hand, 5.0% of fishermen responded that they did not use them and 16.7% used gloves made of rubber. However, during the inspections no fishermen were found using this type of glove, considered to be suitable for good handling.

The last implement evaluated according to its use was the hair cover. It was found according to inspections and responses to the surveys, that 80.0% and 68.3% of fishermen respectively, use this type of implement on board the boats during the fishing task. In contrast, 20.0% and 31.7% do not use it

An important aspect that was taken into account and evaluated on board the vessels as part of a good practice of handling the fish product implemented by the artisanal fisherman was the storage characteristics. In this respect, it was observed that the majority, 76.7% of fishermen who were in their task did not have the product gutted at the moment of the inspection to the boats. To the question during the inspection; about how long they had to be fishing, these responded times that went from 2 to 4 hours. They were also asked why they had the fish without gutting, to which they replied that they had less

than an hour of having lifted or collected the fishing gear. On the other hand, only 23.3% of the fishermen had the product that was aboard the eviscerated vessel. This percentage of fishermen responded that they had 4 to 6 hours of fishing, which is why they had it eviscerated, due to the longer time that had elapsed since the capture.

Following the gutting issue, the survey reported that 93.3% of fishermen eviscerate the fish in the boat, while only 6.7% do so when they reach the coast. On the other hand, to the question of the survey about how long it takes to eviscerate it, was obtained that the majority of the fishermen surveyed (66.7%) responded "immediately after the capture", which is the best to keep the product well preserved. Only 13.3% of the fishermen indicated that they do it from 30 minutes to one hour after capture and in a lower percentage, 8.3% and 3.3% indicated that they did 1 to 2 hours and 2 to 3 hours after capture respectively. Finally, only 8.3% of the fishermen surveyed reported that they eviscerated the fish at the fishery.

In the storage or stowage that is given to the fishery product after it is captured, also characteristics such as the cleanliness of the storage tank, its proximity to the fuel tank, the type of storage and the correct use of ice were considered. During the inspections of the fishermen and their boats, 25 fishermen, representing 83.3%, stored the fishery product away from the fuel,

while only 5 of the fishermen inspected (16.7%) kept the product in a cooler, basket or floor of the boat, a few centimeters from the fuel storage.

On the other hand, in terms of the type of storage used, it was obtained that the majority of the fishermen inspected, 76.7% stored the fishery product in the refrigerators or coolers of the boat, which were verified that they contained very little ice in relation to the amount of product stored. On the other hand, it was observed that 16.7% and 6.7% stowed the fishery product in totally inadequate conditions, in dirty plastic basket and on the floor of the boat respectively.

The survey confirmed the use of freezers as the method most used by fishermen to store the post-catch fishery product, it was found that 93.3% of fishermen use this type of storage. Where only 3.4% stored the product in plastic basket, bucket or jar, and 3.3% responded to do so on the floor of the boat. These data were very similar in proportion to those obtained through checklist inspections.

As for the percentage distribution of fishermen who answered yes or no on the use of ice on board boats, the survey reported that 54 of the 60 fishermen surveyed do use ice on board the boats to conserve the fishery product after capture, representing 90.0% of the total fishermen. While the remaining 6 fishermen responded to use it sometimes or not to use ice in their

fishing activity, which represented only 5.0% for both instances.

Finally, it is important to mention that 100.0% of the fishermen inspected carried clean and potable water. However, through the survey it was found that 100.0% of the fishermen surveyed stated that they used water only to drink and not to wash and clean the product, none of the fishermen indicated that they used it for that purpose.

#### **4. Discussion**

To consider the duration of the fishing chore is very important, since depending on how long it lasts at sea, it is necessary to take into account the method of conservation of the product, as well as the use of cold cameras or a good use of the ice.

Regarding the cleaning of the boats, all the characteristics found in the survey do not have a correct manipulation of the product on board the boats, allowing for possible risks of contamination of the fish from the very moment it is captured and coming into contact with dirty surfaces, which accelerates its decomposition over time, reducing its useful life. Only a relatively low percentage of artisanal fishers do maintain the appropriate conditions for good handling of the product on board.

With regard to the implements used, based on the results obtained respecting to the use of boots on board

the boat, it is possible to indicate that fishermen who "use" or "no" this type of implement are averaged. The fishermen who do not use them, indicated that their use is dangerous, since if they accidentally fall into the water it would be hard to swim wearing them, therefore they consider it dangerous to use boots.

On the other hand, the cloth gloves used by most fishermen are not appropriate for handling the fishery product, because they are porous and moist, suitable to retain fish mucus during handling and therefore can be a good way for the proliferation of different bacteria.

In conversations with fishermen, they indicated that this implement is used for protection against fishing gear. In other words, this type of glove is a protection for the fisherman, so they do not suffer wounds or cuts in the hands, instead of being a protection so that the fish does not get contaminated

Respect to the results of the use of the hair cover obtained through checklist and surveys, it can be indicated that most artisanal fishermen use it. However, in discussions with fishermen, they indicated that this implement is used for protection against the sun's rays.

On the storage conditions, it could be determined that the fisherman is aware that if the fishery product is maintained with the viscera throughout the storage time, a decrease on the quality and freshness

would be seen more quickly. For Agüeria (2008) it is due to the faster bacterial proliferation when passing the bacteria from the intestines to the muscle. Because evisceration depends on the length of time the fisherman is in fishing and collecting the gear; it is not possible to indicate with certainty that the time between the capture and the evisceration is incorrect, as observed in the inspected boats.

Most of the artisanal fishermen are aware of the serious problem and danger of storing the product near the fuel, due to the risk of oil contamination of the meat. Fishermen who kept the product near the fuel were advised of this serious fault, to which many replied that it was either separate or that the fuel tanks were closed and tight, without spills. However there is always the risk of contamination when the product and fuel are close.

For the use of ice, was observed that they stowed the product in the refrigerator around a sack with ice or on an ice layer located in the bottom of the storage tank, which is not the most indicated and based to the observed, can be indicate that the fisherman does not use the correct amount of ice to preserve fresh the fish product immediately after its capture.

In general, the fish was not surrounded or covered with ice, which is optimal and ideal to maintain the appropriate temperatures: between 0 and 4 ° C. According to Ramírez and others (2006) the appropriate ratio of

ice: fish is 1: 1, for example, to cool a kilo of fish requires one kilogram of ice. The use of ice is very important in good handling practices to ensure and maintain the quality and safety of the product. However, although most of the ice is used on board, the amount is not sufficient to lower the temperature to adequate levels (less than 4 ° C) to keep the product cool for longer time.

Finally, respecting to the cleaning of the product, it is very important to do it after gutting in order to remove blood and scraps that may remain, this operation must be performed with clean water, either salty or sweet. It is not advisable to wash it with sea water near the coast, where pollution levels are usually higher.

## **5. Conclusions**

Gloves used by the majority of artisanal fishermen in the Gulf of Nicoya are used for purposes of protecting their hands against fishing gear, and not for the purpose of implementing proper handling of the product, the type of cloth material is not the suitable to be in contact with the fish at the time of its manipulation.

The majority of artisanal fishermen in the Gulf of Nicoya take more than 6 hours in the fishing process, which requires storing the fish product in optimal conditions to ensure its preservation while it reaches port.

Respecting to the stowage, although ice is used on board boats, it

is not used in sufficient quantities to reduce the temperature of the product sufficiently to ensure its preservation, as noted, the amount of ice in the fridges on board is not enough for the amount of product that is obtained on the process.

Most artisanal fishermen store their products away from fuel. Regarding evisceration, it was not possible to determine if it is done correctly in short times after the capture, because it depends on the time that the fisherman takes in fishing and collecting the fishing gear, as observed on the boats inspected.

Finally, artisanal fishermen of the Gulf of Nicoya have some knowledge about the proper handling of the product and they try to apply them, however there are many aspects that must be improved like the cleaning of the boats, the type of gloves, the prompt evisceration and the proper use of ice on board

## **Acknowledgments**

The authors thank the Marine Biology Station of the Universidad Nacional for providing the necessary infrastructure and equipment for the analysis. As well as all those who made possible the realization of this work, among them: Angie Zavala and Pricilla Zavala, for their important help in the field work. Hania Vega and Rebeca Quezada, for their help in the mapping of the areas surveyed and points where the checklists were

applied To Captain Orlando Torres, for his aid in the tours to the sea to perform the inspections to the boats. To all artisanal fishermen of the gulf of Nicoya, for giving us their time and providing the required information.

## Bibliography

Agüeria D. 2008. De la laguna a la mesa: ¿Cómo evaluar la calidad del producto pesquero y cómo conseguirla? (Internet) Argentina: p. 111-118. Available in: <https://www.scribd.com/document/327940973/Capitulo-8>. (Accesed 2017 March 14)

Connell, J. 1978. Control de la calidad del pescado. Zaragoza, Acribia: p. 236.

Galán L, Luna H, García J. 2011. Control de Calidad de Productos Pesqueros. Department of microbiology. Faculty of biological sciences., U.A.N.L. México: p. 52-66.

González F, Cornejo A, Peteán N. 2006. Manipulación, Higiene y Calidad para Nuevos Productos de Pescado (Internet). Programa Agua, Humedales y Pesca, Fundación PROTEGER, Comité Argentino de la UICN Santa Fe – Argentina: p. 12. Available in: [http://www.ecmar.una.ac.cr/index.php/repositorio-de-archivos/category/1-documentos-fao?download=43:el-pescado-fresco-su-calidad-y-](http://www.ecmar.una.ac.cr/index.php/repositorio-de-archivos/category/1-documentos-fao?download=43:el-pescado-fresco-su-calidad-y-cambios&start=20)

[cambios&start=20](http://www.ecmar.una.ac.cr/index.php/repositorio-de-archivos/category/1-documentos-fao?download=43:el-pescado-fresco-su-calidad-y-cambios&start=20). (Accesed 2017 April 26)

Huss H. 1998. El pescado fresco: su calidad y cambios de su calidad. FAO, Fishery Technical Document. No. 348. Rome: p. 202.

Jiménez H. 1981. Correlación de métodos Para determinar frescura en Corvina Aguada (*Cynoscion squamipinnis*). Thesis presented to qualify for a degree in Food Technology. Universidad de Costa Rica: p. 123.

Massa E. 2006. Cambios bioquímicos *post-mortem* en músculo de diferentes especies pesqueras. Determinación de la vida útil de las mismas en frío (Internet). Thesis for the title of Doctor of Science, Biology area. Universidad Nacional de Mar de Plata. Argentina: p. 236. Available in: [http://www.scielo.cl/scielo.php?script=sci\\_arttext&pid=S071816202015000200012](http://www.scielo.cl/scielo.php?script=sci_arttext&pid=S071816202015000200012). (Accesed 2016 November 13)

Méndez M, Sammartino R. 2007. Verificación de la Inocuidad y Calidad de los Productos Pesqueros (Internet). El Boletín del Inspector Bromatológico. Administración Nacional de Alimentos. Medicamentos Instituto Nacional de Alimentos: p 9 .Available in: [http://www.anmat.gov.ar/webanmat/BoletinesBromatologicos/boletin\\_inal\\_7.pdf](http://www.anmat.gov.ar/webanmat/BoletinesBromatologicos/boletin_inal_7.pdf). (Accesed 2017 March 15)

Ramírez R, Ishihara H. 2006. Los Métodos para Definir la Frescura de los Pescados. Pruebas Químicas

para Determinar la Frescura (Valor K).  
Proyecto manejo sostenible de las  
pesquerías para el golfo de Nicoya.  
Area control de calidad. Instituto  
Costarricense de Pesca y Acuicultura-  
INCOPECA

UNA, JICA, JP, INCOPECA.  
2007. Presentación de conclusiones y  
recomendaciones. Proyecto Manejo  
Sostenible de la Pesquería para el  
Golfo de Nicoya: p. 154.