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Information and Communication Technologies for the Safety and Security of Fish and Fishery Products

Liliana Mihaela MOGA[1]*

Abstract

The food industry is becoming more customer-oriented and needs faster response times to deal with food scandals and incidents. Good traceability systems help to minimize the production and distribution of unsafe or poor quality products, thereby minimizing the potential for bad publicity, liability, and recalls. The current food labelling systems cannot guarantee that the food is authentic, good quality and safe. Therefore, traceability is applied as a tool to assist in the assurance of food safety and quality as well as to achieve consumer confidence. This paper presents comprehensive information about traceability systems and the evolution concerning the actors involved and the information about safety and quality in the food supply chain administrated within the systems. Some inventive factors, which influence the traceability systems adoption, are underlined.

Keywords: *traceability system, information, supply chain, fish and fish products.*

1. Introduction

Fish and fishery products have an important role in human nutrition around the world. The reinforcement of the confidence in the aquatic products depends on the management performed in the fish and fish products supply chain. The traditional fish and fishery products supply chain is a conventional and long one, characterized by complex combinations of upstream and downstream elements, which are difficult to be managed and traced. The global captured fish industry is complex, with different type of

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products and distribution chains. Up to our days, there is no available an integrated concept for the fishery supply chain, which allows both the complete and continuous monitoring of food safety and quality, together with environmental concerns, and the traceability of the entire supply chain.

Consumers became awarning regarding the nutritional benefits of fish and fishery products consumption on their health, but, at the same time, but this involve the need of accessing more information regarding where their food, including fish products, has been produced about the process history, and handling actions during the delivery [12], [17]. Therefore, in order to improve the food security, many countries have implemented traceability systems, having as aim to increase the consumers' confidence in the food products.

2. Problem Statement

A traceability system is considered as an effective tool to guarantee safety in fish products and improve the supply chain transparency. A traceability system is defined by ISO [21], like being 'all data and operations that are capable of maintaining the desired information about a product and its components through the whole, or part of its production and distribution chain'. In addition, a traceability system records and follows the products and materials provided by the suppliers and are processed and distributed as final products [20].

Therefore, in the food safety incidents, a traceability system implemented at a national level permits the identification in a short period and the identification of hazardous food products, which have to be recalled [3]. Moreover, since 2005, traceability systems become mandatory for all food chain businesses in the European Union, which contributes of their adoption and implementation. For new added countries, which have a certain period until the moment when the European regulation will enter in force, the traceability systems works like islands in the national food supply chain, without connections between the companies' traceability system.

3. Aims of the research

Traceability is used as a tool to assist in the assurance of food safety and quality as well as to achieve consumer confidence. The research presents comprehensive information about traceability systems and the evolution concerning the actors involved and the information about safety and quality in the food supply chain administrated within the systems. Some

inventive factors, which influence the traceability systems adoption, are underlined.

4. Research Methods

This paper presents comprehensive information about traceability systems and the evolution by making a review of the scientific literature focused on traceability systems. The information about safety and quality in the food supply chain administrated within the systems concerning the actors involved is presented. The information description is a result of an empirical study conducted at the level of Romanian companies, governmental bodies and consumers. Some inventive factors, which influence the traceability systems adoption, are underlined, as result of the empirical study.

5. Findings

Paper traceability is the oldest method and the more used from all traceability systems, being used for a long time throughout the supply chains. It is, also, the cheapest method and this is what for it is accessible to all contributors from the supply chain, being practicated in many instances, including now, in the countries where having a traceability system connected at a national one, is not mandatory for the companies from the food sector [5].

5.1. Evolution of the Fish and Fish Products Traceability System

The paper based traceability is time-consuming for retrieving the records in the system and the number of documents that need to be archived can be overwhelming and require a lot of storage space, in case of a very large data sets [14]. In addition, another disadvantage is the time lost for checking the information about a product. First, it is necessary to identify the "batch identification code" from the product label and after that it has to be searched for the individual processing records in order to find the information regarding the process history [7].

Barcodes are widely used in the food industry since the 1970s, and they became popular as a small digital image of lines and spaces applied to retail products and identification cards [7]. Barcodes can be used either for labelling or for identifying the products during all stages of processing. An effective bar code traceability system includes hand held scanners, label printers and a computerised data management system. Therefore, the information is quickly transferred in a database. Firstly, special optical

scanners scanned the barcodes, but nowadays many software and mobile applications have been developed in order to read the barcodes information. The main advantage of barcodes include the following aspects: introducing and storing a wide range of information, fast and reliable data entry saving more time, easy to use central database for audit and reporting. As disadvantages, barcodes can be affected by the risk of electronic malfunction.

Recently, due to the development of information technology, many companies developed new software in order to meet the requirments of fishery companies for traceability [4]. Radio-frequency identification (RFID) is an innovative information technology tool and very accepted in new the traceability systems. It is considered as a good opportunity for improving information flow and food safety [2]. Generally, a RFID system is an identification system and it is quite similar to barcode technology. Bar code systems require a reader and adhesive labels stuck on objects, while RFID requires a reader and special tags or cards attached to the objects. RFID systems use wireless microchips to identify and to create tags and do not require the direct contact or particular alignment with the reader [4], [15]. A RFID system is made up of an antenna, an integrated circuit, a reader that gathers information from the id tag, and a database system, which is used to store the information, gained through interrogating the ID tag [16]. Generally, the tags are written with electronically stored information, such as the traceability code [4]. Quite recently, there have been developed several solutions in order to implement systems of controlled temperature measurement for traceability through RFID labels with temperature sensors included [8], [13]. In addition, one of the challenges involved by this kind of labels is also the incorporation of some chemical sensors inside so as to monitor, for example, the degree of maturation or degradation by measuring the gases generated by food products [1].

RFID have many advantages, being able to store large amounts of data in a precise manner [14], have a fast reading speed, significant reduction of the size of the tag, and have no compatibility problems with foods [15]. Between the major disadvantages of RFID system we list the cost, complexity, and environmental sustainability [9].

Cloud computer-based traceability system which could include the Bare code or RFID facilities will transform the traceability system for fish and fishery products in a more accessible one, and the information access will be more convenient for the consumers. By using cloud computing it is expected that any information concerning the distribution chain of fishery products be able to be obtained immediately by anyone interested and has access to network.

5.2. Factors with impact on traceability system design

In order to achieve the purpose for which it is designed, a traceability system for fish and fishery products has to ensure the implementation of the requirements of Law 178/2002 [18], which regulates the path of the food, known as distribution chain, which includes all stages of production and stops at the end user [10]. Law 178/2002 stipulates that the stages of production, processing and distribution means "any stage, including import, starting with and including the primary production of a food product and ending with and including its storage, transport, sale or supply to the final consumer and, where appropriate, import, production, manufacture, storage, transport, distribution, sale and supply of feed". In addition, the traceability system has to ensure the requirement of European Union Regulation 1224/2009 [19], to make that all fishery products be "placed in batches before the first sale".

The stakeholders are interested to know what happened along the supply chain with the fish and the fish products. The storage of information facilitates the transmission of products history to the institutions of control, as well as access by end-users, through providing various means of access, thus being also observed the requirement from Article 18 of the Law no. 178/2002 [18]. The traceability system should have functionalities that would help the operators within the food sector comply with the obligation to identify suppliers and customers, to determine which products are supplied and by which supplier, and what products are delivered, to which customers.

Also, the system contributes, through the implemented processes, to ensuring both external and internal traceability. The system helps companies within the food sector to ensure external traceability through the availability of documents for raw materials entry, with batch identification, delivery documents for final products, and batch marking in commercial documents. As concerns internal traceability, the system helps companies to keep note of their own system of separation into batches, sheets for the record of internal production, by batches and methods of identifying semipreparations and ingredients during processing and establishing the batch and product marking.

The global fishing industry is characterized by complexity, having various types of product and supply chains. These factors make difficult to achieve the implementation of information technology in the distribution chain of aquaculture product. If the traceability system fulfills the requirements of all participants - consumers and companies in the fish industry, then there will be achieved the expected benefits. The main

stakeholders in the distribution chain of fish and fishery products are the producers, that is, farms specialized in producing spawn, hatcheries, production enterprises and distributors, as well as the consumers. The processing enterprises turn out to be the supply chain center, here being concentrated most of the capital, technology and human resources. It is within the processing enterprises where are occurring most transformations and often changes on the batch.

Depending on the fish origin, the producers are for products from aquaculture, hatcheries and recirculating systems; for commercial fishing; wild fish; industrial fishing (inland natural basins and Black Sea) and traditional fishing (inland natural basins and Danube Delta). First sale centers are the link in the chain between the producer and the processors/distribution. From the producers or first sale centers, fish and fish products are delivered to the other actors, that is Processors and/or Distributors. The last actor in the commercial stream is the final consumer, for whom it is very important to be able to receive information on the purchased product. For the trading systems of fish and fish products, these include wholesale markets/distributors, supermarkets and hypermarket chains; direct purchase from local producers, small independent stores, and, less widespread, e-commerce. Consumers close the supply chain.

Hellesoy identificated some certain categories of stakeholders and their interest in traceability systems implemented at national level [6]. The certification agencies motivation is in the improved integrity during certification exercises. The importing countries are interested in the public safety assurance, while the exporting countries have mostly economic interests. Economic issues, too, motivate the supply chain partners while the motivation for retailers is primarily risk management for legal and economic. When the traceability system meets all the stakeholders, consumers and producers' requirements, then the anticipated benefits will be obtained. Therefore, a system of traceability intended for fishery products should harmonize the requirements of each of the categories presented [11].

6. Discussions

For fish and fishery products, the most used traceability systems range from paper-based systems to electronic systems, such as barcoding and Radio Frequency Identification Devices [14]. They still have many limitations and depend on the sector in which they are applied. Following an analysis of the traceability systems evolution it can be seen that, during the last years due to the huge development of information technologies, many companies try and succeeded in developing and using new software for

assuring the traceability of the fishery sector. It is important to be mentioned that reaching the objectives intended by using the traceability system is based on the accuracy and continuity of information.

7. Conclusions

In the countries where it is not available a legal framework that would impose the collection, entry and reporting of this information on a centralized basis, in an unitary system, implemented at national level, by processors and distributors, they can accept reluctantly the traceability system. Under these circumstances, no matter how efficient the systems developed by the software manufacturers would be, it cannot be guaranteed the collection and entry of information by all those involved in the information flow, and it is possible that the information provided at the time of system enquiry be truncated and thus, irrelevant.

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