Quality signalling and assurance of fish products from a consumer point of view

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DECLARES

That the present thesis entitled "Quality signalling and assurance of fish products from a consumer point of view", carried out by Beatriz Rodríguez Salvador under his supervision in the official PhD programme "Economic Analysis and Business Strategy" and that opts for international mention, meets the requirements to qualify for the degree of doctor.

A Coruña, 1 April 2021

Supervisor   PhD Candidate

Dr. Domingo Calvo Dopico   Beatriz Rodríguez Salvador

To my parents and Joni

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Resumo

As etiquetas corrixen as asimetrías de información e axudan aos produtores a diferenciar os seus produtos. Non obstante, a etiquetaxe non garante que os alimentos sexan seguros, de boa calidade e auténticos. Co obxectivo de satisfacer as demandas dos consumidores de información fiable e relevante e garantías, introducíronse diferentes iniciativas de rastrexabilidade. Para transmitir información de maneira eficiente aos consumidores, garantir a viabilidade da rastrexabilidade e implementar estratexias de diferenciación, é necesario comprender as súas percepcións. O propósito desta tese é investigar a sinalización e o aseguramento da calidade dos produtos pesqueiros desde o punto de vista do consumidor. Os resultados indican que a maioría dos consumidores buscan e están dispostos a pagar máis por peixe de maior calidade. As etiquetas e a súa información son importantes para os consumidores non só como fontes de información senón tamén para identificar produtos de maior calidade. O coñecemento dos consumidores sobre a rastrexabilidade é baixo, o que pode actuar como barreira á súa aceptación. Unha vez informados, os consumidores consideran necesaria a súa implementación. Con todo, a maioría deles non están dispostos a pagar máis por produtos pesqueiros rastrexables. Os resultados desta tese teñen implicacións para autoridades e produtores.

Resumen

Las etiquetas corrigen las asimetrías de información y ayudan a los productores a diferenciar sus productos. Sin embargo, el etiquetado no garantiza que los alimentos sean seguros, de buena calidad y auténticos. Para satisfacer las demandas de los consumidores de información fiable y relevante y garantías, se han introducido diferentes iniciativas de trazabilidad. Para transmitir información de manera eficiente a los consumidores, garantizar la viabilidad de la trazabilidad e implementar estrategias de diferenciación, es necesario comprender sus percepciones. El propósito de esta tesis es investigar la señalización y el aseguramiento de la calidad de los productos pesqueros desde el punto de vista del consumidor. Los resultados indican que la mayoría de los consumidores buscan y están dispuestos a pagar más por pescado de mayor calidad. Las etiquetas y su información son importantes para los

consumidores tanto como fuentes de información como para identificar productos de mayor calidad. El conocimiento de los consumidores sobre la trazabilidad es bajo, lo que puede actuar como barrera a su aceptación. Una vez informados, los consumidores consideran necesaria su implementación. No obstante, la mayoría de ellos no están dispuestos a pagar más por ella. Los resultados de esta tesis tienen implicaciones para autoridades y productores.

Abstract

Labels correct information asymmetries and helps producers to differentiate products. However, labelling system alone cannot assure that the food is safe, of good quality and authentic. To address consumer demands for reliable and relevant information and guarantees, different traceability initiatives have emerged. Traceability increases production costs and prices may rise. Therefore, understanding consumers' perception and willingness to pay is critical to transmit information efficiently to consumers, ensure the viability of traceability and implement differentiation strategies. The aim of this thesis is to investigate the quality signalling and assurance of fish products from a consumer point of view. Results indicate that most consumers look and are willing to pay more for higher quality fish, particularly those differentiated by origin and species. Labels and their information are important for consumers as information sources but also to identify higher quality products. Consumers' knowledge on traceability is generally low, which may act as a barrier to its acceptance, and it is associated to safety and quality. Once informed, consumers consider the implementation of traceability systems is necessary. Nonetheless, most of them are not willing to pay more for it. The results of this thesis have a number of implications for authorities and producers.

Table of Contents

List of Tables

List of Figures

CHAPTER 1

INTRODUCTION

1.1. Motivation

Global consumption of fish has been growing steadily growth since 1961, twice as fast as world population (FAO, 2020). According to a report issued by the FAO (2020), this rapid growth has been driven by a number of factors such as increase of production, technological developments in shipping and distribution; rising incomes and increased consumer awareness of the health benefits of fish. Contrary to the increasing global trend, according to EUMOFA (2020b), apparent consumption and per capita consumption of fish products in the European Union has decreased from 2017 to 2018, downing to 12.48 million tonnes and 24.36 kg, respectively. Nonetheless, household expenditure on fish has increased to 59.3 billion € (1%) for the total of Europe but also in almost all countries (EUMOFA, 2019) due to inflation. The household expenditure in Italy (11679 million €) and Spain (10569 million €) is the highest among European countries and Spain has recorded the greatest growth (400 million €, 4%). According to EUMOFA (2019), fresh fish accounts for the highest share of household expenditures in the European Union. Nevertheless, the consumption of and expenditure on fresh fish has been decreasing steadily in the last years. This negative trend is explained by the decrease of consumption of hake, cod and sardine in the top consumers, namely Spain, Italy and France.

Quality is a key criterion for consumers to decide which product to buy (Altintzoglou & Heide, 2016; Olsen et al., 2017). Nonetheless, the globalization and internationalization of the food markets and the industrialization of the food production have increased the complexity of food chains and the availability and variety of food products. At the stores, consumers find a broad variety of products from different sources of which they know very little about (Sarig, 2003). For consumers, quality of fish is mainly associated to freshness (Olsen, 2004) but also to wholesomeness (Brunsø, 2006), taste and nutritional value (Carlucci et al., 2015). Fish products are particularly fragile (Hyldig et al., 2007; Olafsdottir et al., 2004) and their quality and freshness are influenced by intrinsic factors, such as biological characteristics of the species or individual, as well as by pre-harvesting, harvesting and post-harvesting conditions (Boziaris, 2014; Freitas et al., 2020; Olafsdottir et al., 2004), such as catching methods, handling, processing and storage techniques (Jørgensen et al., 2006).

Consumers' knowledge about fish is low and they find difficulties in assessing fish quality and form quality expectations only through fish physical properties, such as the fat content, appearance or smell (Birch & Lawley, 2012; Lawley et al., 2012; Pieniak et al., 2013). Fish labels are important sources of information for consumers at the time of purchase (Jørgensen et al., 2006; Pieniak et al., 2013). Labelling reduces search costs and corrects information asymmetry (Hanss & Böhm, 2012), helps producers to differentiate products (Alfnes et al., 2018), encourages consumer purchase of seafood products (Fernández-Polanco et al., 2013; Kempen et al., 2011) and increases the perceived value of products (Alfnes et al., 2018; Jørgensen et al., 2006; Pieniak, Verbeke, Vermeir, et al., 2007). Nonetheless, the information portrayed in labels must be carefully chosen (Pieniak et al., 2011). Consumers are not all alike and simply providing more information to consumers is not enough to reduce information asymmetry and uncertainty (Verbeke, 2005). Furthermore, food fraud has eroded consumers' trust in producers and they are concerned about food safety, quality and origin fraud. Even though labels are considered to be necessary to guarantee safety in fish markets (Pieniak & Verbeke, 2008), according to Aung and Chang (2014), the labelling system alone cannot assure that the food is safe, of good quality and authentic.

To address consumer demands for reliable and relevant information and guarantees, different voluntary and mandatory traceability initiatives have emerged in different countries (Hobbs et al., 2005). Traceability systems may increase consumer confidence by reducing the potential vulnerability of food chains to contamination (Kher et al., 2013). The complexity of seafood supply chain allows illegal, unreported, and unregulated fishing and entails a higher risk of quality control failures such as parasites, pollutants or heavy metals that may affect quality and be a safety hazard, and seafood fraud such as mislabelling or substitution (Freitas et al., 2020). Furthermore, several companies have added elements of marketing to stress attributes that can add value to their products (Morrissey & DeWitt, 2014). According to Opara and Mazaud (2001) and Roos et al. (2005), traceability satisfies consumer increasing demands for information about content, origin and process of food products. These attributes cannot be uncovered even with specialized testing (Golan et al., 2002). Thus, traceability emerges as a necessary tool for food businesses to label accurately, support marketing claims and inform consumers about credence attributes (Roos et al., 2005).

Consumers' perceptions and expectations often differ from those of experts. Since consumers are at both ends of the value chain, it is necessary to understand their perception regarding labelling information in order to assess the efficiency of the mandatory information and adapt the voluntary information. Likewise, the implementation of traceability systems increases production costs and may push up market price. Therefore, understanding consumers' perception and willingness to pay is critical to ensure the viability of traceability.

1.2. Objectives

The aim of this thesis is to investigate the quality signalling and assurance of fish products from a consumer point of view. To achieve this main objective, the following specific objectives were established:

1. Evaluate the relative importance to consumers of potential and existing information on fish labels and to identify consumer segments according to the perceived importance of the different types of information.
2. Explore consumer knowledge regarding and associations to traceability, as well as the perceived need for its implementation in the fishing market and expected the benefits.
3. Investigate consumers' willingness to pay more for higher quality fish products and for product with quality assurances provided by traceability.

1.3. Structure

The organization of this thesis is as follows. This thesis begins with preliminary section which includes supervisor's declaration, dedication, acknowledgements, abstracts, table of contents, lists of tables and figures.

Chapter 1 defines the motivation behind this thesis and the main objectives it aims to attain. Furthermore, this chapter presents the structure of this work as well as the methodology employed in this thesis, with information about the data collection and its analysis.

Chapter 2 lays out the theoretical and conceptual background necessary to properly understand this thesis. This chapter includes studies about food quality, fish quality, fish labelling and fish traceability.

Chapters 3 to 5 build upon three different empirical studies. Chapter 3 explores the relationship between the importance of the attributes that could be portrayed in fish labels and the product-specific determinants of and influences on the purchase of fish products, focusing on product specific, socio-economic and demographic factors.

Chapter 4 provides information on perceptions and expectations of traceability of fish products by evaluating consumers' knowledge and associations to traceability, investigating the perceived necessity for traceability in fish products and analysing the desirability of the potential benefits of traceability based on consumers' perceived necessity.

Chapter 5 investigates consumer search for differentiated high quality fish products and WTP for a certain origin and species as well as their interest in labels showing differentiating attributes. Furthermore, this chapter evaluates consumer WTP for traceable fish products.

Chapter 6 discusses the main results of this thesis and presents the general conclusions.

References and appendix are presented at the end of this thesis.

1.4. Methodology

The data for this study were collected in six cities in the northwestern, northeastern, central, eastern, and southern peninsular Spain: A Coruña and Ourense, Zaragoza, Madrid, Valencia and Sevilla, respectively. Including these cities provide representativeness of Spain's cultural, economic and social regional heterogeneity. The fieldwork took place during September and October 2013. In order to collect data, a survey was conducted in person at the participant's home (see Appendix B for the questions used in this thesis). The sampling unit was the household and the respondent was the person responsible for food shopping for the household. Subjects that bought fishery products less than once a year were excluded. Households were randomly selected in the cities previously mentioned. A total of 295 questionnaires were gathered. Furthermore, before data collection, a pre-test with eight

consumers was conducted in A Coruña to assess the clarity, understandability and length of the questionnaire.

The main database was divided in three subsets of variables that were analysed in each of the three studies and variables were coded, or recoded, when necessary for the analysis. For these subsamples, data exploration was performed to detect and exclude observations with missing values and outliers that could bias later analyses. Once the subsets for each study were cleaned up, 214, 216 and 215 observations remained, respectively, for analysis. The analyses performed in this thesis to group variables and observations as well as to evaluate associations between variables and the size effect are showed in Figure 1.

The analyses employed in this thesis were performed using SPSS statistics and R with different packages detailed in Chapters from 3 to 5.
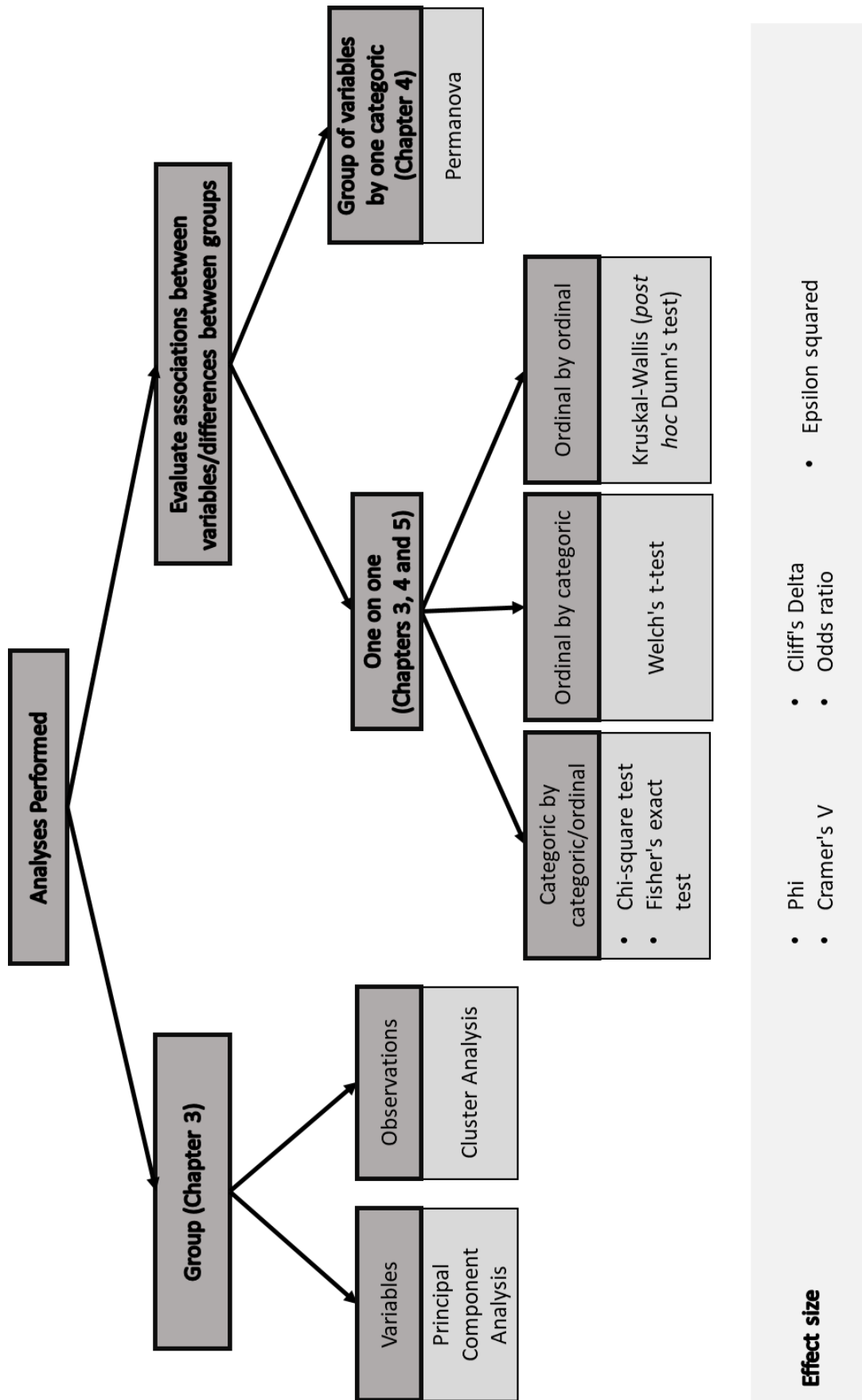
Figure 1. Analyses employed in this thesis

CHAPTER 2

THEORETICAL AND CONCEPTUAL BACKGROUND

2.1. Food quality

In literature, one of the most used words when talking about quality definition is "complex" (e.g., Brunsø et al., 2002; Cardello, 1995; Verkerk et al., 2007). There are multiple definitions of quality, yet a satisfactory global one does not exist (Lawless, 1995). According to the review carried out by Reeves and Bednar in 1994, quality was already defined as value, conformance to specifications, conformance to requirements, fitness for use, loss avoidance and meeting and/or exceeding customers' expectations (Reeves & Bednar, 1994). Nevertheless, according to Grunert (2005, 2007), it is generally accepted that quality is multidimensional, containing both objective and subjective components. An exception to this agreement is Cardello (1995), who states that quality is a consumer-based concept that focuses on acceptability as the key measurement and implies the relativity of evaluation. This author extends the definition provided by Galvez and Resurrecion (1992) for sensory quality "*the acceptance of the perceived characteristics of a product by consumers who are the regular users of the product category or those who comprise the target market*" by interpreting perceived characteristics in their definition as all characteristics of the food. This point of view implies that objective quality is not actual and has been criticised by Lawless (1995).

2.1.1. Objective quality

According to Zeithaml (1988), objective quality refers to the technical superiority or excellence of the products, and it is related to measurable and verifiable superiority compared to ideal standards. Though measures of the specifications may be actual, the standards are based on what managers or authorities consider to be important. A further distinction of objective quality is provided by Lawless (1995) who proposed that two types of food objective quality exist. Product-oriented quality, which is related to the physical properties of a food product, such as nutritional content, and process-oriented quality, which is determined by the conformance of the product to certain standards, such as ecological standards. In addition, Grunert et al. (1996) name these types of quality as product-oriented and quality control, respectively and define a third type – process-oriented –, which consists in the way the product has been made and may not have an effect on the product's physical characteristics.

2.1.2. Perceived quality

Just like for quality, several definitions of subjective or perceived quality exist. For Zeithaml (1988), perceived quality corresponds to consumer's judgment about a product's overall excellence or superiority. Accordingly, it is different from objective or actual quality, implies a higher-level abstraction rather than a specific attribute of a product and a global assessment similar to attitude and an evaluation made in an evoked set. This term is equivalent to the user-oriented quality in Lawless (1995), which this author defined as "*the subjective quality perception of a user, and this may be the end user or an intermediate user in the food chain*". Furthermore, Steenkamp (1990) states that perceived quality (i) entails preference understood as evaluative judgements, (ii) it is comparative, differs from person to person and depends on the context and finally, (iii) it resides on the consumption, not on the purchase. Based on these propositions, Steenkamp (1990) defines perceived quality as "*an idiosyncratic value judgment with respect to the fitness for consumption which is based upon the conscious and/or unconscious processing of quality cues in relation to relevant quality attributes within the context of significant personal and situational variables*".

What can be concluded from this brief review is that quality collects technical or managerial criteria but also consumer perceptions, which is completely subjective and contextual. Therefore, and according to Reeves and Bednar (1994), there must be different definitions applicable to different circumstances.

2.2. Quality frameworks

Following Caswell et al. (2002), there are two different approaches to analyse quality and quality assurance: the economic approach and perceived quality approach.

2.2.1. Economic approach

Economic models focus on how consumers' ability to perceive quality influences the functioning of markets. More specifically, the economic approach focuses on the level of quality firms offer in different conditions, the levels and types of information they provide to consumers as well as the truthfulness of this information (Caswell et al., 2002). Two different types of economic models can be distinguished based on differentiation: vertical and

horizontal. Vertical differentiation models assume that products are different in their characteristics and not all of these characteristics can be judged by consumers at the time of purchasing or even after consumption. On the contrary, horizontal differentiation models assume that perceptions and importance of product attributes differ from consumer to consumer.

2.2.1.1. Vertical differentiation models

Stigler (1961) termed the phenomenon of checking different sellers to determine the lowest price as "search". Searching has a cost which is in terms of time and does not have to be equal for all consumers or goods. The more expensive one's time is (e.g., the higher the income) and the lower the value of the good, the more expensive the search will be. The optimum amount of search will be found when the cost of an additional search exceeds its expected marginal return.

Based on the work of Stigler, Nelson (1970) developed a search and experience theory. While the former referred the term of search to the context of price, the latter did to that of quality of goods and identified one further information process, experience. Furthermore, while the information problem for Stigler was knowing the available options, for Nelson it is evaluating the utility of each option. Nelson defined search as the evaluation of the available options by inspecting them before purchase. According to this author, information about quality can be acquired by search just like price. Nonetheless, information about quality is more expensive than that of price and if the cost rises too much, the price of the product is low or the search procedure is not appropriate for a good, consumers will try to get it in other ways. Consumers can get quality information purchasing and using a good several times. Nelson calls this process "experience".

Darby and Karni (1973) extended Nelson's theory by assuming that one good could have different types of qualities and not just one. Moreover, these authors added a third type of qualities to the Nelson's search and experience, which they termed "credence". Darby and Karni identified search qualities as those that can be known in the search process before purchase. Experience qualities were defined as those that can be ascertained without cost after purchase during the use. Finally, credence qualities are those that cannot be evaluated

even after purchase with the use and are expensive to acquire. Nonetheless, according to these authors, the difference between experience and credence is not always clear.

2.2.1.2. Horizontal differentiation models

Lancaster (1966) developed a new approach to consumer theory. The key assumptions breaking with traditional theories is that characteristics of goods increase consumers' utility and not the goods themselves. Furthermore, a good may have more than one characteristic and these characteristics may not be exclusive of this good. Finally, combination of goods may possess different characteristics than those goods separately.

2.2.2. Perceived quality approach

According to Caswell et al. (2002), perceived quality approach focuses on how consumers form quality judgements. More specifically, these models refer to the role of information and communication available in consumers' quality judgments and purchase decisions.

2.2.2.1. Olson and Jacoby's model

Olson and Jacoby (1972) aimed to identify those product attributes or cues that were considered in making purchase decisions and had the greatest impact in perceptions of brand quality across product categories. According to them, the earlier studied lacked model and direction and tended to limit the number of cues examined to one or two and four at most. These authors classified cues based on their physical basis and at an abstract level so they could be generalised beyond products and consumers, "intrinsic" and "extrinsic" to the product. Intrinsic cues are attributes that cannot be changed or manipulated without changing the physical characteristics of the product. On the contrary, extrinsic cues are not part of the physical product and if they are manipulated the physical characteristics of the product do not necessarily have to change. Three conclusions were obtained from their exploratory research. First, consumers may use several attributes to evaluate and choose brands. Second, intrinsic cues were perceived to be more accurate indicators of quality than extrinsic cues and therefore, would have a stronger effect on judgments of quality. Third, price is not perceived to be as good indicator of quality as certain intrinsic cues. Furthermore, these authors developed a framework including extending two dimensions suggested by Cox

(1962) (cue predictive value and cue confidence value) and a classificatory factor of cues (intrinsicness and extrinsicness of the cue). For Olson and Jacoby (1972), predictive value refers the extent to which the consumer believes that a cue is associated to or indicative of product quality. Confidence value was defined as the extent to which the consumer trusts his or her capability to correctly perceive and judge that cue. According to these authors, predictive and confidence value have an interactive effect on the probability of the utilization and the magnitude of its effect. Consumers generally believe that intrinsic cues have a higher predictive value and, therefore, they may be used more often and have a greater effect on quality perception than extrinsic cues. When available intrinsic cues have low predictive and/or confidence value, consumers may tend to use extrinsic cues and vice versa.

2.2.2.2. Steenkamp's model

Steenkamp (1989) applied the Dudycha and Naylor (1966) conceptualization of Brunswik (1956) lens model (for further information see Dudycha and Naylor, 1966) to quality attributes and quality cues and incorporated concepts from Cox (1962) (predictive and confidence value), Olson and Jacoby (1972) (Extrinsic-Intrinsic cues), Nelson (1970) and Darby and Karni (1973) (search, experience and credence attributes). Based on Nelson's search attributes, Steenkamp defined quality cues as "*informational stimuli that are, according to the consumer, related to the quality of the product, and can be ascertained by the consumer through the senses prior to consumption*". The model developed by this author attempted to describe how consumers form quality perceptions at the point of purchase (Figure 2).
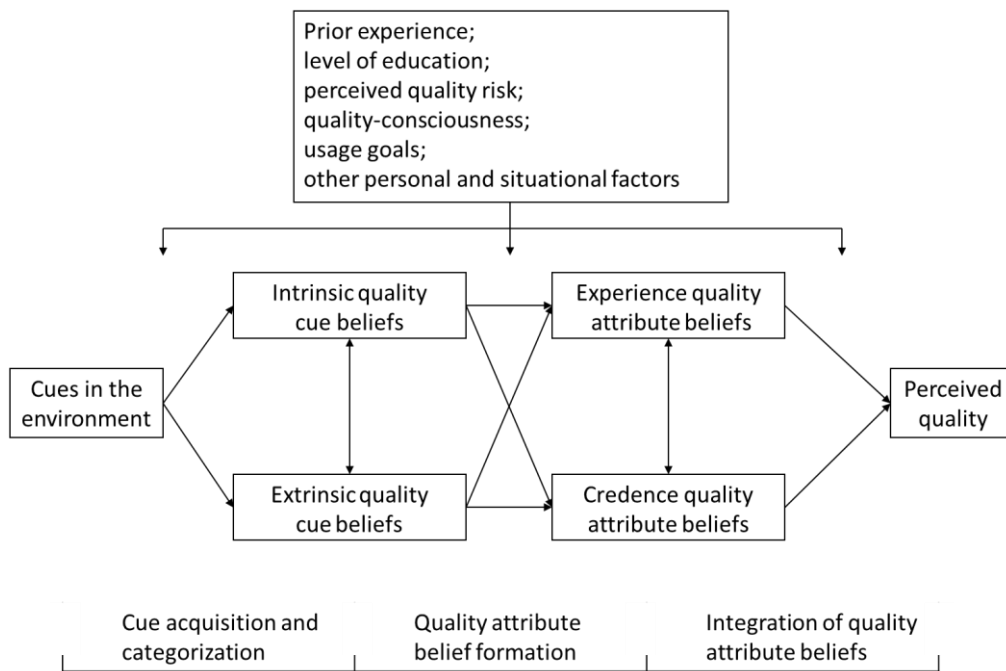
Figure 2. Steenkamp's conceptual model of the quality perception process (Steenkamp, 1989)

According to this model, the quality perception process would consist of three subprocesses. First, consumers would acquire and categorize a few of the cues present in the environment. It is more likely that consumers acquire cues that are perceived to have a strong relationship with attributes, that are vivid as well as more easily available, acquired and understood. Second, consumers form inferential beliefs about the experience and credence quality attributes with respect to the few cues acquired and categorized. The magnitude of the effect of a cue with respect to an attribute is hypothesised in this model to be (i) positively affected by the strength of the perceived relationship between the cue and the attribute, (ii) positively affected by the confidence value of the cue and (iii) greater for intrinsic than for extrinsic cue. Consumers can also form informational beliefs accepting information from other outside sources such as friends or salespeople but according to Steenkamp, this process is less relevant for quality attribute belief formation. Third and last subprocess, consumers integrate quality attribute beliefs. When time pressure is high non-compensatory models are more likely to be used while processing by alternatives is more likely in most purchase situations. Furthermore, personal and situational variables such as experience with the product or usage goals are expected to influence the formation of perceived quality judgements.

2.2.2.3. Total Food Quality Model

Grunert et al. (1996) developed the Total Food Quality Model (Figure 3) that attempted to cover all major elements of the quality perception process. It aimed to serve as a framework for the analysis of consumers' food quality perception and its relation to the intention to buy.
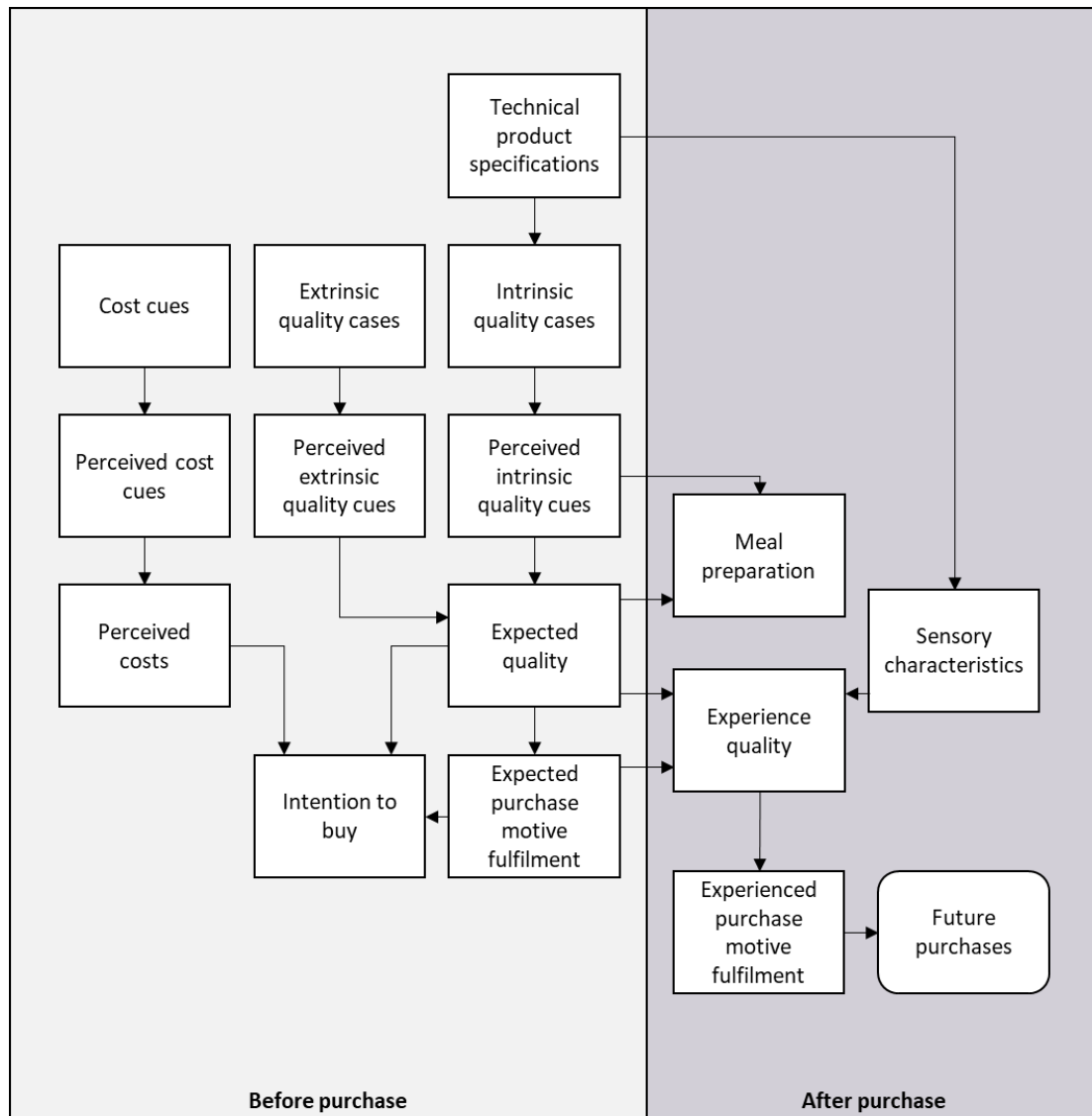
Figure 3. The total food quality model (Grunert et al., 1996)

The Total Food Quality Model distinguishes two different momentums of purchase evaluation, before and after purchase which is the basis of this model.

Before purchase, many product characteristics cannot be ascertained, and consumers form quality expectations based on some of the available cues. This model differentiates between intrinsic and extrinsic quality cases, which may be equal to Olson and Jacoby (1972) intrinsic

and extrinsic quality cues, as well as cases, cues and perceptions, which are similar to Steenkamp (1989) cues, beliefs and perceptions. In addition, this model assumes that technical product specifications affect intrinsic quality cases and includes a new type of cue, cost cues. These quality cases and cues contribute to form expected quality and perceived cost, respectively. Consumer's expected quality evaluation determines intention to buy but only in relation to the perceived costs. Finally, expected quality influences the expectations of purchase motive fulfilment.

After the purchase, the consumer will experience quality. Experienced quality may be affected by technical product specifications mediated by the sensory characteristics of the product, characteristics used as quality indicators to infer quality, product characteristics not used by the consumer in the quality evaluation process and the way the product is used in meal preparation. Additionally, this model goes beyond quality and looks at consumer purchase motive.

2.3. Fish quality

It is necessary to remember that "quality" does not have a unique definition and means different things to different people, in different contexts and for different product types (Gill, 1990). What seems certain is that fish is a highly perishable commodity which makes freshness fundamental for the quality of fish products (Alasalvar et al., 2011; Olafsdottir et al., 2004).

2.3.1. Objective fish quality

According to Bremner and Sakaguchi (2000), fish have certain compositional and structural properties at the time of catch or harvest, but these properties change after death due to chemical, physical, biochemical, enzymatic, and bacterial influences. Thus, fish characteristics, freshness and quality are influenced by intrinsic factors, such as biological characteristics of the species or individual, and extrinsic such as the time and temperature history, pre-harvest and post-harvest handling (Boziaris, 2014; Freitas et al., 2020; Olafsdottir et al., 2004).

In each link, the fish is exposed to different factors that influence the properties of the product (Olafsdottir et al., 2004), like its colour, translucency and extensibility as well as the rate, duration and intensity of rigor (Bremner & Sakaguchi, 2000). According to Bremner and Sakaguchi (2000) these fish properties could be considered freshness indicators, where an indicator is defined as "*that measurable entity which can be used to describe one or more of the post-mortem changes that have occurred*". Based on this idea, different methods exist to assess the freshness of fish products: chemical, physical, microbiological and sensory (Borderías & Moreno, 2018). Chemical methods analyse muscle to look for chemicals that correlate with sensory attributes. Physical methods are related to image analysis while microbiological examination identifies, enumerates and measures microbial metabolism. Finally, different authors have acknowledged the importance of sensory methods (e.g., Alasalvar et al., 2011; Olafsdottir et al., 2004) which are considered the most effective to measure fish quality and is often the standard for all objective comparisons (Gill, 1990). These methods are designed to evaluate intrinsic attributes of fish (e.g., eyes, gills, skin) and they must be adapted to the different species. Three different specific sensory methods exist for assessing fish freshness: the UE Quality Grading Scheme (The Council of the European Union, 1996), the Torry scheme (Shewan et al., 1953), and the "Quality Index Method" (QIM) (Bremner & Sakaguchi, 2000).

The particular fragility of fish makes it necessary to monitor the product quality in each chain link to ensure product quality (Hyldig et al., 2007; Olafsdottir et al., 2004). Nonetheless, according to Alasalvar et al. (2011), it is believed that no single method is reliable enough to assess the freshness and quality of fish products. Information about the history of the product is critical for the agents in the value chain (Olafsdottir et al., 2004) and unless it is known, no method can provide a measure of freshness (Freitas et al., 2020).

2.3.2. Fish quality perception

For processors, a fish has low quality if it is too small, in an unfit condition for a certain process or if it results in a low profit; while for health authorities good quality may mean the absence of hazardous agents (Borderías & Moreno, 2018). Nonetheless, consumers can only evaluate fish products based on their subjective perception of quality (Gill, 1990). Fish quality is a key criterion for consumers to decide which product to buy (Altintzoglou & Heide, 2016; Olsen et

al., 2017). Therefore, positive consumer perception of the seafood products is critical for the fish industry (Alasalvar et al., 2011).

Using the structure and terminology introduced with the Total Food Quality Model (Grunert et al., 1996), Brunsø (2006) gives an overview of major trends on consumer attitudes and behaviour in relation to fish in Europe.

2.3.2.1. Cost and quality cues

First, Brunsø (2006) suggests that perceived cost cues include not only price but also quality label, type of fish, special offer, outlet, brand and origin.

Second, according to this author, the most important intrinsic cues are kind of fish, fat content, whether the fish is fresh, frozen or canned, appearance and smell. Along the same line Matos et al. (2017) suggest that organoleptic properties such as freshness, flavour, taste, aroma, texture and visual appearance, are important intrinsic quality cues for the consumer. Nevertheless, these authors state that there are other aspects not immediately apparent that are necessary to understand the perception of fish quality and value, such as nutritional value, food safety and product stability, farming ethics and environmental impact. Furthermore, different authors have shown that consumers face difficulties in evaluating fish quality using only intrinsic cues and many of the relevant cues are not available to consumers unless a sample of the product is offered (e.g., Birch & Lawley, 2012; Brunsø et al., 2009; Lawley et al., 2012; Pieniak et al., 2013; Sogn-Grundvåg & Østli, 2009). For instance, Pieniak et al. (2013) showed that European consumers' knowledge about fish is generally poor but differed between countries. Results from Sogn-Grundvåg and Østli (2009) in Portugal showed that judging the quality of an unbranded and unlabelled fish product is very hard for consumers. They evaluate the quality of dried and salted cod by inspecting it visually, touching and smelling the product. Consumers use the appearance and dryness of the product as well as other aspects not related to "objective" quality as quality indicators. However, even though Portuguese consumers spend up to 10 minutes assessing dried and salted cod, they are uncertain about their quality. Brunsø et al. (2009) carried out six focus groups in Spain and Belgium finding heavy users are very skilled in evaluating fish quality and use different intrinsic cues. For these consumers, fish must be bright-eyed, have pink gills, look fresh and smell well. In contrast, light users do not know much about which indicators to use for

evaluating fish quality and tend to make irrational assumptions of intrinsic cues such as the rotation of the fish and use extrinsic cues. In Australia, Birch and Lawley (2012) found that consumers lack familiarity, knowledge and confidence in selecting and preparing seafood. Likewise, results from Lawley et al. (2012) in this same country indicate that taste appears to be the most relevant intrinsic cue for consumers when evaluating barramundi quality. Mouthfeel, sweetness, oiliness, saltiness and level of bitterness along with colour and aroma were also correlated with overall liking. Nonetheless, most Australian consumers lack knowledge, confidence and expertise in utilizing intrinsic cues to buy fish and rely more heavily on extrinsic cues.

Consumers also use extrinsic cues to infer quality. Regarding fish, extrinsic cues, price, origin, outlet, quality label, date of catch, packaging, information on control and whether the fish is farmed contribute to form quality expectations in many countries (Brunsø, 2006). According to results obtained by Verbeke et al. (2008), consumers use those cues that they are most familiar and confident with. Those who are less experienced with fish are more interested in extrinsic attributes such as information which helps them to evaluate fish quality and form quality expectations. A review carried out by Carlucci et al. (2015) highlights the importance of country of origin, production method, preserving method, product development, packaging, and eco-labelling of fish for consumers. First, these authors suggest that consumers prefer domestic fish because they perceive it as being of greater quality, safety and freshness. This can be explained by the shorter distance between the production place and the store which affects freshness and environmental costs, but also stereotypes, emotional sensations and incorrect information such as patriotism or ethnocentrism. Second, most of consumers prefer wild fish over farmed fish in terms of taste, safety, healthiness and nutritional value. Third, regarding preserving methods, chilled (fresh) fish was the preferred by consumers, followed by frozen, canned and smoked/salted fish. Consumers perceived that taste, odour and texture changed in the other preserving methods as well as quality, safety, healthiness, nutritional value and naturalness diminished. Fourth, consumers appreciate new convenient fish products if product characteristics are not significantly altered. Fifth, most respondents prefer traditional unpackaged fish. Finally, due to concerns for sustainable fisheries, eco-labels are becoming an important attribute for fish choice. In France, results from Rickertsen et al. (2017) suggest that French consumers perceive that wild fish is better

than farmed in terms of safety and health but worse for environmental sustainability and fish welfare. Sensory characteristics and willingness to pay depend on the species. In Italy, the research carried out by Gaviglio et al., (2014) indicates that there are differences in Italian consumers' perception of fish based on fish species and presentation forms. Likewise, results from Boncinelli et al. (2018) show that Italian consumers are willing to pay a price premium for knowing the catch zone of fish used as an ingredient of processed food. In Spain, Claret et al. (2012) found that the most relevant factors for Spanish consumers are origin, storage conditions, price and production method, with wild fish perceived as having a better overall quality and consumers being willing to pay a significant price premium in price for it. In this same country, based on a hedonic analysis, Asche and Guillen (2012) determined that origin is the most important attribute for the price of hake, with consumers preferring local products. Furthermore, fish size and the fishing gear used in harvesting are also important attributes in price determination of hake. In Spain and Belgium, Brunsø et al. (2009) found that, beside using intrinsic cues, heavy consumers of fish believe that attributes such as "species", "country of origin" and "wild" affect quality preferring fish of national origin and they clearly prefer wild fish and fresh fish to farmed fish and frozen fish, while light consumers use cues such as price or outlet. In Norway, results from Heide & Olsen (2017) suggest that consumers perceive informational attributes like freshness statements, information about taste and convenience to be more important than visual attributes, such as shape of packaging and colour, when choosing cod fillets. Furthermore, the most relevant factors were related to freshness, with shelf life being more important than other affective information such as "unique freshness". In the Netherlands, Kole et al. (2009) found that cod evaluation is affected by information about product type, price, freshness and the advantages of fish farming. While cod labelled as wild, highly priced or recently caught was judged more favourably, the advantages of farming had a negative effect. In Australia, the study carried out by Lawley et al. (2012), showed that country of origin was the most important extrinsic cue, particularly country of origin when purchasing seafood. ''Australian'' was an indicator of freshness, superior quality and safety but also of a higher price. Furthermore, positive subjective evaluation based on extrinsic cues improved the negative objective evaluations based on intrinsic cues.

2.3.2.2. Expected fish quality and purchase intention

According to Brunsø (2006), expected quality is mainly associated to freshness, wholesomeness, taste and nutrition. Other factors like usability and difficult to prepare, low in calories, high digestibility, luxury, natural and like/do not like and motive fulfilment, such as keeping the family healthy, being adventurous and being a meal for the whole family are also associated to fish quality. In a similar vein, Olafsdottir et al. (2004) suggest that, from a consumer perspective, quality of fish products includes safety, nutritional quality, eating quality, freshness, convenience, integrity and size as well as availability, the physical attributes of the species and product type. In Norway, Olsen et al. (2017) found that, when buying fish for home consumption, consumers perceive quality attributes such as taste, freshness, nutritional value and naturalness as the most relevant. These authors also found that consumers are not homogeneous and identified three different consumer segments based on the importance of product attributes: "Perfectionists", "Quality Conscious" and "Careless". In the Netherlands, Luten et al. (2002) found that quality of cod was correlated to taste, liking and colour. Furthermore, according to Heide and Olsen (2017), freshness is the most desired fish attribute for consumers. In fact, Brunsø (2009) found that some consumers equal fish quality to freshness.

Nonetheless, Brunsø (2006) suggests that some consumers do not like fresh fish due to the presence of bones and its taste. In the same way, other consumers perceive it as non-convenient, expensive, and its purchase and preparation as time-consuming. The ability to judge the quality of fresh fish in the purchase situation along with the ability to clean and prepare fresh fish and its availability also influence consumers purchase intentions.

2.3.2.3. Information sources regarding fish

Since consumers encounter difficulties in evaluating fish quality from intrinsic cues at the time of purchase, their expectations may not match their experienced quality, increasing the possibility of disappointment and lowering the probabilities of future purchases. Uncertainty regarding fish attributes can be reduced with information (Shiu et al., 2011). Information on food and particularly on fish can be obtained from different sources. According to Capps (1992), external information sources can be classified into personal (e.g., health professionals, dieticians or nutritionists), media (e.g., radio, television, newspapers) and labels (or food

packages). Previous studies have shown that personal sources are the most important external information sources regarding fish (Pieniak, Verbeke, Scholderer, et al., 2007; Pieniak, Verbeke, Vermeir, et al., 2007; Verbeke et al., 2008). In particular, consumers trust fishmonger (Claret et al., 2012; Verbeke et al., 2008), doctors, dieticians and family or friends as opinion leaders (Pieniak, Verbeke, Scholderer, et al., 2007). However, at the time of purchasing fish products, Pieniak et al. (2013) found that, along with personal sources, labels are one of the most used sources of information. According to Verbeke (2011), labels signalling sought attributes backed up by traceability systems will play a critical role in communications about food by providing information and reassurance about the intrinsic and extrinsic cues of food products.

Both mandatory and additional information must be carefully chosen (Pieniak et al., 2011). Verbeke (2008) noted that much of the information provided to consumers may be irrelevant or overloading and does not attract consumers' interest. Along the same line, Salaün and Flores (2001) suggest that much of this information does not address consumer needs or expectations, looking for the desired data is very time-consuming and the meaning or relevance of the information provided may not always be understood by consumers. Verbeke (2005) states that consumers are not all alike and simply providing more information to consumers is not enough to reduce information asymmetry and uncertainty.

Based on use of and trust in fish information sources, different studies indicate that the use and trust of information related to fish and seafood is heterogeneous among consumers (e.g., Altintzoglou & Heide, 2014; Altintzoglou & Nøstvold, 2014; Verbeke et al., 2008). For instance, results obtained by Altintzoglou and Nøstvold (2014) indicated the existence of three different segments of Norwegian consumers according to their use of and trust in information sources and reactions to information cues at the time of purchase and consumption of fish products: "Label trusters", "Info skippers" and "Info seekers". Differences in their needs regarding labelling were also found. While "Info seekers" reported the highest use and trust in all types of information, "Label truster" used and trusted label information to make decisions and "Info skippers" showed the lowest use and trust in all types of information. Finally, Altintzoglou et al. (2014) identified three distinct consumer segments in France based on the consumers' use of and trust in information sources regarding fish freshness. "Unsure consumers" displayed a moderate use of and trust in information sources when evaluating

fish quality, but the lowest interest in most information cues among groups. "Enthusiast consumers" scored high in both use of and trust in information sources. Finally, "Confident consumers" did not trust the employees at supermarkets much, but they trusted and used their own judgement. Differences regarding interest in information cues were also found.

2.4. Fish labelling

2.4.1. Functions of labels

Fish labels are important sources of information for consumers (Jørgensen et al., 2006; Pieniak et al., 2011; Pieniak, Verbeke, Scholderer, et al., 2007; Pieniak, Verbeke, Vermeir, et al., 2007) since they are of interest for consumers with high quality involvement and aid those with low self-confidence in evaluating fish quality and forming quality expectation (Verbeke et al., 2007, 2008). According to Caswell (2006), labels provide two types of signals to consumers. Only by their presence on a product they put the spotlight on issues that should be considered by consumers while the information they carry allows consumers to infer quality and compare products. Labels can turn credence attributes into search cues (Halawany et al., 2007) and improve the environment for the latter (Caswell & Mojduszka, 1996). By doing so, labelling reduces search costs and corrects information asymmetry (Hanss & Böhm, 2012), helps producers to differentiate products (Alfnes et al., 2018), encourages consumer purchase of seafood products (Fernández-Polanco et al., 2013; Kempen et al., 2011), increase the perceived value of products (Jørgensen et al., 2006; Pieniak, Verbeke, Vermeir, et al., 2007) and obtain price premiums (Alfnes et al., 2018). Therefore, although the main objective of labelling programs is providing consumers with information they may use to make purchase decisions (Caswell, 2006), not only quality labels are beneficial for consumers (e.g., easing decision making), they also provide benefits to producers (e.g., reducing consumer inspections and increasing sale stability) and processors (e.g., provides information on suppliers acceptability and assists due diligence defence) (Luten, 2003).

2.4.2. Interest in and use of labels

Reading food labels has become a generalised practice among consumers (Szlachciuk & Ozimek, 2017; Vemula et al., 2014; Viola et al., 2016) and it seems to be an increasing habit (Jo & Jung, 2019). According to a study carried out by Viola et al. (2016), almost all consumers

read labels with half of them doing so most of the time or always. Furthermore, according to these authors, the more informed is a subject the more he or she cares about reading labels. Results from focus group discussions carried out by Halawany et al. (2007) in France and Germany suggest that consumers do read and pay attention to labels and their information. However, this reading is fast and superficial.

Previous research reviewed by Hall and Osses (2013) indicates that consumers use food labels to infer characteristics that are not observable before consuming the product. In India, Vemula et al. (2014) found that consumers mainly check labels for safety and quality concerns. In the same vein, results from Zhang et al. (2017) indicate that, in the United States, about 72% of consumers often used food labels "to see how high or low the food is in nutrients such as calories, salt, vitamins or fat" 60% to "judge the nutritional quality of the food"; 50% to "compare foods", 54% to check for ingredients they wanted to avoid, 47% to decide which brands to buy. Less frequent uses of food labels included "to check if claims are true" (33%), "to figure out how much of the food you should eat" (41%), and "to help in meal planning" (36%). Likewise, Kempen et al. (2011) found that, in South Africa, consumers look at labels to evaluate the nutritional value, personal benefits, health attributes and quality of the product. According to Hall and Osses (2013) this behaviour is influenced by factors such as values, attitudes, knowledge, perceived control and barriers, social norms and socio-demographics. Furthermore, previous studies have shown that, even though labels are mainly used at the time of purchase, they are also used at home. Szlachciuk and Ozimek (2017) found that 13.2% of young Polish read food labels, more than half do it while shopping, while almost a third read them at home. Consistent with these results, research carried out in South Africa by van der Merwe et al. (2014) indicate that most respondents used labels before purchasing but also at home, which indicates that labels are not only used as a signal of quality but also to maintain it.

Different studies have investigated consumers' interest in and use of fish labels. Pieniak et al. (2013) carried out a survey in eight different European countries finding that consumers are interested in seeing labels when buying fish which would indicate that the fish is safe and of good quality. Information related to product attributes and issues such as sustainability and welfare was of the greatest interest for consumer. Altintzoglou et al. (2012) found that price, date, then sustainability, fresh, line/hook caught and whether home freezing is possible were

important criteria for English consumers to choose fresh cod products. According to the studies carried out by Pieniak et al. (2011) in Poland, Pieniak, Verbeke, Vermeir, et al. (2007) in Belgium and Spain and Pieniak, Verbeke, Scholderer, et al. (2007) in five different European countries, consumers are most interested in a safety guarantee, quality mark, recipes and health benefits as potential information cues, and they use basic mandatory cues from fish labels such as price, expiry date, fish species, and weight. Moreover, in Poland the frequency of use and interest were affected by the frequency of fish consumption, while in Belgium and Spain interest in information and labelling was found to be heterogeneous and consumers doubt whether label information is reliable. Results from Altintzoglou et al. (2014) in France suggest that consumers were most interested in "previously frozen", "date of capture" and "wild/farmed" while they mainly used "expiry date", "price" and "fish species/name" to ascertain the freshness of cod fillets. A review carried out by Alfnes et al. (2018) suggested that consumers use information related to species, origin, and production method to infer unobserved levels of fish quality.

2.4.3. Problems related to labels

Labels must be appreciated by consumers for them to increase the value of the labelled seafood (Alfnes et al., 2018). Hall and Osses (2013) state that the amount of information and how it is displayed on food labels is important for consumers and affects how they use the information provided to them. Grunert (2005) suggests that food labels may not act as quality cues because consumers do not think they are predictive of the quality dimension; they are interested in or feel more confident using other cues. Furthermore, according to this author, consumers may not understand labels' meaning and make incorrect inferences. Different studies provide empirical evidence indicating the existence of a number of problems related to labelling. For instance, research carried out by Halawany et al. (2007) in Germany and France and Giraud and Halawany (2006) in twelve countries indicate that consumers are not satisfied with the size of the letters and the transparency of the label. In France, the latter authors found that consumers could not understand labelling which in some cases was misleading. Likewise, results obtained by Verbeke et al. (2007) and Verbeke et al. (2008) in Belgium and Spain showed that consumers perceive label reading as a very time consuming task and labels as very difficult to understand and loosely related to the intrinsic fish attributes. Along the same line, according to Vemula et al. (2014) most consumers in India

find nutritional label information hard to understand because they do not have the knowledge, the information is too complicated or the font too small. Furthermore, results from Pieniak, Verbeke, Vermeir, et al., (2007) suggest that most consumers do not trust the information provided by fish labels. Salaün and Flores (2001) suggest that consumer confidence may be affected when they are overloaded with information. Likewise, Bitzios et al. (2017) state that confidence in product attributes may be lowered by information being hard to understand. Misleading information, mislabelled products, false and faulty labels have increased consumer concerns about the trustworthiness of the information portrayed on labels. These authors also identify three aspects to these concerns: (i) food safety and where the food has been handled and by whom; (ii) perceived quality, and (iii) risk of being sold something under false pretences, which may have safety or quality implications. According to these authors, all these aspects have been linked to traceability. Along the same line, Asensio and Montero (2008) suggest that traceability systems are necessary to transmit information from economic operators to retailers and avoid an incomplete fish labelling. Finally, Pieniak et al. (2011) state that introducing a safety guarantee or quality mark backed up by credible traceability could raise consumers' trust.

2.5. Fish traceability

Policy makers and producers in different countries have addressed consumer demands for reliable and relevant information and guarantees with different voluntary and mandatory traceability initiatives (Hobbs et al., 2005; Roos et al., 2005).

2.5.1. Definition of traceability

Despite the increasing popularity of traceability, there is no general agreement on how to define it (Karlsen et al., 2013). Results of a systematic literature review carried out by Olsen and Borit (2013) show that scientific papers not only use multiple definitions but also, in several of the assessed documents, traceability is used in an incorrect context.

For instance, in the literature, Moe (1998) defined traceability as "*the ability to track a product batch and its history through the whole, or part, of a production chain from harvest through transport, storage, processing, distribution and sales or internally in one of the steps in the chain for example the production step*". Nonetheless, results obtained by Olsen and Borit

(2013) indicate that the most frequently used definition is provided by the EU General Food Law. This law defines traceability as "*the ability to trace and follow a food, feed, food-producing animal or substance intended to be, or expected to be incorporated into a food or feed, through all stages of production, processing and distribution*" (European Parliament & Council of the European Union, 2002).

2.5.2. Functions of traceability

By linking consumers to the life history of the product, traceability fills the information gap between agents of the value chain reducing inefficiencies from information asymmetries such as safety issues (Ortega et al., 2011) and may increase consumers' confidence in food products (Bosona & Gebresenbet, 2013). Hobbs (2003, 2004) distinguished between ex-ante preventive and ex-post reactive traceability functions. This author states that, with traceability, quality is signalled ex-ante and reliable quality information flows from producer to consumer. Once quality is revealed, traceability allows the establishment of liability and product trace-back in case of a food safety incident. Therefore, traceability incentivises producers to market safer products and minimizes costs for the other market agents (Hobbs, 2003, 2004). Additionally, according to Opara and Mazaud (2001) and Roos et al. (2005), traceability satisfies consumers' increasing demand for information about content, origin and the production process of food products. These attributes cannot be uncovered, even with specialized testing, and traceability becomes the only way to differentiate them (Golan et al., 2002). Thus, traceability emerges as a necessary tool for food businesses to label accurately, support marketing claims and inform consumers about credence attributes (Roos et al., 2005).

2.5.3. Consumer knowledge and associations to fish traceability

Consumer knowledge and associations to traceability have been studied by different authors (e.g., Kehagia, Chrysochou, et al., 2007; Kher et al., 2013; Lopes et al., 2017; van Rijswijk et al., 2008; van Rijswijk & Frewer, 2008). Nonetheless, much previous consumer research on traceability has focused on meat chains (Roos et al., 2005) and food in general, while studies on traceability of fish products are scarce (e.g., Calvo Dopico et al., 2016; Chrysochou et al., 2009; Haghiri & Simchi, 2012; Metref & Calvo-Dopico, 2016; Wang et al., 2009). For instance,

results from the study of Fabinyi and Liu (2014) carried out in Beijing suggested that the awareness of this term shown by consumers of seafood banquets was low. Likewise, Wang et al. (2009) investigated consumers' awareness to fish traceability in Beijing and found that only 19.6% knew of the existing traceability system in this area while 9.1% of consumers knew some details about it. In contrast, studies in Europe have shown that most European consumers have heard the term "traceability" and are familiar with it, suggesting that the introduction of traceability systems in Europe has increased consumers' awareness of this concept (Gellynck et al., 2006; Kher et al., 2013). However, the term "traceability" is still very confusing and hard to understand for them and most of consumers are not able to define it (e.g., Giraud & Amblard, 2003; Kehagia, Chrysochou, et al., 2007). A study carried out by Metref and Calvo-Dopico (2016) in Spain showed that about 70% of tuna consumers did not know the meaning of traceability, but it was mainly associated to quality, origin and the path of a particular product in the supply chain. Other studies that do not focus on fish have shown that consumers also associate traceability to the ingredients of the product, food scares and control (Giraud & Halawany, 2006) as well as to labelling (Giraud & Amblard, 2003), general product information, production process, tracking back to production (Chryssochoidis et al., 2006) and safety (van Rijswijk & Frewer, 2008).

2.5.4. Desirability and perceived benefits of fish traceability

Previous research on consumers' demand and attitudes towards traceability of fish products show that, in general, consumers are well-disposed towards the introduction of traceability in the value chains. For instance, Maciel et al. (2013) found that, in Brazil, the majority of participants considered fish traceability a good or very good initiative (73.2%). Along the same line, the study carried out by Metref & Calvo-Dopico (2016) showed that most Spanish consumers of Tuna (87%) demanded the implementation of traceability systems in fish value chains. Likewise, Haghiri and Simchi (2012) investigated consumer attitudes toward mandatory traceability of farmed Atlantic salmon in Newfoundland and Labrador and they identified three different factors: "costly requirement", "beneficiary requirement" and "unnecessary requirement". These authors also identified three differentiated segments of consumers according to their attitudes toward traceability: "Knowledge-cognizant", "Price-conscious" and "Self-confident". Knowledge-cognizant segment (27.5%) comprised consumers moderately in favour of mandatory traceability systems. Consumers in the price-

conscious segment (42.5%) associated traceability with some benefits but believed it would rise prices. Only consumers in the self-confident segment (30.0%) were reluctant to accept mandatory traceability. Furthermore, research by Pulcini et al. (2020) in Italy showed that almost a quarter of Italian consumers considered that organic aquatic food should be traceable while traceability was not so critical for frozen products. Traceability was also more important for older consumers and residents of central regions and islands.

Nonetheless, consumers seem to be interested in cues derived from traceability rather than in direct indication to traceability but also show that there is some heterogeneity among consumers. For example, Pieniak & Verbeke (2008) found that consumers of five different European countries were highly interested in cues that can result from traceability of fish products such as safety guarantees and quality marks while the least interesting cue was the batch identification number. Likewise, Fabinyi and Liu (2014) found that consumers of seafood banquets in Beijing showed low interest in traceability issues. Along the same line, the results obtained by Pieniak, Verbeke, Scholderer, et al. (2007) showed that, in general, consumers were mostly interested in safety guarantee, quality mark and recipes for fish. Nonetheless, these authors identified four different consumer segments according to their use and trust in information sources of fish, which also differed in their interest in traceability information. Enthusiasts (41.4%) who reported the highest use of all information cues, had the highest score for direct interest in traceability too. Sceptics (24%) showed the lowest use of ''basic'' on-pack or on-label information cues and a moderate use of nutritional composition, capture area and date of capture. These consumers scored the lowest interest in traceability. Confidents (34.6%) not only displayed the lowest usage of all given information cues but also reported a moderate to low score on direct interest in traceability. Finally, the results of Kehagia et al. (2017) regarding the information sought by Greek and German consumers about traceability of chilled fish fingers indicated that information search is affected by consumers' literacy.

According to van Rijswijk et al. (2008), traceability is important to consumers because of the potential benefits they expect to obtain from it. Different studies have shown that consumers recognise that traceability in the fish sector will be beneficial for them. For instance, results from Calvo Dopico et al. (2016) in five different European countries indicated that, in general, the most frequently expected benefits from traceability were to be able to know the origin

and whether the fish came from sustainable fisheries, as well as to make sure that the product is safe, manage a food crisis and allocate liability. Consumers also expected traceability to let them know the quality of the product, whether it has gone through a quality control as well as its ingredients but to a lesser extent. Nonetheless, significative differences between countries in consumer expectations were found. Along the same line, Metref and Calvo-Dopico (2016) found three different factors grouping expectations regarding traceability in tuna value chains: food safety, control in the value chain and crisis management.

2.5.5. Consumers' willingness to pay for traceable fish products

Several studies have investigated whether consumers would be willing to pay a premium for traceable fish products with mixed results. For instance, according to Maciel et al. (2013) consumers in São Paulo perceive that fish products should be more expensive when characteristics such as safety, quality, traceability, high nutritional value, and availability are required. In the study carried out by Haghiri and Simchi (2012) in Newfoundland and Labrador, more than two-thirds of respondents would be willing to pay 15% more to purchase traceable farm-raised Atlantic salmon. Results obtained by Wang et al. (2009) indicated that 85.7% of consumers in Beijing thought that fish prices would rise if traceability was implemented and 89% of them would be willing to pay a higher price. Nonetheless, the average premium would be only 6%. Furthermore, these authors found a correlation between age and willingness to pay, with those between 20 and 35 years old expressing a higher willingness. Along the same line, Metref and Calvo-Dopico (2016) found that only 27.09% of consumers would pay a premium in price for traceable tuna products and the majority of those consumers (66.20%) would only pay up to 0.50€ over a reference price of 10€.

CHAPTER 3

LABEL INFORMATION DEMANDED BY CONSUMERS AND

DETERMINANTS OF FISH PURCHASE: THE CASE OF COD

Abstract

Information portrayed in labels allows consumers to make quality inferences and comparisons between products. However, labels might be ignored if it does not meet consumer needs for information. The objectives of this study were to evaluate the relative importance to consumers of potential and existing information on cod labels and to identify consumer segments according to the perceived importance of the different types of information. Results show that the importance given to different label information is related to the sociodemographic characteristics of consumers such as gender, household type, household income and the place of residence. The information related to safety, such as best before and whether the product had undergone a health control, was considered to be the most important. A cluster analysis based on the perceived importance of different label information revealed four groups of consumers: *traditional*, *safety-conscious*, *quality-orientated* and *enthusiasts*. The *traditional* segment was the largest and comprised those consumers attaching the least importance to label information. Nonetheless, these consumers considered health and safety attributes to be the most relevant. Significant differences were found in purchase motives between the four segments. The results presented here can be used by authorities and producers to design more effective labels.

Keywords: Labelling; Motives; Segmentation; Fish; Quality; Safety

3.1. Introduction

In the highly competitive fish market driven by demand, producing a good product alone is not enough to succeed. Consumers make purchase and consumption decisions based on an evaluation of its quality attributes (Caswell et al., 2002). However, quality of fish products is associated to freshness, size and to organoleptic characteristics such as flavour and taste, but also to features like sustainability and, particularly, safety and healthiness which cannot be uncovered even after consumption (Korthals, 2008; Matos et al., 2017). Therefore, consumers encounter difficulties when trying to evaluate fish quality without any aid (Sogn-Grundvåg & Østli, 2009).

In conditions of uncertainty, consumers make quality inferences using the available intrinsic (i.e., part of the physical product) and extrinsic quality cues (i.e., not directly related to the product). Consumers select cues based on their quality diagnosticity and their accessibility or confidence value (Grunert, 2006). While diagnosticity refers to the efficiency of the signal to predict the quality of the product, accessibility is related to confidence in the ability to make the right inference using that cue. In general, intrinsic cues have a higher diagnostic value than extrinsic cues. There is evidence that intrinsic cues related to the appearance of seafood, such as the colour (Nielsen et al., 2002), the brightness of the eyes and the pinkness of the gill, as well as the smell of the fish (Pieniak, Verbeke, Vermeir, et al., 2007) and the texture (Sogn-Grundvåg & Østli, 2009) are important for consumers in fish quality evaluation. Nonetheless, some authors also argue that many consumers believe they know little about fish (Sogn-Grundvåg & Østli, 2009) and are more familiar with extrinsic cues (Lee & Lou, 2011). Extrinsic cues include price, brand name, information related to the origin and quality labels, among others (Caswell, 2006).

Quality labels can signal specific attributes, such as fair-trade, while others can be general quality labels and refer to a bundle of quality attributes (Grunert, 2005). They have become an important and effective means for producers to communicate fish product attributes to consumers (Pieniak et al., 2011; Pieniak, Verbeke, Vermeir, et al., 2007) and a way of differentiation (Alfnes et al., 2018). Labels are one of the most trusted sources of information by consumers (Wills et al., 2009) and they are considered as necessary to guarantee safety in fish markets (Pieniak & Verbeke, 2008). Two different signals are provided to consumers by

labels (Caswell, 2006). The existence of a label highlights relevant issues that should be taken into account and, therefore, they may alter consumer behaviour (Potts & Haward, 2007). At the same time, the information portrayed in labels allows consumers to make quality inferences and comparisons between products (Caswell, 2006), minimizing search costs and easing the decision-making process (Hanss & Böhm, 2012).

Different fish labelling schemes exist, both mandatory and voluntary, such as Marine Stewardship Council, French Label Rouge, Scottish Quality Salmon label or Seafood Safe. According to Caswell (2006), labelling schemes become mandatory when there is a market failure and the critical information for making purchasing decisions is not being provided. The international framework for seafood labelling is set by the Codex Alimentarius, which is a collection of voluntary standards, guidelines and codes of practice created by World Health Organization (WHO) and the Food and Agriculture Organization (FAO) (WHO & FAO, 2018). Codex texts must be incorporated into the legislation of the different members of these organizations to become enforceable. For instance in Spain, the European Union regulations 1169/2011 (The European Parliament and Council of the European Union, 2011) and 1379/2013 (The European Parliament and Council of the European Union, 2013) along with national Royal Decrees 126/2015 of 27th February (BOE, 2015) and 1334/1999 of 31st July (BOE, 1999) establish the requirements of the information provided to consumers regarding fish products. These regulations stipulate that for unprocessed, salted or smoked fish, consumers must be provided with information on commercial designation and scientific name, catch area or country of production, fishing gear, whether it has been defrosted, best before or use by date and possible allergens if applicable. For non-prepacked fish products only information on allergens must be disclosed to consumers. Finally, in the case of prepacked unprocessed and processed fish products, further information is required.

Information portrayed on labels, both mandatory and additional, must be carefully chosen (Pieniak et al., 2011). Previous research has shown that only providing more information does not lead to better informed consumers (Verbeke et al., 2008). Overloading consumers with information may result in a lot of time searching through it to extract the pieces needed (Salaün & Flores, 2001). Another important issue is that consumers may not understand label information. This may lead to consumers misinterpreting its meaning, making inferences that go far beyond what the label was intended to communicate and feeling that information has

a low predictive power of the quality attributes they are interested in (Grunert, 2005). All these problems might result in indifference, ignorance, boredom and misunderstanding (Verbeke, 2008) and, consequently, the loss of trust in the product (Salaün & Flores, 2001).

Different researches have investigated consumer interest, use and trust of different information sources about fish (Altintzoglou & Nøstvold, 2014; Pieniak, Verbeke, Scholderer, et al., 2007), attitudes and preferences for fish labels (Fonner & Sylvia, 2015; Wang et al., 2013), as well as perceptions, importance, interest and use of quality cues portrayed in them (Pieniak et al., 2011; Pieniak, Verbeke, Vermeir, et al., 2007; Pieniak & Verbeke, 2008; Verbeke et al., 2007). However, the importance for consumers of mandatory and potential fish label information has received little attention (e.g., Pieniak, Verbeke, Vermeir, et al., 2007; Verbeke et al., 2008). Understanding the importance for consumers of different label attributes is necessary to assess the efficiency of mandatory information and tailor the voluntary information provided to consumers.

According to different studies (Altintzoglou & Nøstvold, 2014; Pieniak et al., 2011; Pieniak, Verbeke, Vermeir, et al., 2007; Verbeke, 2008; Verbeke et al., 2007), consumer interest in labelling and information is heterogeneous, and segmentation is advised in order to provide targeted information. Segmentation is increasingly important in social marketing (Verbeke, 2008). Several studies have used segmentation to identify groups of consumers based on their trust and use of information sources during the decision making of purchasing and consuming fish products (Altintzoglou et al., 2014; Altintzoglou & Nøstvold, 2014; Pieniak, Verbeke, Scholderer, et al., 2007), the importance of product attributes when purchasing seafood (Heide & Olsen, 2017; Olsen et al., 2017), consumer preferences for fish attributes (Claret et al., 2012) and the relevance attached to fish quality and self-confidence (Verbeke et al., 2007). Nonetheless, the relationship between the importance of the attributes that could be portrayed in food labels and the product-specific determinants of and influences on the purchase of food products has been scarcely researched.

Thus, this study contributes to literature by exploring this relationship, focusing on product specific, socio-economic and demographic factors as determinants and influences of the consumption of cod products. Specifically, the objectives of this study were to (a) evaluate the relative importance to consumers of potential and existing information on cod labels; (b)

identify consumer segments according to the importance of the different types of information, and (c) profile consumer segments based on determinants of and influences on the purchase of cod as well as on the frequency of consumption.

Spain is one of the largest markets for fish and seafood in Europe. In 2017, Spanish apparent per capita consumption of fish reached the amount of 45.6 kilos and the expenditure was of 218 euros per capita, which is twice as much as the average European citizen. Cod is one of the most consumed species in Spain, both in volume and expenditure, along with hake, sardine, salmon and sole (EUMOFA, 2019). Not only in Spain but also in the EU, cod is among fish species with the highest consumption per capita, in 2016 second only after tuna, and its consumption is increasing (EUMOFA, 2020a). It is available in a variety of forms, either fresh, frozen, salted or dried. In Spain, salted cod has been consumed for centuries. However, Spanish preferences and consumption have recently suffered profound changes. Spaniards now prefer white, less cured and with softer texture salted cod. Traditionally salted cod is decreasing in favour of fresh cod as well as of more convenient products, such as already desalted or ready to cook (Larsen & Lindkvist, 2014). Therefore, cod is an appropriate representative of the changes occurring in the fish market and it seems adequate to use it as case in this study.

3.2. Materials and methods

3.2.1. Sampling

Data were collected in six cities in the northwestern (A Coruña and Ourense), northeastern (Zaragoza), central (Madrid), eastern (Valencia) and southern areas (Sevilla) of peninsular Spain during September and October 2013. These cities were chosen to reflect the regional economic, social and cultural diversity of Spain. To gather data, households were randomly selected in the six Spanish cities where the fieldwork took place and participants were interviewed face-to-face at their homes. The respondent was the person responsible for food purchase for their households. Only respondents over 18 years of age were included in the study. A total of 295 interviews were conducted. After removing those participants who did not buy cod products at least once a year and debugging the database, a total of 214 valid questionnaires from A Coruña (27), Ourense (17), Zaragoza (32), Madrid (39), Valencia (43)

and Sevilla (56) remained for the analysis. Participant characteristics were compared with the census data from the Spanish National Institute of Statistics (INE) to evaluate the representativeness of the sample. Compared to the Spanish population, women, higher educated and consumers living in areas more densely populated had a larger share in the sample. The biases in the gender and habitat may be caused by the recruitment locations and criterion. Women are usually responsible for and more influential in household food purchases (Belch & Willis, 2002; Guàrdia et al., 2006). The biased education of the sample may be explained by the better predisposition to participate of higher educated consumers (Claret et al., 2012). Previous studies indicate that gender can influence food label reading (Wandel, 1997), while the place of residence may be related to the importance attached to label information (Bernués et al., 2003, 2012). Likewise, existing research indicates that education level may affect perception related to fish (Verbeke et al., 2005). Therefore, these differences along with the sample size should be considered when interpreting the results of this research. Table 1 shows detailed sociodemographic characteristics of participants and population.

Table 1

Sociodemographic characteristics of the sample (*n* = 214) and population

Demographic characteristics	Category	Subject (no.)	Percent (%)	Population[a] (%)
Gender	Male	60	28.0	48.8
	Female	154	72.0	51.2
Age	<30	18	8.4	18.0 (16-30 yr)
	30-39	37	17.3	19.7
	40-49	52	24.3	19.4
	50-59	65	30.4	15.8
	>59	42	19.6	27.1
Level of education	No studies or Primary School	21	9.8	27.2
	Junior High School	61	28.5	26.2
	High School	67	31.3	20.2
	University	65	30.4	26.4
Household type	Household with children under their care	89	41.6	34.9
	Independent person without children	36	16.8	24.2
	Household without children under their care	51	23.8	21.6
	Single parent	13	6.1	9.4
	Other	25	11.7	9.8
Monthly household income (€)	<1001	36	16.8	Mean 1869.1
	1001-2000	89	41.6	
	2001-3000	35	16.4	
	>3000	14	6.5	
	No response	40	18.7	
Place of residence (no. of inhabitants)	Rural (<10001)	4	1.9	60.4
	Small city (10001-100000)	60	28.0	19.7
	Medium city (100001-500000)	35	16.4	11.8
	Big city (>500000)	115	53.7	8.0

Note: Mean age = 48.98 years old

[a] Source INE data (Spanish National Institute of Statistics)

3.2.2. Questionnaire

Before fieldwork, the questionnaire was pretested by eight consumers in A Coruña to evaluate its clarity, understandability and length. Once refined, the questionnaire included four sections part with questions used in work. The first section covered purchase habits and purchase motives of cod. First, using a ten-point scale, respondents were asked to indicate how often they purchased (1 = five times a week or more often to 10 = less than once a year or never) four different categories of codfish: fresh, frozen, dried or salted and chilled precooked. Second, using a multiple-choice question with multiple answer options, participants were asked to select the motives for which they bought cod. These motives were elaborated based on the existent literature and current regulations (Table 2). In section three, consumers were asked to rate using a five-point scale (1 = not important to 5 = very important) the importance of seventeen attributes that could be on cod labels prepared based on previous research (Table 3). Finally, section four collected sociodemographic characteristics of the sample such as gender, age, level of education, household type, monthly household income and the place of residence of the participants. Additionally, the questionnaire included other variables not relevant for this study.

Table 2

Items used in the study to measure the importance of different labelling attributes based on the existent literature and current regulations

Items	Requirements*	References
Catch date	Voluntary	Altintzoglou et al. (2014); Altintzoglou and Nøstvold (2014); The European Parliament and Council of the European Union (2013)
Packaging date	Not required	Heide and Olsen (2017)
Best before	Mandatory	Altintzoglou and Nøstvold (2014); Heide and Olsen (2017); The European Parliament and Council of the European Union (2013)
Fisherman name	Not required	Jaffry et al. (2016)
Commercial designation or common name	Mandatory	Altintzoglou et al. (2014); The European Parliament and Council of the European Union (2013)

Scientific name of the species	Mandatory	Altintzoglou and Heide (2014;) Altintzoglou and Nøstvold (2014); The European Parliament and Council of the European Union (2013)
Storage conditions	Mandatory	Altintzoglou and Heide (2014); Altintzoglou and Nøstvold (2014); The European Parliament and Council of the European Unior (2011)
Origin or FAO area where the product was caught	Mandatory	Altintzoglou et al. (2014); Altintzoglou and Nøstvold (2014); The European Parliament and Council of the European Union (2013)
Production and catch method (wild/farmed & fishing gear)	Mandatory	Altintzoglou et al. (2014); Altintzoglou and Nøstvold (2014); The European Parliament and Council of the European Union (2013)
Health control	Voluntary[a]	Altintzoglou et al. (2014); Caswell (2006); The European Parliament and Council of the European Union (2004)
Name of the company that processed the cod	Mandatory[b]	The European Parliament and Council of the European Union (2011)
Processing method (fresh/frozen/salted/precooked)	Voluntary[c]	Asche and Bronnmann (2017); Bronnmann and Asche (2017); The European Parliament and Council of the European Union (2013)
If it is a protected or in danger species	Voluntary[d]	Altintzoglou and Nøstvold (2014); The European Parliament and Council of the European Union (2013)
How cod was transported and stored	Mandatory[e]	Altintzoglou et al. (2012); Altintzoglou and Nøstvold (2014); The European Parliament and Council of the European Union (2013)
Nutritional information	Mandatory	Altintzoglou and Heide (2014); Altintzoglou and Nøstvold (2014); The European Parliament and Council of the European Union (2011)
Health claims	Not required	Altintzoglou et al. (2014); Altintzoglou and Nøstvold (2014)

*The different types of information have been classified into mandatory, voluntary and not required based on regulations 1379/2013 (The European Parliament and Council of the European Union, 2013), 853/2004 *(The European Parliament and Council of the European Union, 2004)* and 1169/2011(The European Parliament and Council of the European Union, 2011).
[a](15)"*… food business operators responsible for establishments that are subject to approval in accordance with this Regulation should ensure that all products of animal origin that they place on the market bear either a health mark or an identification mark".*
[b]Art. 9.1 (h) of regulation 1169/2011: "*the name or business name and address of the food business operator referred to in Article 8(1)".*
[c]Art.39.1 (g) of regulation 1379/2013: *"information on production techniques and practices".*
[d]Art.39.1 (e) of regulation 1379/2013: *"environmental information".*
[e]Art.35.1 (d) of regulation 1379/2013: *"whether the product has been defrosted".*

Table 3

Items used in the study to measure purchasing motives based on previous research

Items	References
It is a tasty product	Olsen et al.(2017); Verain et al. (2016)
It is available	Altintzoglou and Heide (2016); Olsen et al., (2017)
It is easy to preserve	Carlucci et al., (2015); Olsen et al. (2017)
It is fast to cook	Heide and Olsen (2017)
It is accepted by the members of the household	Gaviglio et al. (2014)
It is part of a healthy diet	Altintzoglou and Heide (2016); Verain et al. (2016)
It has good nutrients	Carlucci et al. (2015); Olsen et al. (2017)
It is a natural product	Heide and Olsen (2017)
It is easy to digest	Gaviglio et al., (2014)
It is affordable	Heide and Olsen (2017); Verain et al. (2016)
It is a product for special dates	Gaviglio et al. (2014)

3.2.3. Data analysis

First, a frequency analysis was performed to evaluate the relative importance of the different attributes for the whole sample. Kruskal-Wallis test followed by *post hoc* Dunn's test and mean ranks were then performed to profile the sample according to sociodemographic characteristics. Second, in order to explore the possible underlying dimensions of labelling attributes and avoid redundancy in the subsequent cluster analysis, a principal component analysis (PCA) with Oblimin rotation was conducted on polychoric correlations of the different attributes according to their importance. Cronbach's α was calculated to measure the internal reliability consistency. Third, to identify homogeneous groups of respondents according to the importance attached to labelling attributes, a Hierarchical Cluster Analysis based on Euclidean distance and using Ward's method for sorting was performed on the factor scores obtained in the PCA. To determine the number of clusters, thirty different criterions along with interpretability of the results were evaluated. Finally, groups were profiled attending to frequencies and using Chi-square test for nominal variables (namely gender, household type and purchase motives). Mean ranks and Kruskal–Wallis rank sum test followed by Dunn's test of multiple *post hoc* comparisons were used with ordinal variables (labelling attributes, age, level of education, monthly household income, place of residence and purchase habits).

Differences between groups were considered statistically significant when the *p*-value was lower than 5% (0.05). Effect sizes were computed using Cramer's V (V) for categorical data, ranging from 0 indicating no association to 1 strong association. Likewise, epsilon-squared (E^2) was calculated for ordinal data, where E^2 greater than 0.25 indicates a large effect, between 0.25 and 0.08 medium effect and less than 0.08 small effect. All statistical analyses in this study were performed using R version 3.6.1. (R Core Team, 2019). Cronbach's *α* was calculated using 'psych' package. Kruskal-Wallis test and Chi-square test were conducted using 'stats' package and Dunn's test was performed using 'FSA' package. Cluster analysis was conducted using 'stats' while the criterions to define the number of clusters were computed with 'NbClust' package. Cramer's V and epsilon-squared were calculated using 'DescTools' and 'rcompanion' packages, respectively.

3.3. Results

3.3.1. Importance of labelling attributes

Importance of the different attributes by sociodemographic characteristics can be seen in Tables C1-C6 in Appendix C. The majority of respondents considered most of attributes quite or very important. Almost 95% of participants considered quite or very important that best before and information regarding whether the product had gone through a health control appear on labels of cod. The importance attached to best before was significantly related to gender ($n = 174$; H = 4.35, d.f. = 1, $p = 0.037$, $E^2 = 0.02$), as well as marginally significantly and inversely related to the size of the residence place of the respondents ($n = 174$; H = 7.18, d.f. = 3, $p = 0.066$, $E^2 = 0.03$); based on mean ranks females and respondents from small cities considered it more important. However, no significant associations were found between health control and sociodemographic characteristics.

Storage conditions, nutritional information and packaging date were considered quite or very important by more than 85% of the respondents. The importance attached to storage conditions was significantly related to monthly household income ($n = 174$; H = 7.84, d.f. = 3, $p = 0.049$, $E^2 = 0.04$); respondents with a monthly household income between 1001 and 2000 euros attached more importance to it. Packaging date was significantly associated to household type (H = 17.57, d.f. = 4, $p = 0.001$, $E^2 = 0.08$); it was considered more important by

single parents. No significant association was found between the importance attached to nutritional information and sociodemographic characteristics.

Almost 90% of the sample considered catch date and health claims to be quite or very important. The importance attached to the catch date was significantly related to the household type (H = 11.15, d.f. = 4, p = 0.025, E^2 = 0.05). Likewise, a marginal significant relationship was found between the importance of catch date and the level of education (H= 6.99, d.f. = 3, p = 0.072, E^2 = 0.03). Single parents and those participants with junior high school level considered it to be more important. The importance of health claims was not significantly associated to sociodemographic characteristics.

Information regarding transportation, processing method, origin of the cod and if it is a protected or in danger species was quite or very important for about 75% of participants. Processing method was significantly related with the monthly household income (H = 8.02, d.f. = 3, p = 0.046, E^2 = 0.04); respondents with a monthly household income between 2001 and 3000 euros considered it more important. There was a direct marginal significant association between the importance attached to origin and the age of respondents (H = 9.10, d.f. = 4, p = 0.059, E^2= 0.04); respondents older than 60 years old considered it more important. No significant associations were found between the importance of having information regarding if it is a protected or in danger species and sociodemographic characteristics.

More than 70% of participants considered having the commercial designation and the name of the company that processed the product on the label quite or very important. Importance attached to commercial designation was significantly related to household type (H = 12.00, d.f. = 4, p = 0.017, E^2 = 0.06) and the place of residence of participants (H = 11.10, d.f. = 3, p = 0.011, E^2 = 0.05); respondents part of other types of households and respondents living in medium-sized cities considered it more important.

Production method was considered quite or very important by more than 55% of the sample. The importance of the production method was significantly associated with gender (H = 3.94, d.f. = 1, p = 0.047, E^2 = 0.02) and the place of residence (H = 9.69, d.f. = 3, p = 0.021, E^2 = 0.05); males and respondents from medium-sized cities considered it more important.

Finally, only the fisherman name and scientific name were considered quite or very important by less than 50% of the participants. The importance of the scientific name was significantly related to gender (H = 3.98, d.f. = 1, p = 0.046, E^2 = 0.02). Likewise, the scientific name was significantly associated to monthly household income (H = 7.84, d.f. = 3, p = 0.050, E^2 = 0.04), to the household type (H = 9.17, d.f. = 4, p = 0.057, E^2 = 0.04) and to the place of residence of participants (H = 6.53, d.f. = 3, p = 0.088, E^2 = 0.03). It was considered more important by males, single parents, participants with a monthly household between 1001 and 2000 euros and respondents from big cities. No significant associations were found between the fisherman that caught the cod and sociodemographic characteristics.

A PCA with oblimin rotation based on the importance of labelling attributes was performed to identify underlying dimensions and improve the subsequent cluster analysis by reducing data. PCA (KMO = 0.84, χ^2 = 1274.26, d.f. = 120, p < 0.01) revealed four components with an eigenvalue greater than Kaiser's criterion of one, explaining 55.39% of the total variance. The variables loading on these components indicated that underlying dimensions of labelling information correspond to *identification* (α = 0.8), *process* (α = 0.8), *safety* (α = 0.5) and *health* (α = 0.7). More specifically, the highest loadings for *identification* corresponded to fisherman, processing company and production method. Catch date, packaging date and protected species for *process*. Best before and health control for *safety*. Finally, the higher loadings for *health* corresponded to health claims and nutritional information. The loadings of the different labelling attributes on the four factors can be seen in Table 4.

Table 4

Importance of labelling attributes and their loadings on the factors obtained in the PCA

Labelling attributes	Factor 1	Factor 2	Factor 3	Factor 4	Communalities
Factor 1- Identification					
Fisherman name	**0.769**	-0.191	0.000	0.140	0.560
Processing company	**0.730**	0.052	0.026	0.103	0.614
Production method	**0.645**	0.333	-0.077	-0.246	0.657
Scientific name	**0.600**	0.053	-0.324	0.305	0.621
Commercial designation	**0.573**	0.071	0.315	-0.143	0.477
Origin	**0.420**	**0.402**	0.046	-0.175	0.466
Factor 2- Process					
Catch date	-0.113	**0.803**	0.065	0.000	0.617
Packaging date	-0.064	**0.739**	0.123	0.251	0.708
Protected species	0.109	**0.739**	-0.026	-0.079	0.595
Transport information	0.146	**0.536**	0.015	0.235	0.495
Processing method	0.251	**0.481**	-0.023	0.331	0.591
Factor 3- Safety					
Best before	-0.082	-0.069	**0.798**	0.205	0.669
Health control	-0.016	0.138	**0.789**	-0.131	0.697
Storage conditions	0.330	0.276	**0.503**	-0.073	0.598
Factor *4*- Health					
Health claims	-0.025	0.186	-0.057	**0.813**	0.729
Nutritional information	0.285	0.005	0.328	**0.620**	0.695
Eigenvalues	5.61	1.88	1.29	1.01	
% of variance explained	16.97	16.94	11.61	9.87	

Note: Factor loadings greater than 0.40 in absolute value appear in bold.

3.3.2. Segmentation according to the perceived importance of labelling attributes

Four segments of respondents were identified in the cluster analysis based on the importance attached to the different labelling attributes (Table 5). The first segment (n = 80, 37.38%) might be named as *traditional*. For these participants, safety and health attributes are quite or very important. Nonetheless, these participants generally display the lowest interest of all the four groups in labelling attributes.

The second segment (n = 23, 10.75%) might be identified as *safety-conscious*. This group is characterised for attaching the greatest importance to process and safety. According to mean ranks, compared to *traditional* participants *safety-conscious* respondents attach significantly

more importance to most attributes related to identification (production method, commercial designation, origin and processing company), safety (storage conditions and health control) and process-related attributes (protected species, catch date, processing method and packaging date). On the contrary, these participants care significantly less for one health attribute (health claims) than *traditional* respondents.

The third segment (*n* = 50, 23.36%) might be called *quality-orientated*. These participants attach the greatest importance to process and health-related attributes. Compared to the *traditional* segment, *quality-orientated* participants care significantly more for all attributes related to identification, process, health and one attribute related to safety (storage conditions). Only one safety-related attribute (best before) is significantly less important for *quality-orientated* than for *traditional*. Furthermore, in relation to *safety-conscious* segment, *quality-orientated* participants consider all health-related attributes, some identification (scientific name and fisherman) and one process-related (processing method) attribute to be significantly more important. In contrast, safety attributes were significantly less important for the *quality-orientated* participants than for the *safety-conscious* group.

The fourth segment (*n* = 61, 28.50%) might be named as *enthusiasts*. This segment attaches high importance to almost all attributes, especially to safety, health and process-related. Compared to *traditional* participants, this segment significantly attaches more importance to all attributes. Furthermore, compared to *safety-conscious* participants, this segment considers all health attributes, most of process attributes (packaging date, transport information, processing method and catch date), one identification-related attribute (scientific name) and one safety-related (best before) to be significantly more important. Finally, compared to *quality-orientated* participants, this segment considers all safety attributes and the majority of process attributes (catch date, transport information, protected species and packaging date) to be significantly more important. In contrast, *enthusiasts* consider one identification attribute (scientific name) to be significantly less important than *quality-orientated* segment.

Table 5

Importance attached to the different labelling attributes by group of participants

	Total	1 Traditional (37.38%)	2 Safety conscious (10.75%)	3 Quality orientated (23.36%)	4 Enthusiasts (28.50%)	p	E²	Post hoc test 1-2	1-3	1-4	2-3	2-4	3-4
Factor TC4- Identification													
Fisherman name	3 [2 to 4]	3 [2 to 4]	3 [2 to 4]	4 [3 to 5]	4 [3 to 5]	<0.001***	0.11	=	<	<	<	=	=
Processing company	4 [3 to 5]	3 [2 to 4]	4 [4 to 5]	5 [4 to 5]	4 [4 to 5]	<0.001***	0.25	<	<	<	=	=	=
Production method	4 [2.25 to 4]	2 [1 to 3]	5 [4 to 5]	4 [4 to 5]	4 [3 to 5]	<0.001***	0.36	<	<	<	=	=	=
Scientific name	3 [1 to 4]	2 [1 to 3]	1 [1 to 2]	4 [3 to 4]	3 [2 to 4]	<0.001***	0.24	=	<	<	<	<	>
Commercial designation	4 [3 to 5]	3 [3 to 4]	5 [4 to 5]	4 [4 to 5]	5 [4 to 5]	<0.001***	0.24	<	<	<	>	=	=
Origin	4 [3.25 to 5]	3 [3 to 4]	4 [4 to 5]	4 [4 to 5]	5 [4 to 5]	<0.001***	0.29	<	<	<	=	=	=
Factor TC1- Process													
Catch date	4 [4 to 5]	4 [3 to 4]	4 [4 to 5]	5 [4 to 5]	5 [5 to 5]	<0.001***	0.23	<	<	<	=	<	<
Packaging date	4 [4 to 5]	4 [4 to 4]	4 [4 to 5]	5 [4 to 5]	5 [5 to 5]	<0.001***	0.33	<	<	<	=	<	<
Protected species	4 [3 to 5]	3.5 [2 to 4]	5 [4 to 5]	4 [4 to 5]	4 [4 to 5]	<0.001***	0.25	<	<	<	=	=	<
Transport information	4 [4 to 5]	4 [3 to 4]	4 [3 to 5]	4 [4 to 5]	5 [4 to 5]	<0.001***	0.24	=	<	<	=	<	<
Processing method	4 [4 to 5]	4 [3 to 4]	4 [3 to 5]	4 [4 to 5]	5 [4 to 5]	<0.001***	0.28	<	<	<	<	<	=
Factor TC2- Safety													
Best before	5 [4 to 5]	5 [4 to 5]	5 [4 to 5]	4 [4 to 5]	5 [5 to 5]	<0.001***	0.25	=	>	<	>	<	<
Health control	5 [4 to 5]	5 [4 to 5]	5 [5 to 5]	4 [4 to 5]	5 [5 to 5]	<0.001***	0.29	<	=	<	>	=	<
Storage conditions	4 [4 to 5]	4 [3 to 4]	5 [5 to 5]	4 [4 to 5]	5 [5 to 5]	<0.001***	0.41	<	<	<	>	<	<
Factor TC3- Health													
Health claims	4 [4 to 5]	4 [3 to 4]	2 [1 to 3]	5 [4 to 5]	5 [4 to 5]	<0.001**	0.38	>	<	<	<	<	=
Nutritional information	5 [4 to 5]	4 [4 to 5]	4 [3 to 5]	5 [4 to 5]	5 [5 to 5]	<0.001**	0.22	=	<	<	<	<	=

Note: Data are presented as median [interquartile range]. Differences are tested statistically using Kruskal-Wallis and Dunn's *post hoc* tests. Signif. codes: *** = p < 0.01. Effect size is computed as epsilon-squared.

3.3.3. Consumer group profiling according to determinants of and influences on the purchase

Profiles of the segments regarding purchase motives, purchase habits and sociodemographic characteristics can be seen in Table 6. Taste appears as the main purchase motive in all segments. Additionally, most *traditional* participants also buy cod because it is affordable. *Safety-conscious* respondents mainly buy cod because it is available and part of a healthy diet. Most *quality-orientated* participants buy it because they think it is part of a healthy diet, nutritious, natural, affordable and members of the household like it. Finally, *enthusiast* segment mostly purchases cod because it is part of a healthy diet. Significative differences between groups exist regarding the purchase of cod for perceiving it as natural (χ^2 = 8.58, d.f. = 3, *p* = 0.035, V = 0.20), of easy digestion (χ^2 = 10.13, d.f. = 3, *p* = 0.018, V = 0.22) and to prepare it on special dates (χ^2 = 9.67, d.f. = 3, *p* = 0.021, V= 0.21). Based on odds, it is more likely that *quality-orientated* respondents buy cod because it is natural, easy to digest or to cook it on special dates than the other groups. *Enthusiast* group is the second more likely to purchase cod for these motives. Careless are the least likely to buy it because it is natural or easy to digest while *quality-orientated* are the least likely to buy it to prepare it on special dates.

Regarding purchase habits, most of *traditional* and *quality-orientated* participants are occasional buyers of fresh and salted cod. *Safety-conscious* respondents are mainly frequent buyers of fresh cod and occasional of salted cod. Finally, most *enthusiast* participants are frequent buyers of fresh and salted cod. Concerning frozen and precooked cod, the majority of respondents in all segments are non-buyers of these products. No significative differences were found between groups regarding the purchase frequency of fresh (H=1.87, d.f.= 3, *p*= 0.599, E^2= 0.01), frozen (H = 1.51, d.f. = 3, *p* = 0.681, E^2 = 0.01), salted (H = 3.29, d.f. = 3, *p* = 0.349, E^2 = 0.02) nor precooked (H = 5.04, d.f. = 3, *p* = 0.169, E^2 = 0.02).

The majority of respondents in the four groups are female, being the greatest frequency in the *enthusiast* group. Regarding age, most respondents in all segments are above 40 years old, *safety-conscious* participants are the oldest being mostly above 50 years old. Regarding level of education, most *enthusiasts* and *quality-orientated* participants finished high school while *safety-conscious* and careless respondents have university studies. Participants in the

four segments are mainly part of a household with children under their care, *safety-conscious* group registered the highest frequency of this group. Household income of most participants in the four segments is between 1001 and 2000 euros, *quality-orientated* with the highest frequency. Finally, the majority of respondents in the four groups live in big cities, being the *quality-orientated* participants those most frequently living in these cities. No significant differences were found between groups regarding gender (χ^2 = 5.85, d.f. = 3, *p* = 0.119), age (H = 4.42, d.f. = 3, *p* = 0.219, E^2 = 0.02), level of education attained (H= 4.15, d.f. = 3, *p* = 0.246, E^2 = 0.02), household type (χ^2 = 9.52, d.f.= 12, *p*= 0.658, V= 0.12), monthly household income (H = 4.01, d.f. = 3, *p* = 0.260, E^2 = 0.02) and place of residence (H = 0.87, d.f. = 3, *p* = 0.834, E^2 = 0.00) of respondents.

Table 6
Purchase motives, purchasing habits and sociodemographic characteristics of the segments

	Total	Traditional (37.38%)	Safety conscious (10.75%)	Quality orientated (23.36%)	Enthusiasts (28.50%)	Effect size		
						p	E^2	*V*
Purchasing motives								
Taste	82.2	82.5	87.0	72.0	88.5	0.154		0.16
Health	52.8	46.2	52.2	60.0	55.7	0.452		0.11
Affordability	45.8	50.0	30.4	50.0	42.6	0.340		0.13
Nutrition	43.0	41.2	30.4	54.0	41.0	0.246		0.14
Household acceptance	42.5	37.5	43.5	50.0	42.6	0.577		0.16
Availability	41.1	38.8	52.2	40.0	41.0	0.712		0.08
Natural	35.5	25.0	34.8	50.0	37.7	0.035*		0.20
Special dates	35.0	35.0	8.7	46.0	36.1	0.021*		0.21
Digestion	29.9	20.0	26.1	46.0	31.1	0.018*		0.22
Easy storage	22.4	22.5	21.7	22.0	23.0	0.999		0.01
Fast cooking	16.8	15.0	4.3	24.0	18.0	0.193		0.15
Frequency of cod purchase[a]								
Fresh	2 [1 to 3]	2 [1 to 3]	1 [1 to 3]	2 [1 to 2.75]	2 [1 to 3]	0.599	0.01	
Frequent	34.6	26.2	52.2	34.0	39.3			
Occasional	34.6	45.0	17.4	40.0	23.0			
Non-buyer	30.8	28.7	30.4	26.0	37.7			
Frozen	3 [2 to 3]	3 [2 to 3]	3 [2 to 3]	2.5 [1 to 3]	3 [1 to 3]	0.681	0.01	
Frequent	23.4	16.2	21.7	28.0	29.5			
Occasional	20.6	28.7	13.0	22.0	11.5			
Non-buyer	56.1	55.0	65.2	50.0	59.0			
Salted	2 [2 to 3]	2 [2 to 3]	2 [1.5 to 3]	2 [2 to 2.75]	2 [1 to 3]	0.349	0.02	
Frequent	24.8	17.5	26.1	18.0	39.3			
Occasional	43.5	47.5	43.5	56.0	27.9			
Non-buyer	31.8	35.0	30.4	26.0	32.8			
Precooked	3 [3 to 3]	3 [3 to 3]	3 [3 to 3]	3 [3 to 3]	3 [3 to 3]	0.169	0.02	
Frequent	4.7	7.5	0.0	2.0	4.9			

Occasional	13.1	16.2	8.7	18.0	6.6		
Non-buyer	82.2	76.2	91.3	80.0	88.5		
Socioeconomic characteristics							
Gender						0.119	0.17
Male	28.0	26.2	30.4	40.0	19.7		
Female	72.0	73.8	69.6	60.0	80.3		
Age	3.5 [2 to 4]	3 [2 to 4]	4 [3 to 4.5]	3.5 [3 to 4.75]	3 [3 to 4]	0.219	0.02
<30	8.4	16.2	4.3	0.0	6.6		
30-39	17.3	17.5	13.0	22.0	14.8		
40-49	24.3	18.8	17.4	28.0	31.1		
50-59	30.4	31.2	39.1	24.0	31.1		
>59	19.6	16.2	26.1	26.0	16.4		
Level of education	3 [2 to 4]	3 [2 to 4]	3 [3 to 4]	3 [2 to 3]	3 [2 to 4]	0.246	0.02
No studies or Primary School	9.8	10.0	8.7	16.0	4.9		
Junior High School	28.5	32.5	13.0	26.0	31.1		
High School	31.3	23.8	34.8	36.0	36.1		
University	30.4	33.8	43.5	22.0	27.9		
Household type						0.658	0.12
Household with children under their care	41.6	40.0	47.8	36.0	45.9		
Independent person without children	16.8	15.0	13.0	18.0	19.7		
Household without children under their care	23.8	30.0	13.0	24.0	19.7		
Single parent	6.1	5.0	4.3	6.0	8.2		
Other	11.7	10.0	21.7	16.0	6.6		
Monthly household income (n = 174)	2 [2 to 3]	2 [2 to 3]	2 [2 to 3]	2 [2 to 2.5]	2 [1 to 2]	0.260	0.02
<1001	20.7	15.6	19.0	20.9	28.3		
1001-2000	51.1	51.6	47.6	53.5	50.0		
2001-3000	20.1	20.3	19.0	23.3	17.4		
>3000	8.0	12.5	14.3	2.3	4.3		
Place of residence	5 [3 to 5]	5 [3 to 5]	4 [4 to 5]	5 [3 to 5]	5 [3 to 5]	0.834	0.00
Rural	1.9	1.2	0.0	2.0	3.3		
Small city	28.0	28.7	17.4	28.0	31.1		
Medium city	16.4	17.5	39.1	8.0	13.1		
Big city	53.7	52.5	43.5	62.0	52.5		

Note: Data are presented as percentages. Differences in gender and household type between groups are tested statistically using Chi-Square while effect sizes are computed as Cramer's V. Median [IQR] of frequency of purchase, age, level of education, monthly household and place of residence are presented in the table. Differences in these variables are tested using Kruskal-Wallis test and effect sizes are computed as epsilon-squared. Signif. code: * = _p_ < 0.05.
[a]Occasional buyers (purchase cod more than once a month), frequent (between five times every six months and once a year) and non-buyer (less than once a year or never).

3.4. Discussion

Labels are an efficient means for consumers to communicate with consumers (Pieniak et al., 2011). However, they may be ignored if they do not address consumer needs for information (Verbeke, 2008). Therefore, it is necessary to understand the importance of information labels and its relationship with determinants of purchase of cod products in order to assess the efficiency of mandatory information and tailor the voluntary information provided to consumers.

Results show that information portrayed in cod labels is quite or very important for the majority of consumers. Best before and information regarding whether the product had gone through health control were considered quite or very important by the highest number of participants, followed by storage conditions and nutritional information. On the contrary, fisherman name and scientific name were considered quite or very important by the least respondents. The importance of label information was found to be more related to gender, household type, household income and place of residence of the respondents and less to their age and education level. These findings are in accordance with previous studies indicating that best before (Altintzoglou et al., 2012; Olsen et al., 2017) and health control are important for consumers (Verbeke et al., 2008). Results from Verbeke and Roosen (2009) suggest that fish consumers consider information cues easy to understand, such as best before or health control to be more relevant than other cues harder to interpret, such as the fisherman that caught the cod and the scientific name of the species. Furthermore, the results presented here indicate that best before and health control are safety-related attributes, confirming previous research (van Rijswijk & Frewer, 2006). Safety is a credence attribute (Caswell, 2006) and fish products are highly perishable (Freitas et al., 2020), therefore consumers might not be able to know if a product is safe even after consumption. Verbeke et al. (2008) found that consumers trust and expect governments and other independent organizations to inspect products for sale. Nonetheless, the present study indicates that consumers would appreciate the existence of a cue in the label signalling that the product has been inspected.

Four different segments of consumers were identified according to the importance attached to the information that could be portrayed on cod labels: *traditional*, *safety-conscious*, *quality-orientated* and *enthusiasts*. The first and biggest segment comprises *traditional*

consumers (37.38% of the sample). Compared to the other segments, these consumers generally attached the least importance to labelling attributes. Notwithstanding, the most relevant attributes for these consumers were those related to health and safety. This group is similar to "Pro-self mean" in Realini et al. (2014), "Unsure" in Altintzoglou et al. (2014) and "Traditional" beef consumers in Bernués et al. (2003). The second segment might be named *safety-conscious* (10.75% of the sample). The most important attributes for this segment are related to safety but also to process. Compared to *quality-orientated* pro-self, *safety-conscious* generally attach greater importance to all attributes but to those related to health. This segment could be compared to the "Safety oriented" beef consumers in Bernués et al. (2003). The third segment can be called q*uality-orientated* (23.36% of the sample). These consumers attach the greatest importance to health and process-related attributes. Furthermore, *quality-orientated* attach more importance to these attributes than *traditional* consumers. Additionally, this segment considers all health-related attributes to be significantly more relevant and safety attributes less important than *safety-conscious* consumers. The fourth segment is termed *enthusiasts* (28.50% of the sample). To this group of consumers, almost all labelling attributes are very important, especially those related to process, safety and health. This segment is comparable to "Perfectionists" in Olsen et al. (2017), "Quality/ Safety oriented" lamb consumers in Bernués et al. (2003), "Info seekers" in Altintzoglou and Nøstvold (2014) and "Enthusiasts" in Verbeke et al. (2008).

Differences between groups according to purchase motives were found, specifically in perceiving it as natural, of easy digestion and to prepare it on special dates. Similar results were obtained by Bernués et al. (2003), who found significative differences between beef consumer segments according to the type of information demanded in labels regarding motives of consumption. Finally, no significative differences in sociodemographic characteristics nor frequency of purchase were found. These results are in accordance with previous research. For instance, Altintzoglou et al. (2012) segmented consumers according to the information used during the decision of fish purchase and consumption not finding differences in gender, education and income. Gaviglio et al. (2014) found that perception of fish species and different presentation forms were not related to consumer gender, age and education.

In summary, the results of this study indicate that cod labelling attributes are important for Spanish consumers. Information cues related to safety are perceived as the most important, both mandatory and additional. Consumers also attach great importance to voluntary and additional information associated to health and the process the product has gone through. The importance given to potential and mandatory label attributes is related to the sociodemographic characteristics of the consumers, such as gender, household type, household income and place of residence. Furthermore, this study provides evidence of the existence of four different consumer segments based on the importance attached to the different cod labelling attributes.

The findings presented here have implications for authorities and producers. First, label information is important for cod consumers, particularly that related to safety. In contrast, relevant information such as scientific names do not seem to receive enough attention despite conditioning many fish attributes. Therefore, education and information campaigns are needed in order to increase consumer awareness. Furthermore, the use of internet links or QR codes on the label or package is advised to provide additional information and avoid overwhelming consumers with extensive information. Second, marketers can use signalling of additional cues related to freshness and health as a means of product differentiation. This information should be complemented with credible certifications and traceability to increase consumer confidence in the quality cues portrayed on the label. Third, the results of this study suggest that distinctive consumer groups exist based on the importance they attach to the mandatory and potential label cues with differences in the determinants of and influences on the purchase of cod. Therefore, marketers can use these results to identify market niches and provide consumers with tailored information. Additionally, the finding of a *quality-orientated* segment is novel. They are interested in information regarding health and the process that the product has gone through, while not caring about safety information. For these consumers, labelling can be an efficient means to differentiate cod products by their quality.

The main limitation of this work is that the fieldwork was carried out in Spain and cultural differences may have influenced the findings presented here. Therefore, future studies could reproduce this research in other countries to evaluate cultural differences. Likewise, in this research, only one species was investigated. Since there may be differences regarding the species generalization of these results should be done with caution. It is suggested to carry

out additional research focusing on other species. In addition, only a number of determinants of consumption and labelling quality cues were included in this work. It is encouraged to carry out future research to extend this study by including other determinants of consumption, such as lifestyle factors, or other labelling cues, such as those related to fish wellness, accordingly to the species of study. Finally, it is suggested to investigate consumer preferences for information carriers such as a QR code or a link to a webpage on the package.

CHAPTER 4

UNDERSTANDING THE VALUE OF TRACEABILITY OF FISHERY PRODUCTS FROM A CONSUMER PERSPECTIVE

Abstract

Traceability is a valuable tool for all the agents in the fishery value chain where consumers are at both ends. Consumers' perceptions often differ from those of experts and information campaigns are usually employed to increase consumers' knowledge and awareness. This study aims to provide an overview of consumer knowledge and associations to traceability, evaluate the need for traceable fishery products as perceived by consumers and the effect of information provision, according to their knowledge and socioeconomic characteristics and, finally, examine the perceived necessity of traceability functions based on consumers' perceived necessity for traceability in fishery products. Results show consumers have a low level of knowledge on traceability and generally associate it to the origin and the entire process from fishing. Additionally, most consumers perceive traceability of fishery products as necessary but low pre-existing knowledge appears as a barrier. Additionally, a significant association between household type and perceived necessity was found. Consumers value traceability as a means to know the origin, the ingredients and verify that producer claims are true. Furthermore, traceability is important to allocate liability and manage a food crisis. These findings may have implications on the communication of information about traceability to consumer.

Keywords: Benefits; Consumer; Fisheries; Knowledge; Necessity; Traceability

4.1. Introduction

The globalization and internationalization of the food markets and the industrialization of the food production have increased the complexity of food chains and the availability and variety of food products. At the stores, consumers find a broad variety of products from different sources of which they know very little about (Sarig, 2003) and acquiring enough information is often not possible due to information asymmetries.

Inferring fishery products quality and safety without any aid becomes especially hard for consumers (Wang et al., 2009). There are multiple and very similar species and numerous catch methods (Hastein et al., 2001) which determine fish quality attributes and key quality aspects such as freshness are very difficult to measure (Denton, 2003). Furthermore, according to Korthals (2008), consumer trust in producers and government control has been eroded by food fraud, food scares and the lack of transparency, increasing consumer perceived risk (Stefani et al., 2008). This is especially important for fishery products given that their value chains are characterized for being long and complex, implying a greater distance between consumers and producers, a higher chance of critical information being lost in the multiple break points and, therefore, entailing a higher safety and fraud risk (Bitzios et al., 2017). As a result, consumers demand higher transparency regarding relevant fish attributes like geographical origin, production and preserving methods, healthiness and sustainability (Carlucci et al., 2015; Roos et al., 2005).

Policy makers and producers in different countries have tried to fulfil consumer demands for reliable and relevant information and guarantees with numerous voluntary and mandatory traceability initiatives (Hobbs et al., 2005; Roos et al., 2005). Even though there is no consensus on how to define traceability (Karlsen et al., 2013), the most frequently used definition is the one provided by the EU General Food Law (Olsen & Borit, 2013). This law defines traceability as "The ability to trace and follow a food, feed, food-producing animal or substance intended to be, or expected to be incorporated into a food or feed, through all stages of production, processing and distribution" (European Parliament & Council of the European Union, 2002).

In the European Union, traceability systems have existed since 1990. However, mandatory traceability fisheries and other food products was introduced in 2005 by the General Food

Law by the EC regulation 178/2002 (European Parliament & Council of the European Union, 2002) and in 2010 an specific regulation on traceability of fisheries products was created with the EC regulation 1224/2009 (Council of the European Union, 2009). Furthermore, in 2011 the requirements of traceability of food animal origin were specifically stablished by the EC regulation 931/2011 (European Commission, 2011). These regulations also stablish the minimum information that must be provided to consumers. Moreover, in the aquaculture sector there are three international mechanisms that combine traceability with quality control systems: the GlobalGAP and Quality Management Program, the Hazard Analysis and Critical Control Points and, finally, the radio frequency identification and quick response code-system (Haghiri, 2016). Likewise, ecolabels and other sustainability programs such as Marine Stewardship Council, Aquaculture Stewardship Council, Naturland, Friend of the sea, KRAV, AIDCP, and Responsible fishing scheme require strict standards of traceability in order to guarantee the source of the product (World Wildlife Fund International, 2009).

By linking consumers to the life history of the product, traceability fills the information gap between agents of the value chain reducing inefficiencies from information asymmetries such as safety issues (Ortega et al., 2011) and may increase consumers' confidence in food products (Bosona & Gebresenbet, 2013). Hobbs (2003, 2004) distinguished between ex-ante preventive and ex-post reactive traceability functions. This author states that, with traceability, quality is signalled ex ante and reliable quality information flows from producer to consumer. Once quality is revealed, traceability allows the establishment of liability and the trace back of products in case of a food safety incident. Therefore, traceability incentivises producers to market safer products and minimizes costs for the other agents of the market (Hobbs, 2003, 2004). Additionally, according to Opara and Mazaud (2001) and Roos et al. (2005), traceability satisfies consumer increasing demands for information about content, origin and process of food products. These attributes cannot be uncovered even with specialized testing and traceability becomes the only way to differentiate them (Golan et al., 2002). Thus, traceability emerges as a necessary tool for food businesses to label accurately, support marketing claims and inform consumers about credence attributes (Roos et al., 2005).

Traceability is a valuable tool for all the agents in the food value chain in terms of consumer satisfaction, product quality and differentiation, crisis management, food supply chain

management, competence development, market growth, technological and scientific contribution and sustainability (Bosona & Gebresenbet, 2013; Mai et al., 2010). However, consumers' perceptions and expectations often differ from those of experts. Since consumers are at the both ends of the value chain, it becomes indispensable to understand consumers' point of view on traceability in order to guarantee its viability. Different studies have investigated consumer knowledge and associations to traceability (Giraud & Amblard, 2003; Giraud & Halawany, 2006; van Rijswijk et al., 2008), consumer interest (Verbeke & Ward, 2006), its perceived necessity (Gellynck et al., 2006; Gracia & Zeballos, 2005), acceptance and intention to purchase traceable food (Menozzi et al., 2015; Wu et al., 2011), willingness to pay for traceable food products (Jin et al., 2017; Wang et al., 2009; Zhang et al., 2012) and the benefits consumers expect to obtain from traceability (Chrysochou et al., 2009; Chryssochoidis et al., 2006; van Rijswijk et al., 2008).

Much of previous consumer research on traceability has focused on meat chains or food in general while research on traceability of fishery products is scarce. Existing studies indicate that, although consumers do not totally understand traceability (Wang et al., 2009), they perceive it as necessary (Haghiri, 2014; Metref & Calvo Dopico, 2016). Furthermore, consumers associate traceability to the path of a particular product in the supply chain (Metref & Calvo Dopico, 2016). Likewise, interest in traceability itself is low while consumers are very interested in information cues that result from it, such as safety and quality guarantees (Pieniak & Verbeke, 2008) and in traceability as a support to the quality and origin guarantees (Verbeke & Roosen, 2009). Additionally and according to Calvo Dopico et al. (2016), consumer primary expectations of traceability are in terms of being able to know the origin, if the fish comes from sustainable fishery, to make sure the product is safe, to manage a food crisis and recall the infected products, to allocate liability in case of crisis and to know the intrinsic attributes of the product.

According to means-ends basic assumption, consumers value products for what they can do for them (Reynolds & Olson, 2001). There is evidence indicating that traceability is important to consumers based on the potential benefits they expect to obtain from it (van Rijswijk et al., 2008). Additionally, existing research suggest that prior beliefs and knowledge on the relationship between cues and attributes may affect cue acquisition (Steenkamp, 1990). Moreover, according to Pieniak & Verbeke (2008) consumer familiarity with information cues

affects the use they make of them. Furthermore, previous studies indicate that sociodemographic characteristics may have an effect on consumer perceptions (Menozzi et al., 2015; Verbeke & Ward, 2006).

Therefore, this study aims to provide new information on perceptions and expectations of traceability of fishery products. More specifically, the objectives of this paper are: (i) to evaluate fishery products consumers' knowledge and associations to traceability, (ii) to investigate perceived necessity for traceability in fishery products & the effect of information provision, according to consumers pre-existing knowledge, and its association with sociodemographic characteristics, (iii) to analyse the desirability of the potential benefits of traceability in fishery products based on consumers' perceived necessity.

4.2. Materials and methods

4.2.1. Sampling

The data for this study were collected in six cities in the northwestern, northeastern, central, eastern, and southern peninsular Spain: A Coruña and Ourense, Zaragoza, Madrid, Valencia and Sevilla, respectively. Including these cities provide representativeness of Spain's cultural, economic and social regional heterogeneity.

The fieldwork took place during September and October 2013. In order to collect data, a survey was conducted in person and at the participant's home. The sampling unit was the household and the respondent was the person responsible for food shopping for the household. Subjects that bought fishery products less than once a year were excluded. Households were randomly selected in the cities previously mentioned. A total of 295 questionnaires were gathered. Removing invalid responses resulted in 216 usable observations from A Coruña (35), Ourense (11), Zaragoza (26), Madrid (39), Valencia (48) and Sevilla (57), giving an effective response rate of 73.22%.

4.2.2. Questionnaire

A pre-test was conducted in A Coruña to assess the clarity, understandability and length of the questionnaire. Eight consumers participated in the pre-test. After being refined accordingly to the feedback received, the questionnaire consisted on four sections identified

by the concept or concepts summarizing each section. Section one aimed to evaluate consumer pre-existing knowledge and associations to traceability with a qualitative approach. Consumers were asked to spontaneously express their perception of traceability without any additional information. Before starting section two, consumers were given a definition of traceability adapted from the definition devised by Moe (1998). The definition used was:

"Traceability is the ability to follow, at any given time, the path of a fishery product or lot of fishery products through the supply chain".

Section two addressed consumers' perceived necessity for traceability in fishery products after receiving information. Using a dichotomous question, consumers were asked whether they thought a traceability system was necessary. Section three concerned consumers expectations regarding the functions of a traceability system. Participants were requested to evaluate twelve statements containing the functions they expected traceability to perform on a five-point Likert scale ranging from "totally disagree" to "totally agree" elaborated based on previous studies (Table 7). Fourth and final section collected participants' sociodemographic variables. Respondents were asked to provide their gender, age, level of education, household type and monthly household income. The questionnaire also contained other measures of constructs and variables not included in this work.

Table 7

Items used in the study to measure expectations based on previous research

Items	References
To know the origin of the product	Chryssochoidis et al. (2006); Gellynck and Verbeke (2001); Giraud and Halawany, (2006); van Rijswijk et al. (2008)
To know the quality of the product	Chryssochoidis et al. (2006); van Rijswijk et al. (2008)
Being sure that the product is safe and risk free	Chryssochoidis et al. (2006); van Rijswijk et al. (2008)
Be sure that the product has undergone a hygiene control	Chrysochou et al. (2009); Chryssochoidis et al. (2006)
To know if the product has undergone a quality control	Chrysochou et al. (2009); Food Standards Agency (2002); van Rijswijk et al. (2008)
To know if it is a sustainable product	van Rijswijk et al. (2008)
Allows to allocate liability in case the product is in a bad condition	Gellynck & Verbeke (2001)
To know the product processing method	Based on Golan et al. (2004)
To know all the ingredients of the product	Food Standards Agency (2002)
Allows to manage a food scare and to identify and recall products in bad condition	Chrysochou et al. (2009); Chryssochoidis et al. (2006); Food Standards Agency (2002); Gellynck and Verbeke (2001); Giraud and Halawany (2006); van Rijswijk et al. (2008)
To verify the information that appears on the label	Chrysochou et al. (2009); van Rijswijk and Frewer (2012)
Helps to get authenticity in fishery products	Chrysochou et al. (2009); van Rijswijk and Frewer (2012)

4.2.3. Data analysis

Cross-tabulation and Fisher's exact test were performed using SPSS for Windows (version 25) to look for relationships between the perceived necessity for traceability in fishery products & the pre-existing knowledge on traceability and sociodemographic characteristics. Effect sizes were computed as odds ratios. Variables regarding benefits consumers expect to obtain from traceability of fishery products were ranked for the analysis. In order to test for

differences in the expected benefits between consumers who perceive traceability as necessary and those that do not, a permutational multivariate analysis of variance (PERMANOVA) using 999 permutations based on Euclidean distances was performed using the function *adonis* from the "vegan" package in R (version 3.5.2). To further investigate these differences, post-hoc one-tailed Welch's t-test for independent samples was then applied using "stats" package in R in order to draw attention to significant differences in the measured expected benefits between the participants considering traceability as necessary and those who do not. Effect sizes were computed as Cliff's delta; values close to +1.0 or -1.0 indicate the absence of overlap between the two groups, while values close to 0.0 indicate group distribution overlapping completely (Macbeth et al., 2010). Cliff's delta was obtained using "musto101/wilcox_R" package in R. In all of the analyses, the level of significance was set at 5% ($p < 0.05$).

4.2.4. Consumer characteristics

Economic, social and demographic characteristics of the 216 participants are shown in Table 8. Provided that respondents were the person responsible for food shopping in their households, women accounted for the 73.61% of the sample. The participants sample characteristics were compared with the census data from the Spanish National Institute of Statistics (INE) to evaluate the representativeness of the sample. The age of the participants ranged from 19 to 81 and the mean age was 48.75 years old. In addition, more than half of the respondents had high school or university level education (34.26% and 29.64% respectively). For household type, 42.59% of the respondents were part of a couple with children under their care. Finally, almost 56.67% of the participants had a monthly household income below 2,001€, with the largest group (40.28%) reporting a monthly household income between 1,000€ and 2,001€. The skewed education of the sample may indicate that consumer need for traceable fishery products could be overestimated and it should be taken into account when interpreting the findings of this study. For instance, Wang et al. (2009) found that consumers with higher education paid more attention to safety incidents, which may increase risk perception (Stefani et al., 2008), and had a higher willingness to pay for traceable fish products. Additionally, the results obtained by these authors also indicate that education is not associated to food safety knowledge.

Table 8

Characteristics of the study subjects and population (*n*=216)

Demographic characteristics	Category	Subject (no.)	Percent (%)	Population[a] (%)
Gender	Male	57	26.4	48.8
	Female	159	73.6	51.2
Age	<30	18	8.3	18.0 (16-30yr)
	30-39	39	18.1	19.7
	40-49	51	23.6	19.4
	50-59	68	31.5	15.8
	>59	40	18.5	27.1
Level of education	No studies or Primary School	20	9.3	27.2
	Junior High School	58	26.9	26.2
	High School	74	34.3	20.2
	University	64	29.7	26.4
Household type	Household with children under their care	92	42.6	34.9
	Independent person without children	37	17.1	24.2
	Household without children under their care	50	23.1	21.6
	Single parent	13	6.0	9.4
	Other	24	11.1	9.8
	Category	(no.)	(%)	Mean[a]
Monthly household income (€)	<1000	36	16.7	1,869.1
	1000-2000	87	40.3	
	2001-3000	36	16.7	
	>3000	15	6.9	
	No response	42	19.4	

Note: Mean age = 48.75 years old

[a] Source INE data (Spanish National Institute of Statistics)

4.3. Results

4.3.1. Pre-existing knowledge and unprompted associations to traceability

In their own words, none of the participants were able to define "traceability" accurately. In fact, only a 36.57% of the participants were able to form a definition although incomplete of this term while 13.89% were only able to say loose words related to traceability. On top of

that, 5.56% had a misconception of the term and 43.98% of respondents stated that they did not know what it was.

Those participants who were able to give an incomplete definition of traceability (n = 79, 36.57% of the sample), used a wide range of diverse, general and imprecise concepts. The majority of these participants (74.68%) associated the term with "the origin of the fish" and almost half of them (48.10%) stated that traceability is related to "the entire process, from fishing to the consumer". Furthermore, between 10.13% and 17.72% of the participants connected traceability to "the controls fish has overcome", "the labelling of the fish", "the quality of fish", "all the information about the fish product" and to "the food safety of the products we eat", in descendent order. Finally, for 35.44% of these participants traceability elicited various and diverse terms such as expiration date, fish species or catch method.

4.3.2. Perceived necessity for traceability, pre-existing knowledge and information provision & sociodemographic characteristics

After receiving information on traceability, the majority of participants considered that traceability is necessary in fishery products (Table 9). In fact, less than a 10% stated otherwise. Furthermore, there was a significant association between the degree of previous knowledge consumers have on traceability and their perceived need for its implementation (p = 0.007, Fisher's exact test). Based on the odds ratio, the odds of consumers' perceiving traceability as necessary were 3.54 (18.75, 5.29) times higher when they were able to form an incomplete definition of traceability than when they did not know what traceability was or had a misconception of this term. Moreover, the odds to perceive traceability as necessary were the highest when participants were only able to say single words associated to traceability.

Table 9

Level of pre-existing knowledge and perceived necessity for traceability in fishery products after information provision

Participants' level of knowledge	Necessary		Not necessary		Total	
	n	%	*n*	%	*n*	%
Did not know traceability/ had a misconception	90	84.11	17	15.89	107	49.54
Only said loose words related to traceability	30	100.00	0	0.00	30	13.89
Were able to give an incomplete definition of traceability	75	94.94	4	5.06	79	36.57

Additionally, perceived need for traceability was significantly associated to the household type (*p* = 0.012, Fisher's exact test) while significant associations between the perceived necessity for traceability and gender, age and income were not found. Based on the odds ratio, participants part of households with children under their care were the least likely to perceive traceability as necessary compared to the other groups while single parents were the most likely. In fact, compared to participants part of households with children under their care, those without children under their care were 5.44 (24, 4.41) times more likely to perceive traceability as necessary, independent participants were 8.16 (36, 4.41) and other types of households were 5.21 (23, 4.41) times more likely (Table 10).

Table 10

Household type and perceived necessity for traceability

Household type	Necessary		Not necessary		Total	
	n	%	n	%	n	%
Household with children under their care	75	81.52	17	18.48	92	42.59
Independent person without children	36	97.30	1	2.70	37	17.13
Household without children under their care	48	96	2	4.00	50	23.15
Single parent	13	100	0	0.00	13	6.02
Other	23	95.83	1	4.17	24	11.11
Total	195	90.28	21	9.72	216	100.00

4.3.3. Perceived need for traceability and expectations regarding traceability benefits

Of the total sample (*n* = 216), the majority of participants expect traceability to allow them to "know the origin of the fish", "know if the product has undergone a quality control" and "verify the information that appears on the label" (92.59%, 88.43% and 87.96% of the total sample respectively), whereas only a 74.54%, 72.22% and a 67.12% of the participants believe they will be able to "allocate liability in case the product is in a bad condition", "know the product processing method" and "know if it is a sustainable product". The rest of the expected benefits fall in between (Figure 4).
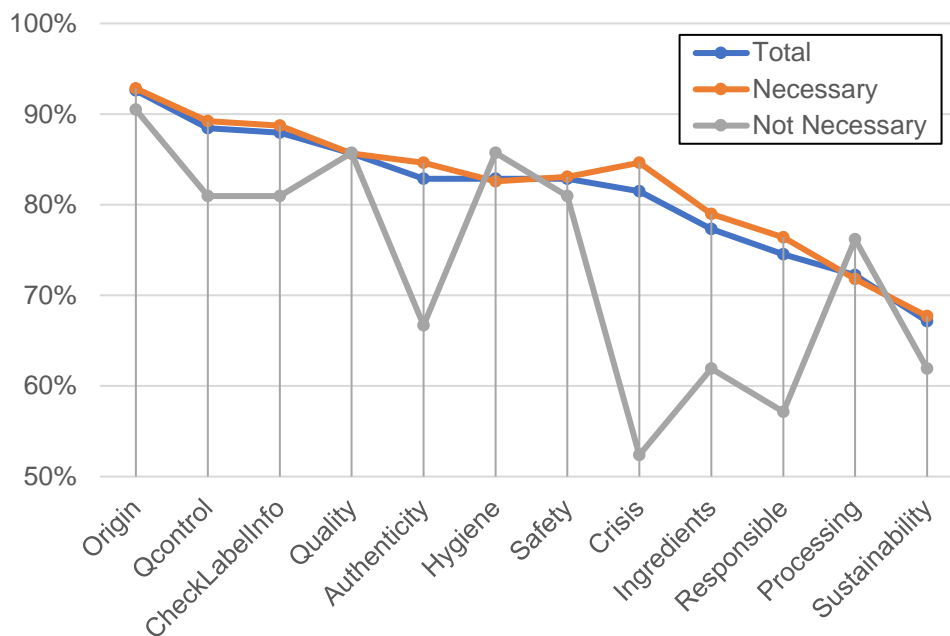
Figure 4. Consumer expectations according to their perceived necessity for traceability in fishery products

PERMANOVA revealed significant differences between the group of participants that consider that fishery products should be traceable and those that do not think so regarding the benefits both groups expect to obtain from its implementation (F = 2.17, d.f. = 1, *p* = 0.05*). Furthermore, the results of Welch's t-test (Table 11) showed that expectations regarding the potential of traceability as a tool to know the origin of the product, to allocate liability in case the product is in a bad, to know all the ingredients of the product, that allows to manage a food scare and to identify and recall products in bad condition and to verify the information

that appears on the label were significatively higher in the group that considered traceability as necessary in fishery products than in the group of those who did not think it was.

Table 11
Results from Welch's t-test for differences between participants considering traceability necessary and those who do not, in expectations regarding traceability

Expectations	t	d.f.	p	Cliff's delta
To know the origin of the product	2.065	25.289	0.025*	0.229
To know the quality of the product	0.141	3.997	0.445	-0.005
Being sure that the product is safe and risk free	0.620	23.969	0.271	0.062
Be sure that the product has undergone a hygiene control	0.925	23.748	0.182	0.043
To know if the product has undergone a quality control	0.528	24.76	0.301	0.107
To know if it is a sustainable product	0.638	23.517	0.265	0.069
Allows to allocate liability in case the product is in a bad condition	2.714	25.607	0.006**	0.300
To know the product processing method	0.614	25.813	0.272	0.048
To know all the ingredients of the product	1.958	24.447	0.031*	0.234
Allows to manage a food scare and to identify and recall products in bad condition	2.338	23.636	0.014*	0.313
To verify the information that appears on the label	2.80	25.898	0.005**	0.305
Helps to get authenticity in fishery products	0.731	22.711	0.236	0.096

Effect size of the differences between groups have been quantified using Cliff's delta and tested statistically using one-tailed Welch's t-tests. Signif. codes: ** = p < 0.01, * = p < 0.05

4.4. Discussion

Mandatory traceability systems were introduced in Europe fourteen years ago (European Parliament & Council of the European Union, 2002). The main driver for the implementation of these systems was to reduce consumer concern and uncertainty (Gellynck & Verbeke, 2001; Sarig, 2003; Verbeke, 2001). Some of traceability features such as product liability allocation provide "passive utility" or "hidden benefits" (Food Standards Agency, 2002) for consumers. In other words, consumers do not need to get involved for those features to function. However, to benefit from other features such as using the information provided by traceability, consumers must take an active part. Traceability will only be effective and efficient if consumers are interested and perceive it as useful. Hence, it becomes crucial to understand consumers' understanding and perceptions of traceability, whether they consider it as necessary in fishery products and to learn consumer expectations regarding traceability functions and which of these functions are desirable and valuable for them.

Consumers do not have a good knowledge of traceability. None of the participants were able to give an accurate definition of the term. Only a small percentage of participants were able to give a partial definition of the term employing imprecise and diverse words to define it which denotes their confusion and the complexity of the term. Spontaneously, participants related traceability to origin and to the entire life history of the product. However, these results must be interpreted with caution keeping in mind the size of the sample used ($n = 79$). Our findings confirm previous studies in Spain (Metref & Calvo Dopico, 2016) and China (Wang et al., 2009) that suggested that consumers of fish products do not understand the meaning of traceability. Moreover, previous research has indicated that fish consumers mostly associate traceability to origin and to the path of a product along the entire supply chain (Metref & Calvo Dopico, 2016). Likewise, results from van Rijswijk et al. (2008) suggest that origin is linked to food quality. Therefore, it can be concluded consumers spontaneous associations to traceability of fishery products are in terms of quality which is consistent with previous research on food traceability, indicating that consumers in France and Spain give greater prominence to food quality (van Rijswijk & Frewer, 2008).

The results presented here reveal that, after being provided with information on traceability, participants stated that they considered traceability of fishery products as necessary. Similar

results were found by Metref and Calvo-Dopico (2016) indicating that the majority of fish consumers in Spain consider traceability systems as necessary. Likewise, Haghiri (2014) concluded that, in the particular case of farmed Atlantic salmon, consumers in Canada would respond favourably to the implementation of traceability systems in this product. This can be explained by fishery products being hazardous and having serious consequences over health if in bad condition (van Rijswijk et al., 2008). On top of that, fishery products are very complex and it is hard for consumers to infer their quality (Denton, 2003). Our results also demonstrate that the lack of pre-existing knowledge of traceability may act as a barrier to the acceptance of traceability even once the information is provided. Pieniak & Verbeke (2008) indicated that consumers use cues they are familiar with and therefore our research suggests that some consumers may not consider traceability desirable in fishery products due to their low understanding of traceability and their lack of familiarity with traceable products. Moreover, in accordance to Menozzi et al. (2015) who found that household type was a predictor of intention to purchase traceable chicken, our results have shown that household type is also associated to the perceived necessity for traceable fishery products.

Participants main expectations regarding traceability functions are in terms of being able to know the origin of the fish, know if the product has gone through a quality control and verify the information that appears on the label. Furthermore, our findings indicate that there are significant differences in the desirability of the different benefits that could be obtained from traceability in fishery products based on consumers' perceived need for traceability. In fact, our results show that, participants who considered traceability necessary held higher expectations about being able to know the origin of the fish than those who did not require it. These results are in accordance with Calvo Dopico et al. (2016), suggesting that with traceability consumers generally expected to be able to know the origin of the fish. Environmental and social factors make of origin an important factor in decision making process in fishery products (Haghiri, 2016). Furthermore, participants who consider traceability as desirable in fishery products have higher expectations about traceability allowing them to know the ingredients of the product. This can be explained by consumers being increasingly interested in information about ingredients, especially to avoid allergens or ingredients they do not agree with (Verbeke, 2005). Therefore, they may want traceability in fishery products to satisfy their information demands regarding origin and ingredients of

the product. Likewise, these participants held greater expectations from traceability allowing them to verify the information that appears on the label. Similarly, Gellynck and Verbeke (2001) found that consumers feeling the strongest need for traceability in meat products are those who attach more importance to being able to check production characteristics. Consumers are sceptical and do not trust information provided by producers (Korthals, 2008). Therefore, it is reasonable to assume that they feel the need to corroborate this information by themselves and believe they will be able to use traceability to do so. Finally, consumers that consider traceability as necessary have greater expectations about traceability making it possible to allocate liability and manage a food scare and recall infected products. This result is in a similar vein as findings reported by Gellynck and Verbeke (2001) in meat, indicating that functional attributes such as identifying the responsible in case of abuse and allowing authorities to intervene in case of a problem in the value chain are most valuable to consumers. However, these authors provide evidence suggesting that these attributes cannot change perceptions.

In summary, the results of this study show that consumers of fishery products have a low knowledge on traceability, and it is generally associated to the origin. Additionally, once given a definition, the majority of consumers perceive traceability in fishery products as necessary. However, the lack of familiarity with the term appears as a barrier to the acceptance of traceability in fishery products even after being informed. Additionally, only household type is significantly associated to its perceived necessity. Generally, consumers expect traceability to perform necessary functions, both ex-ante and ex-post, in the fish market. They believe traceability is valuable as a means to know the origin of the fish, know all the ingredients of the product, to allocate liability, to manage food scares and recall infected products and to verify the information on the label. To fully benefit from these functions, consumers must take an active role which indicates that, once informed on traceability, consumers are willing to get involved and denotes there is a high interest in traceability of fishery products.

The findings presented here have implications for authorities and industry. First, to promote the acceptance of traceable fishery products, it is critical to familiarize consumers with traceability. Governments and other authorities should design and carry out education and information campaigns considering that these have a progressive effect on consumers' perception of traceability and, thus, these actions should be maintained in time to take effect.

Second, in order to address consumers' demand, the implementation of traceability systems in all categories of fishery products is recommended. Third, labels should be accompanied with traceability indicators allowing consumers to verify the information appearing on it in order to increase consumer trust. With technological developments such as internet or 'smart card', it is possible for consumers to validate information reliability and receive personalised information. Therefore, the use of these technologies is advised. Finally, traceability will only be effective if consumers take an active part. Hence, information provided should fit consumers' interest to increase the perceived importance of traceability. Origin and ingredients should be considered when developing differentiation strategies based on credence attributes. However, communication with consumers should not only focus on providing information about the origin and the ingredients of the fishery products. It is also critical to provide consumers with information on traceability as a label assurance and on the benefits traceability reports once a food scare has taken place.

The main limitation of this paper is that the elicitation method chosen to investigate participants' perceived necessity for traceability in fishery products was a single dichotomous variable (yes/no). Since consumers' actual behaviour can differ from that of stated, bias could exist. Therefore, we suggest further research on real consumers' purchase behaviour of traceable fishery products by observation or auction experiments. In addition, the sample used in this research is from a single country, Spain, and we have no way to know how culture affected our results. It is suggested to replicate this study in other countries in order to evaluate cultural differences. Likewise, additional future research could extend this study by investigating consumers' willingness to pay for traceability functions in the fish sector to provide, along with this work, critical information for a more efficient communication with consumers through mandatory and voluntary traceability systems. Finally, we recommend a new research to investigate consumers' preferences on the carriers of traceability information in fishery products.

CHAPTER 5

CONSUMERS' WILLINGNESS TO PAY FOR HIGH QUALITY
FISH PRODUCTS AND QUALITY GUARANTEES

Abstract

The quality of the fish is difficult for consumers to infer. Similarly, companies are faced with the challenge of differentiating high-quality fish products through information. Nevertheless, since labelling cannot guarantee quality and safety of fish products, different traceability initiatives have been introduced. Fish labelling and the implementation of traceability systems comes at a cost and may increase market price. This study aims to investigate consumers' willingness to pay (WTP) more for higher quality fish products and for product with quality assurances provided by traceability. Results of this study indicate that most consumers look for high quality fish products differentiated by their origin and, to a lesser extent, by their species and are WTP up to 10% more for them. Furthermore, consumers are interested in these attributes being documented by labels. Finally, traceability is mainly associated to the origin and safety of the product, to the management of food scares and to quality control. However, only a small proportion of consumers would pay more for traceable fish products, which corresponds to a fraction of those who would also pay a higher price for a higher quality product. These findings may have implications on the communication of information to consumer and producers' differentiation strategies.

Keywords: Traceability; Label; Willingness to pay; Fish quality; Origin; Quality guarantees

5.1. Introduction

Quality means different things for different people. For example, for producers, a fish is of low quality when it is not appropriate for a process or yields low returns. For health authorities, good quality fish may equate to a safe fish (Borderías & Moreno, 2018). Consumers evaluate fish products based on their subjective perception of quality (Gill, 1990). According to Brunsø (2006), expected quality is associated to freshness, wholesomeness, taste and nutrition. Other factors like usability, difficulty to prepare, caloric level, digestibility, luxury, natural and like/do not like and motive fulfilment such keeping the family healthy or being a meal for the whole household are also associated to fish quality.

At the time of purchase, consumers can only know some characteristics of the product by inspection, like colour, size, brand or price, which are termed search attributes (Stigler, 1961). Consumption will uncover additional features such as taste, texture or the presence of bones, which Nelson (1970) named experience attributes. Nonetheless, other characteristics termed credence attributes (Darby & Karni, 1973) like healthiness, origin or production methods and practices, such as fair trade, animal welfare or environmental friendliness, will remain unknown. Results from previous research show that consumers face difficulties when evaluating the quality of fish products solely through their physical properties (i.e., intrinsic cues) (Birch & Lawley, 2012; Sogn-Grundvåg & Østli, 2009). Extrinsic quality cues (i.e., those characteristics that, when modified, the physical product does not necessarily change) can turn experience and credence attributes into search attributes (Caswell & Mojduszka, 1996; Halawany et al., 2007). Thus, they allow consumers to make more accurate quality inferences.

Different studies show that fish labels are important sources of information for consumers (e.g., Jørgensen et al., 2006; Pieniak et al., 2011). Their presence on a product highlights issues that consumers should consider, while the information they provide allows them to infer quality and compare products (Caswell, 2006). In addition to reducing search costs and correct information asymmetry (Hanss & Böhm, 2012), labelling helps producers to differentiate their products and obtain price premiums (Alfnes et al., 2018) by increasing consumers' perceived value of products (Jørgensen et al., 2006). Due to globalization, consumers are concerned about food safety, quality and origin fraud. According to Aung and Chang (2014), the labelling system cannot guarantee that the food is safe, of good quality and

authentic. To address consumer demands for reliable and relevant information and guarantees, different voluntary and mandatory traceability initiatives have emerged in different countries (Hobbs et al., 2005).

Multiple definitions of traceability exist, with no general agreement (Karlsen et al., 2013). The most frequently used definition is provided by the EU General Food Law (Olsen & Borit, 2013), which defines traceability as "*the ability to trace and follow a food, feed, food-producing animal or substance intended to be, or expected to be incorporated into a food or feed, through all stages of production, processing and distribution*" (European Parliament & Council of the European Union, 2002). According to Roos et al. (2005), traceability is necessary for accurate labelling as well as to substantiate marketing claims and information about credence attributes. By providing reliable and accessible information related to the origin and life history of products (Opara & Mazaud, 2001), traceability facilitates transparency in the value chain and provides quality assurance to consumers (Opara, 2003). Therefore, with traceability systems, consumers' confidence is likely to increase (Food Standards Agency, 2002). Although consumer awareness of this term is low (e.g., Giraud & Amblard, 2003; Kehagia, Linardakis, et al., 2007), different studies have shown that once informed about its meaning, they perceive its implementation in the fish value chain as desirable (e.g., Haghiri & Simchi, 2012; Maciel et al., 2013; Metref & Calvo-Dopico, 2016).

Studies investigating the importance of different extrinsic fish attributes for consumers (e.g., Asche & Guillen, 2012; Brunsø, 2009; Gaviglio et al., 2014) and their willingness to pay (WTP) a higher price for products with certain attributes (e.g., Boncinelli et al., 2018; Claret et al., 2012; Lawley et al., 2012; Rickertsen et al., 2017) are scarce. Likewise, there is not much previous research focusing on consumers' associations to fish traceability (e.g., Metref & Calvo-Dopico, 2016) and their WTP for traceable fish products (e.g., Haghiri & Simchi, 2012; Maciel et al., 2013; F. Wang et al., 2009). Therefore, this study focuses on fish products and investigates consumers' WTP for higher quality products and for products with quality assurances of traceability. More specifically, the objectives of this research are: (i) to investigate consumer search for differentiated high quality fish products and WTP for a certain origin and species, (ii) to analyse their interest in labels showing differentiating attributes, (iii) to evaluate consumer associations to traceability and WTP for traceable fish products.

5.2. Materials and methods

5.2.1. Sampling

During September and October 2013, a survey was conducted in six cities of Spain (A Coruña and Ourense, Zaragoza, Madrid, Valencia and Sevilla). These cities are located in the northwestern, northeastern, central, eastern and southern areas of mainland Spain respectively and were chosen to capture regional cultural and economic diversity. The sampling unit was the household which were randomly chosen and the respondents were responsible for food purchasing in their household. Participants under 18 years old or who bought cod products less than once a year were excluded. Data were collected through face-to-face interviews at the participant's home. A total of 295 consumers took part in the study. After cleaning data, 215 valid questionnaires from A Coruña (35), Ourense (11), Zaragoza (26), Madrid (39), Valencia (47) and Sevilla (57) were used for the analysis.

To evaluate the representativeness of the sample, participants' socio-economic characteristics were compared to the Spanish population provided by the Spanish National Institute of Statistics (INE). The sample mainly comprised female respondents (73.5%), highly educated, with 64.2% having finished at least high school, and most of them lived in big cities (53.4%). Biases in gender and level of education may be due to the recruitment criterion, while bias in place of residence may be due to the areas chosen to carry out the fieldwork. Women are usually responsible for food purchases in the household (Belch & Willis, 2002; Guàrdia et al., 2006), and higher educated consumers may have a higher predisposition to participate (Claret et al., 2012). The skewed education and the place of residence of the sample should be considered when interpreting the results of this study. For instance, in the study carried out by Verbeke et al. (2007), Belgian consumers residing in urban areas appeared to be less involved with fish quality than those living in rural areas. Furthermore, results from Charlebois et al. (2016) in Austria showed that consumers with a high level of education are less likely to trust the information on labels. Socio-demographic characteristics of respondents are presented in Table 12.

Table 12

Socio-demographic characteristics of the respondents

Demographic characteristics	Category	Subject (no.)	Percent (%)	Population[a] (%)
Gender	Male	57	26.5	48.8
	Female	158	73.5	51.2
Age	<30	18	8.4	18 (16-30 yr)
	30-39	39	18.1	19.7
	40-49	51	23.7	19.4
	50-59	68	31.6	15.8
	>59	39	18.2	27.1
Level of education	No studies or Primary School	20	9.3	27.2
	Junior High School	57	26.5	26.2
	High School	74	34.4	20.2
	University	64	29.8	26.4
Household type	Household with children under their care	92	42.8	34.9
	Independent person without children	37	17.2	24.2
	Household without children under their care	50	23.3	21.6
	Single parent	13	6.0	9.4
	Other	23	10.7	9.8
Monthly household income (€)	<1001	35	16.3	Mean 1869.1
	1001-2000	87	40.5	
	2001-3000	36	16.7	
	>3000	15	7.0	
	No response	42	19.5	
Place of residence (No. of habitants)	Rural (<10001)	4	1.9	60.4
	Small city (10001-100000)	58	27.0	19.7
	Medium city (100001-500000)	38	17.7	11.8
	Big city (>500000)	115	53.4	8.0

Note: Mean age = 48.75 years old

5.2.2. Questionnaire

A pre-test aiming to evaluate the comprehensibility, clarity, length and precision of the questions was conducted with eight consumers in A Coruña. The feedback was used to improve the questionnaire. The questionnaire used in the fieldwork included five sections with questions used in this work. Section one investigated general fish products purchase habits. Participants were asked to indicate how often they purchased five different categories of fisheries products (fresh, frozen, frozen precooked, chilled precooked and canned) on a ten-point scale, from "five or more times a week" to "less or never". Section two aimed to evaluate consumers' associations to traceability. Participants were given a definition of traceability and requested to evaluate on a five-point Likert scale ranging from totally disagree to totally agree whether traceability was related to seven statements drawn up based on previous studies (Table 13). The definition of traceability in the questionnaire was adapted from the definition developed by Moe (1998):

"Traceability is the ability to follow, at any given time, the path of a fishery product or lot of fishery products through the supply chain".

Section three explored consumers' search for high quality fish based on certain attributes and interest in label containing information regarding the species and origin of fish as a way of differentiation. This section contained two open-ended questions and one closed-ended. First, participants were asked whether they looked for high quality fish products determined by certain attributes like origin, species and preservation or transformation method when making purchase decisions which may help to differentiate them. Then, those participants who answered affirmatively were requested to explain the reasons for doing so. Finally, all respondents were asked to indicate on a five-point scale (from not interested at all to totally interested) if they would like fish labels to contain information related to origin and species as indicative of higher quality. Section four assessed consumers' WTP for a higher quality and traceable fish products. First, respondents were asked to state if they would be willing to pay an extra price for higher quality fisheries products on a dichotomous question (yes/ no). Those who answered positively to this question, were given a reference price corresponding to cod of 10€/kilo and asked to quantify the price premium they would pay for a higher quality product on a seven-point scale (from 0.01 to 0.50€, 0.51 to 1, 1.01 to 1.50, 1.51 to 2, 2.01 to

2.50, 2.51 to 3, more than 3€). Second, using a dichotomous question (yes/no), participants were requested to indicate if they were willing to pay a higher price for traceable fish products. Those who stated they were willing to pay an extra price, were given a reference price of 10€/kilo and asked to specify on a five-point scale (from 0.01 to 0.25€, 0.26 to 0.50, 0.51 to 0.75, 0.76 to 1, more than 1€) the price premium they would be willing to pay. Finally, section five collected sociodemographic characteristics: gender, age, level of education, household type, monthly household income and place of residence. The questionnaire also contained measures of other constructs and variables that are not included in this work.

Table 13
Items used in the study to measure associations to traceability of fish products

Items	References
To the quality of fishery products	van Rijswijk et al., (2008); van Rijswijk and Frewer (2008)
To food safety	van Rijswijk et al. (2008); van Rijswijk and Frewer (2008)
It is a tool for achieving authenticity of fishery products	van Rijswijk and Frewer (2012)
It is a tool that enables you to verify the information provided by suppliers	Based on Golan et al. (2002)
To the origin of the product	Giraud and Halawany (2006); van Rijswijk et al. (2008)
It is a kind of quality control of fishery products	Chrysochou et al. (2009); Chryssochoidis et al., (2006); Giraud and Halawany (2006)
It is a tool to address a food scare and identify and recall contaminated food	Chryssochoidis et al. (2006); Giraud and Amblard (2003)

5.2.3. Data analysis

Before the analysis, the four variables collecting the frequency of purchase were re-coded into two new variables: consumption variety and preferred category. Consumption variety corresponds to the number of categories most often purchased and it was measured on a five-point scale from one category to five categories. Preferred category aimed to identify the category purchased the most by respondents that bought one category more often than the others (n = 124). This variable comprised five categories (fresh, frozen, frozen precooked, chilled precooked, canned). Likewise, the variable corresponding to the interest of respondents in labels showing origin and species as indicative of higher quality was recoded into a new variable of three levels (no interest, medium interest, high interest).

First, the answers to open-ended questions regarding the search for higher quality fish products based on certain attributes and motives for doing so were coded and computed as frequencies. Afterwards, Chi-square test and Fisher's exact test, when appropriate, were used to analyse the relationships between categorical variables. Chi-square test was employed to evaluate the association between WTP for higher quality fisheries products and WTP for traceable fisheries products. Likewise, this test was used to investigate the one-on-one relationship between these variables with the gender of the participants, household type and preferred category. Fisher's exact test was used to evaluate the association between the interest in labels containing information related to species and origin as an indicator of higher quality and WTP for traceable fish products. Effect sizes were computed as Cramer's V and Phi, when appropriate, which range from 0 to 1 where 0.00 to 0.10 means negligible association and 0.80 to 1.00 very strong association (Rea & Parker, 2014). Finally, two-tailed Welch's t-test for independent samples was applied on ranked variables to draw attention to significant differences in the age, level of education, income, place of residence and variety of the products purchased by participants according to their WTP for higher quality fish products and also to their WTP for traceable fish products. Likewise, this test was used to look for significant differences in interest in labels showing origin and species between consumers who look for higher quality fish products and those consumers who do not and also between those who are WTP a premium for a higher quality product based on these same attributes and those who would not pay more. Effect sizes were computed as Cliff's delta, where values close to +1 or -1 indicate the absence of overlap between the two groups and values close to 0.0 indicate a complete group distribution overlapping (Macbeth et al., 2010). All analysis were performed using R version 3.6.1. (R Core Team, 2019). Chi-square and Welch's t-tests were performed using 'stats' package. Cramer's V and Phi were obtained using 'DescTools' package while Cliff's delta was calculated using 'musto101/wilcox_R' packages. The level of significance in all analyses was set at 5% ($p < 0.05$).

5.3. Results

5.3.1. Search for differentiated high quality fish products and WTP for a certain origin and species

5.3.1.1. Search for differentiated high quality fish products

At the time of purchase, most respondents (n = 124, 57.67%) looked for products of higher quality determined by certain attributes. A large proportion of these participants looked for fish of a certain origin or catch area when making purchase decisions (88.71%) and, to a lesser extent, for a fish of a specific species (4.03%). Other less frequent answers were dates, nutrients, catch method, raise method, elaboration method and conservation method. Furthermore, 13.64% of those respondents who paid attention to the origin or catch area (n = 110, 88.71%) stated that they preferred products from their own autonomous community, 9.09% simply said "from here", 8.18% from the Cantabrian sea, 7.27% from Spain, 2.73% simply "from the north" and 8.18% mentioned other origins. Additionally, some of these participants associated a higher quality signalled by origin to a certain species, such as hake (7.27%), mussels (2.73%), anchovies (2.73%), cod (1.82%) and other species (4.55%). Furthermore, a few of these respondents looked for a higher quality product of a certain species from a specific origin or catch zone (n = 16, 7.44%), like hake from the Cantabrian sea and anchovies from Santoña (Cantabria).

Those respondents who searched for higher quality products differentiated by certain attributes (n = 124) did so because they believed these attributes affected quality (39.52%), taste (34.68%), freshness (10.48%) and increased their trust in the product (8.06%). A smaller proportion stated that these attributes affected texture (4.84%) and their perception of safety (1.61%) and they are used to buying products with certain attributes (1.61%). Interestingly, 6.45% simply thought they would affect how good the product is and 4.03% considered these attributes to feel they were buying a product of proximity.

Furthermore, those participants who did not look for higher quality products determined by product characteristics (n = 91) mentioned some motives for not doing so, e.g., a better product would increase the price even more and fish being expensive enough, personal confidence in fish evaluation or trust in the fishmonger to choose the fish.

5.3.1.2. WTP for higher quality fish products defined by origin and species

Most participants were willing to pay a higher price for a higher quality product defined by a certain origin or species (*n* = 137, 63.72%). However, most of these respondents (55.47%) would pay a price premium up to 10% (less than 1€ over a reference price of 10€/kilo), 29.20% would pay between 10.1% and 20% more (from 1.01 to 2.00€) and only a 15.33% would pay an extra price higher than 20% (2€).

5.3.1.3. Profiling consumers willing to pay a premium for a higher quality product

The relationship between respondents' WTP for higher quality fish products and their sociodemographic characteristics and purchase habits can be seen in Table 14. The group of participants willing to pay an extra price was composed by more females (75.2%) and older consumers, where 20.4% of them were older than 59 years old, than the group not willing to pay a premium. Furthermore, the participants in the former group had a marginally significantly higher education level (*t* = 1.814, d.f. = 182.750, *p* = 0.071, d = 0.135), with more than 65% having at least finished high school, and more of these participants were part of household without children under their care (24.8%), single parents (7.3%) and "other types of households" (11.7%). Likewise, this group had a higher household income, with more than 80% of these respondents earning at least 2001€ a month, and lived in areas with a smaller number of inhabitants (only 49.6% lived in big cities).

Regarding purchase habits, the majority of those respondents willing to pay a premium most frequently bought a smaller number of different product categories, with 87.6% most frequently buying one or two different product categories, compared to those who would not pay more. Furthermore, significant differences were found in the category preferred by those participants buying a specific category more often than the others (*n* = 124, 57.7%), between the group willing to pay a premium and the group that would not (χ^2 = 5.998, d.f. = 2, *p* = 0.050, V = 0.220). Among those who buy one category more frequently than others (*n* = 124, 57.7%), a higher number of participants who would pay a price premium preferred fresh fish (68.7%) compared to those not willing to pay an extra price for higher quality, but less frozen (3.6%) and canned (27.7%).

Table 14

Relationship between respondents' WTP for higher quality fish products and their sociodemographic characteristics & purchase habits

	Total	Yes	No	Chi	t	d.f.	p	Effect size d	V	φ
Sociodemographic characteristics										
Gender				0.556		1	0.456			0.051
Male	26.5	24.8	29.5							
Female	73.5	75.2	70.5							
Age	3 [2 to 4]	3 [2 to 4]	4 [2.25 to 4]		0.193	167.700	0.847	0.015		
<30	8.4	8.0	9.0							
30 – 39	18.1	19.0	16.7							
40 - 49	23.7	24.1	23.1							
50 – 59	31.6	28.5	37.2							
> 60	18.2	20.4	14.1							
Level of education	3 [2 to 4]	3 [2 to 4]	3 [2 to 3]		1.814	182.750	0.071†	0.135		
No studies or Primary School	9.3	10.2	7.7							
Junior High School	26.5	24.1	30.8							
High School	34.4	29.2	43.6							
University	29.8	36.5	17.9							
Household type				2.624		4	0.623		0.110	
Household with children under their care	42.8	40.1	47.4							
Independent person without children	17.2	16.1	19.2							
Household without children under their care	23.3	24.8	20.5							
Single parent	6.0	7.3	3.8							
Other	10.7	11.7	9.0							
Monthly household income (n = 173)	2 [2 to 3]	2 [2 to 3]	2 [2 to 3]		0.876	130.040	0.383	0.075		
< 1001	20.2	17.6	24.6							
1001 – 2000	50.3	51.9	47.7							
2001 – 3000	20.8	21.3	20.0							
> 3000	8.7	9.3	7.7							
Place of residence	4 [2 to 4]	3 [2 to 4]	4 [3 to 4]		-1.579	167.620	0.116	-0.115		
Rural	1.9	2.9	0.0							
Small city	27	28.5	24.4							
Medium city	17.7	19.0	15.4							
Big city	53.4	49.6	60.3							

Purchase habits

	1 [1 to 2]	1 [1 to 2]	1 [1 to 2]				
<u>Variety (no. categories)</u>				-1.297	151.790	0.197	-0.096
One	57.4	60.6	52.6				
Two	27.3	27.0	28.2				
Three	12.5	10.2	16.7				
Four	1.9	1.5	2.6				
Five	0.5	0.7	0.0				
<u>Preferred category (n = 124)</u>				5.998	2	0.050*	0.220
Fresh	62.1	68.7	48.8				
Frozen	6.5	3.6	12.2				
Canned	31.5	27.7	39.0				

Note: Data are presented as percentages. Differences in gender, household type and preferred category between groups are tested statistically using Chi-Square while effect sizes are computed as Phi and Cramer's V, when appropriate. Median [IQR] of age, level of education, monthly household income, place of residence and variety are presented in the table. Differences in these variables are tested using two tailed Welch's t-test and effect sizes are computed as Cliff's delta. Signif. code: * = $p < 0.05$, † = $p < 0.10$

5.3.2. Interest in labels showing differentiating attributes

Most participants (n = 136, 63.26%) claimed to be very or totally interested in fish labels showing information related to the origin and species that would signal different levels of quality.

The relationship between participants' WTP for higher quality fish products based on its species or origin and their sociodemographic characteristics and purchase habits is presented in Table 15. Looking for products of higher quality determined by certain attributes and being interested in labels including information regarding species and origin were significantly associated (t = 7.560, d.f. = 152.44, p < 0.001, d = 0.474), with those who look for higher quality products being more interested in labels including this information than those who did not. Almost half of the sample (47.44%) looked for higher quality products based on certain attributes and were also interested in labels showing species and origin. Furthermore, 82.26% of those consumers who look for a higher quality product based on certain characteristics and 37.36% of those who did not, had a high interest in labels including species and origin. Likewise, a significant association between the WTP for a higher quality product based on the species and origin of the product and the interest of this information appearing in labels was found (t = 6.39, d.f. = 131.50, p < 0.001, d = 0.431). Those who were willing to pay a premium were also more interested than those who would not pay more in having species and origin on labels. Remarkably, almost half of the respondents (49.77%) would pay a higher price for a higher quality product and were also highly interested in having this information on labels. Likewise, less than 0.01% of respondents would pay a premium for a product of a higher quality determined by these attributes but were not interested in them appearing on the label.

Table 15

Interest in seeing origin and species on labels by search for differentiated products and WTP more for higher quality products

Interest in labels	Search for differentiated products				WTP for higher quality				Total	
	Yes		No		Yes		No			
	n	%	n	%	n	%	n	%	n	%
No interest	0	0	13	14.29	2	15.38	11	84.62	13	6.05
Medium interest	22	17.74	44	48.35	28	42.42	38	57.58	66	30.70
High interest	102	82.26	34	37.36	107	78.68	29	21.32	136	63.26
Total	124	57.67	91	42.33	137	63.72	78	36.28	215	100
Median [IQR]	3 [3 to 3]		2 [2 to 3]		3 [3 to 3]		2 [2 to 3]		3 [2 to 3]	

5.3.3. Informed associations to traceability and WTP for traceable fish products

5.3.3.1. Informed associations to traceability

After being given a definition of traceability, consumers mostly associated traceability to "the origin of the product" and "food safety" (86.98% and 86.05% of respondents agreed or totally agreed to these statements), followed by being "a tool that makes it possible to address a food scare and identify and recall contaminated food" (83.26%) and to "a quality control of fishery products" (82.79%). Traceability was also perceived as "a tool that enables you to verify the information provided by suppliers" (76.74%), "a tool that makes it possible to achieve authenticity of fishery products" (74.42%) and, to a lesser extent, it was related to "the quality of fishery products" (69.30%).

5.3.3.2. Relationship of interest in labels and WTP for higher quality fish products with consumers' WTP for traceability

Only 23.72% (n = 51) of the participants were willing to pay a higher price for traceable fish products. Moreover, 60.78% of these participants would pay an extra price up to 5% (0.50€ or less over a reference price of 10€/kilo) while 35.30% would be willing to pay between 5.10% and 10% more (from 0.51€ to 1€) and only 3.92% would pay a premium higher than 10% (more than 1€).

Respondents' interest in labels containing information regarding species and origin and their WTP more for additional guarantees provided by traceability was not significantly associated

to (p = 0.560, Fisher's exact test, V = 0.088). Nonetheless, respondents' WTP a price premium for products of specific species and origin was significantly associated to their WTP a higher price for traceable fish products (χ^2 = 26.722, d.f. = 1, p < 0.001, φ = 0.353). Remarkably, 94.12% of those participants willing to pay more for traceability, would also pay a premium for higher quality. However, only 35.04% of those willing to pay an extra price for higher quality products would pay more for traceable products (Table 16).

Table 16
WTP a premium for traceable fish products by interest for labels showing species and origin and WTP more for a higher quality product

WTP more for traceable fish products	Interest in labels showing species and origin						WTP more for higher quality				Total	
	No interest		Medium interest		High interest		Yes		No			
	n	%	n	%	n	%	n	%	n	%	n	%
Yes	2	15.38	13	19.70	36	26.47	48	35.04	3	3.85	51	23.72
No	11	84.62	53	80.30	100	73.53	89	64.96	75	96.15	164	76.28
Total	13	6.05	66	30.70	136	63.26	137	63.72	78	36.28	215	100

5.3.3.3. Profiling consumers WTP a premium for traceable fish products

The relationship between respondents' WTP a premium for traceable fish products and their sociodemographic characteristics and purchase habits can be seen in Table 17. A significant difference was found in the gender of participants willing to pay a premium for traceability and those who were not (χ^2 = 3.961, d.f. = 1, p = 0.047, φ = 0.136), being the former composed by significantly less females (62.7%). Furthermore, these respondents are younger and have a higher education than those not willing to pay a premium, with only 17.6% being above 59 years old and 68.8% with at least high school level. Likewise, the group willing to pay a higher price for traceability is composed by more participants belonging to households with children under their care (45.1%) and are independent persons (19.6%) than the group which would not pay a premium. Finally, these participants tend to have higher incomes and live in areas with a larger number of inhabitants, 90.4% of them earn above 1000€ and 54.9% live in big cities.

Concerning purchase habits, respondents willing to pay a premium for traceability most frequently consumed a wider variety of product categories than those not willing to pay more

(49%). Among those who buy one category more frequently than others (n = 124, 57.7%), participants willing to pay a higher price for traceable products consume more fresh products (65.4%) and less frozen (3.8%) and canned (30.8%) than those not willing to pay a premium.

Table 17

Relationship between WTP a premium for traceable fish products and sociodemographic characteristics & purchase habits

	Total	Yes	No	Chi	t	d.f.	p	Effect size		
								d	V	φ
Sociodemographic characteristics										
<u>Gender</u>				3.961		1	0.047*			0.136
Male	26.5	37.3	23.2							
Female	73.5	62.7	76.8							
<u>Age</u>	3 [2 to 4]	3 [2 to 4]	4 [2 to 4]		-0.722	82.873	0.472	-0.065		
< 30	8.4	7.8	8.5							
30 – 39	18.1	21.6	17.1							
40 – 49	23.7	27.5	22.6							
50 – 59	31.6	25.5	33.5							
> 60	18.2	17.6	18.3							
<u>Level of education</u>	3 [2 to 4]	3 [2 to 4]	3 [2 to 4]		0.933	85.533	0.353		0.082	
No studies or Primary School	9.3	5.9	10.4							
Junior High School	26.5	25.5	26.8							
High School	34.4	35.3	34.1							
University	29.8	33.3	28.7							
<u>Household</u>				0.742		4	0.946		0.059	
Household with children under their care	42.8	45.1	42.1							
Independent person without children	17.2	19.6	16.5							
Household without children under their care	23.3	19.6	24.4							
Single parent	6	5.9	6.1							
Other	10.7	9.8	11							
<u>Monthly household income</u> (*n* = 173)	2 [2 to 3]	2 [2 to 3]	2 [2 to 3]		0.072	75.307	0.943	0.007		
< 1001	20.2	18.6	20.8							
1001 – 2000	50.3	51.2	50.0							
2001 – 3000	20.8	25.6	19.2							
> 3000	8.7	4.7	10.0							
<u>Place of residence (No. of habitants)</u>	4 [2 to 4]	4 [2 to 4]	4 [2 to 4]		0.200	83.734	0.842	0.017		

Rural	1.9	0.0	2.4				
Small city	27	29.4	26.2				
Medium city	17.7	15.7	18.3				
Big city	53.4	54.9	53.0				

Purchase habits

<u>Variety (No. categories)</u>	1 [1 to 2]	1 [1 to 2]	1 [1 to 2]	1.210	79.105	0.230	0.103
One	57.4	51.0	59.8				
Two	27.3	29.4	26.8				
Three	12.5	15.7	11.6				
Four	1.9	2.0	1.8				
Five	0.5	2.0	0.0				
<u>Preferred (*n* = 124)</u>				0.408	2	0.815	0.057
Fresh	62.1	65.4	61.2				
Frozen	6.5	3.8	7.1				
Canned	31.5	30.8	31.6				

Note: Data are presented as percentages. Differences in gender, household type and preferred category between groups are tested statistically using Chi-Square while effect sizes are computed as Phi and Cramer's V, when appropriate. Median [IQR] of age, level of education, monthly household income, place of residence and variety are presented in the table. Differences in these variables are tested using two tailed Welch's t-test and effect sizes are computed as Cliff's delta. Signif. code: * = $p < 0.05$.

5.4. Discussion

The majority of consumers look for differentiated high quality fish products. The origin or catch area of the fish is the most important quality indicator for the majority of consumers, who have a clear preference for domestic products. These findings are in the same vein as previous studies in different countries, which suggested the relevance of the origin at the time of purchase and the preference for domestic products. For instance, in Spain and Belgium, Brunsø et al. (2009) found that country of origin was among those attributes that heavy consumers believe affect quality, with consumers preferring fish of national origin. Similar results were obtained by Lawley et al. (2012) in Australia, where country of origin was the most important extrinsic cue for consumers when purchasing seafood with a clear preference for domestic products. ''Australian'' was an indicator of freshness, superior quality and safety but also of a higher price. Furthermore, in the present study, origin is believed to be a direct indicator of quality but also indirect through taste and freshness. According to Brunsø (2006), expected quality is mainly associated to freshness, wholesomeness, taste and nutrition and some consumers fish quality equates to freshness (Brunsø et al., 2009). In this sense, Carlucci et al. (2015) suggest that consumers prefer domestic fish because they perceive it as being of greater quality, safety and freshness. This can be explained by the shorter distance between the production place and the store, which affects freshness and environmental costs but also stereotypes, emotional sensations and incorrect information such as patriotism or ethnocentrism.

The results of this study indicate that consumers are willing to pay a price premium for higher quality fish products determined by their species and origin. This is in agreement with results obtained by Claret et al. (2012) in Spain, which suggested that origin is one of the most relevant factors for consumers and they are willing to pay a significant price premium for it. Also in Spain and based on a hedonic analysis, Asche and Guillen (2012) determined that origin is the most important attribute for the price of hake, with consumers preferring local products. Similarly, Boncinelli et al. (2018) found that Italian consumers are willing to pay a price premium for knowing the catch zone of fish used as ingredient of processed food. Likewise, results obtained by Rickertsen et al. (2017) in France suggest that sensory characteristics and WTP depend on the species. Furthermore, the res also suggest that those consumers who prefer fresh fish are more willing to pay for a higher quality than those who

prefer other categories. This may be explained by fresh fish being considered as having the best quality of all categories (Olsen, 2004).

Consumers are interested in the information related to origin and species being portrayed on fish labels, particularly those who look for higher quality products based on certain attributes and those willing to pay more for higher quality. These results are in accordance with the findings of Pieniak et al. (2013), who found that in eight different European countries, fish labels are one of the most used sources of information at the time of purchase. According to Alfnes et al. (2018), by documenting desirable attributes, labels not only help producers to differentiate products but also allow them and retailers to obtain price premiums. Finally, different members of the fish sector of twelve different countries interviewed by Jørgensen et al. (2006) agreed that labels would add value to the product.

Traceability is associated to the origin and safety of the product as well as to the management of food scares, to control quality and verify the information provided by supplier. These findings are in agreement with the study carried out by Metref and Calvo-Dopico (2016), who found that tuna consumers in Spain associate traceability to the origin and to the path of a product along the entire supply chain. Different studies in Europe have confirmed that consumers mainly associate traceability to the origin of the product but have also indicated that consumers relate it to other concepts. For instance, results obtained by van Rijswijk et al. (2008) showed that consumers associate traceability to origin, quality and safety but also to the product being controlled and guaranteed in terms of quality or safety. Similarly, Chryssochoidis et al. (2006) suggested that traceability was perceived to be the identification of the origin, a reassurance of food quality and safety as well as a tool to control the production process and for food recalls. Likewise, a study conducted by Giraud and Halawany (2006) showed that consumers associated this term to the origin and ingredients of the product as well as to food scares and control.

Results show that only a small proportion of consumers would pay more for traceable fish products. Furthermore, those willing to pay more for differentiated higher quality products were also more likely to be willing to pay more for traceable fish products. The premium that consumers are willing to pay for a higher quality and traceable fish products is smaller than 10% and 5.01%, respectively. Previous studies have obtained mixed results regarding

consumers WTP more for traceable fish products. For instance, in the study carried out by Haghiri and Simchi (2012) in Newfoundland and Labrador, more than two-thirds of respondents would be willing to pay 15% more to purchase traceable farm-raised Atlantic salmon. In a similar vein, results obtained by Wang et al. (2009) indicated that 86% of consumers in Beijing thought that prices of fish would rise if traceability was implemented and almost 90% of them would be willing to pay a higher price. Nonetheless, the average premium would be only 6%. On the contrary, studies in Spain have indicated that the majority of consumers would not pay more. Metref and Calvo-Dopico (2016) found that only 27% of consumers would pay a price premium for traceable tuna products and two thirds of those consumers would only pay up to 0.50€ over a reference price of 10€. This may be caused by consumers believing that independent or government control organisation inspect the products before reaching the sales point (Verbeke et al., 2008), using substitutes of traceability such as the trust in fishmonger or assuming that it should be standard and not them assuming the cost of introducing traceability systems (Giraud & Halawany, 2006).

In summary, the results of this study indicate that the majority of consumers look for differentiated high quality fish products. Origin and, to a lesser extent, species are believed to be direct indicators of quality but also indirect through taste and freshness with consumers having a clear preference for domestic products. Likewise, most consumers are willing to pay a price premium up to 10% for higher quality fish products determined by their origin or species, especially higher educated consumers and those who prefer fresh fish. Consumers are interested in labels documenting these attributes, especially those who look for differentiated products and those willing to pay a premium for higher quality products. Furthermore, for consumers, traceability is associated to the origin and safety of the product as well as to the management of food scares, to quality control and to verifying the information provided by supplier. However, only a small proportion of the consumer would be WTP more for traceable fish products, which corresponds to a fraction of those who are also WTP a higher price for a higher quality product. Females are less likely to be WTP more for traceable fish products. Furthermore, the premium consumers are WTP for traceable fish products is smaller than 5.01%.

The findings presented here have implications for both, government and industry. First, consumers are interested in using fish labels to find the information they demand and both

policy makers and producers should make use of them to communicate information to consumers efficiently. Second, producers can also use labels to differentiate their products by portraying those attributes that indicate to consumers that the product is of a higher quality. Specifically, producers should focus on differentiation based on origin since it is a key attribute for consumers to infer quality of fish products, with a special emphasis on domestic products. Third, to increase consumers' perceived value of traceability, policy makers should try to improve consumers knowledge through education and information campaigns. Finally, producers could design market strategies to target the higher end niche market identified in this research in which consumers would pay more for traceable and differentiated higher quality fish products by their origin and species.

Finally, this study has some limitations. First, consumers' WTP, for both differentiated higher quality products and traceability, was measured with a dichotomous question (yes or no). WTP values may not be translated into behaviour. Therefore, it is suggested to carry out further research on consumers WTP for differentiated higher quality fish products and traceability in real life or experimental settings. Second, the sample used in this study was only from Spain, and it is not known if or to what extent culture has affected these results. It is recommended to carry out future research to replicate this study in different countries.

CHAPTER 6

DISCUSSION AND CONCLUSIONS

6.1. Discussion

The results of this thesis indicate that the majority of consumers look for and are willing to pay up to 10% more for differentiated high-quality fish products, especially by their origin and, to a lesser extent, their species. Most consumers have a clear preference for domestic products. They believe that these products are of a better quality in general but also in terms of taste and freshness. This is in agreement with Brunsø (2006) who indicated that expected quality is mainly associated to freshness, wholesomeness, taste and nutrition. The findings presented here are in line with results obtained by Claret et al. (2012) in Spain, which suggested that origin is one of the most relevant factors for consumers and they are willing to pay a significant price premium for it. Furthermore, results obtained by Rickertsen et al. (2017) in France suggest that sensory characteristics and WTP depend on the species. Likewise, Brunsø et al. (2009) found that, in Spain and Belgium, country of origin is among those attributes that heavy consumers believe affect quality, with a preference for fish of national origin. Carlucci et al. (2015) suggest that consumers prefer domestic fish because they perceive it as being of greater quality, safety and freshness. This can be explained by the shorter distance between the production place and the store, which affects freshness and environmental costs but also stereotypes, emotional sensations and incorrect information such as patriotism or ethnocentrism.

Fish labels are important for the majority of consumers. They are interested in information related to origin and species being shown on fish labels, particularly those who look for and are willing to pay more for higher quality products defined by these attributes. In the same vein, Pieniak et al. (2013) found that in eight different European countries, fish labels are one of the most used sources of information at the time of purchase. According to Alfnes et al. (2018), by documenting desirable attributes, labels not only help producers to differentiate products but also allow them and retailers to obtain price premiums. Finally, different members of the fish sector of twelve different countries interviewed by Jørgensen et al. (2006) agreed that labels would add value to the product.

The results on cod presented here may suggest that the information portrayed on labels is also important for the majority of consumers, especially that related to safety issues such as best before, whether the product had gone through health control and storage conditions.

On the contrary, fisherman name and scientific name were considered quite or very important by the least respondents. Results from Verbeke and Roosen (2009) suggest that fish consumers consider direct information cues, such as best before or health control to be more relevant than other cues harder to interpret, such as the fisherman who caught the cod and the scientific name of the species. The results presented here indicate that best before and health control are safety-related attributes, confirming previous research (van Rijswijk & Frewer, 2006). Furthermore, the findings of these indicate that best before and health control are important for consumers, confirming previous studies (Altintzoglou et al., 2012; Olsen et al., 2017; Verbeke et al., 2008). This may be explained by safety being a credence attribute (Caswell, 2006), therefore consumers might not be able to know whether a product is safe even after consumption. Nevertheless, consumers are not all alike (Verbeke, 2005) and, in this study, four different segments of consumers were identified according to the importance attached to the different types of labelling information. Likewise, differences between groups according to purchase motives were found, specifically in perceiving it as natural, easy to digest and to prepare it on special dates. Similar results were obtained by Bernués et al. (2003), who found significative differences between beef consumer segments according to the type of information demanded in labels regarding motives of consumption.

Consumers do not have a good knowledge of traceability and mainly associate traceability to origin and, when informed, also to safety, to the management of food scares, to quality control and to verifying the information provided by supplier. These findings are in agreement with the study carried out by Metref and Calvo-Dopico (2016), who found that the knowledge of tuna consumers in Spain regarding traceability is low and they spontaneously associate it to the origin and to the path of a product along the entire supply chain. Likewise, results from van Rijswijk et al. (2008) suggest that origin is linked to food quality. Different studies in Europe have confirmed that consumers mainly associate traceability to the origin of the product but have also indicated that consumers relate it to other concepts. For instance, results obtained by van Rijswijk et al. (2008) showed that consumers associate traceability to origin, quality and safety but also to the product being controlled and guaranteed in terms of quality or safety. Similarly, Chryssochoidis et al. (2006) suggested that traceability was perceived to be the identification of the origin, a reassurance of food quality and safety as well as a tool to control the production process and for food recalls. Therefore, it can be

concluded that consumers not only associate traceability to safety, but also to quality (van Rijswijk & Frewer, 2008).

Informed consumers consider traceability of fish products as necessary. Similar results were found by Metref and Calvo-Dopico (2016), indicating that most tuna consumers in Spain consider traceability systems as necessary. Likewise, Haghiri (2014) concluded that, in the particular case of farmed Atlantic salmon, consumers in Canada would respond favourably to the implementation of traceability systems in this product. This can be explained by fish products being hazardous and having serious consequences over health if in bad condition (van Rijswijk et al., 2008). On top of that, fish products are highly complex and it is hard for consumers to infer their quality (Denton, 2003). The results presented here also demonstrate that the lack of pre-existing knowledge of traceability may act as a barrier to the acceptance of traceability even once the information is provided. Pieniak and Verbeke (2008) indicated that consumers use cues they are familiar with and therefore this research suggests that some consumers may not consider traceability desirable in fish products due to their low level of understanding of traceability and their lack of familiarity with traceable products.

Participants main expectations regarding traceability functions are in terms of being able to know the origin of the fish, know whether the product has gone through a quality control and verify the information that appears on the label. Furthermore, the findings of this thesis show that consumers who consider traceability necessary hold higher expectations about being able to know the origin and the ingredients of the product, to verify the information that appears on labels as well as making it possible to allocate liability, manage a food scare and recall infected products. These results are in accordance with previous studies showing that, with traceability, consumers generally expected to be able to know the origin of the fish (Calvo Dopico et al., 2016). Furthermore, they are increasingly interested in information about ingredients, specially to avoid allergens or certain ingredients (Verbeke, 2005). Likewise, according to Gellynck and Verbeke (2001), consumers who feel the strongest need for traceability in meat products are those who attach greater importance to being able to check production characteristics and functional attributes such as identifying the party responsible in case of abuse and allowing authorities to intervene in case of a problem in the value chain are most valuable to consumers.

Lastly, only a small proportion of consumers would pay more for traceable fish products, especially those willing to pay more for differentiated higher quality products. Nonetheless, the majority of these consumers would only pay up to 5.01% more. Previous studies have obtained mixed results regarding consumers' WTP more for traceable fish products. For instance, in the study carried out by Haghiri and Simchi (2012) in Newfoundland and Labrador, more than two-thirds of respondents would be willing to pay 15% more to purchase traceable farm-raised Atlantic salmon. On the contrary, studies in Spain have revealed that most consumers would not pay more. Metref and Calvo-Dopico (2016) found that only a quarter of consumers would pay a price premium for traceable tuna products and two thirds of these consumers would only pay up to 5%.

6.2. Conclusions

This thesis aimed to investigate the quality signalling and assurance in fisheries markets from a consumer point of view. Quality is a key criterion for consumers to decide which product to buy (Altintzoglou & Heide, 2016; Olsen et al., 2017). However, at stores, as the result of globalization, consumers find a broad variety of products from different sources of which they know very little about. Food producers differentiate their products with a range of attributes, including characteristics that consumers cannot discern even after consumption, such as content (e.g., nutrients) or process attributes (e.g., organic or dolphin-safe) (Golan, 2002). Labelling reduces search costs and corrects information asymmetry (Hanss & Böhm, 2012), helps producers to differentiate products (Alfnes et al., 2018) and increases the perceived value of products (Alfnes et al., 2018; Jørgensen et al., 2006; Pieniak, Verbeke, Vermeir, et al., 2007). Nonetheless, consumers are not all alike and the information portrayed on labels must be carefully chosen (Pieniak et al., 2011). In order to assess the efficiency of the mandatory information, adapt the voluntary information and improve differentiation strategies, it is necessary to understand their perception regarding quality and labelling.

The labelling system alone cannot guarantee that the food is safe, of good quality and authentic (Aung & Chang, 2014). To address consumer demands for reliable and relevant information and guarantees, different voluntary and mandatory traceability initiatives have emerged in different countries (Hobbs et al., 2005). According to Hobbs (2003, 2004), with traceability, quality is signalled ex ante and reliable quality information flows from producer

to consumer. Once quality is revealed, traceability allows the establishment of liability and the trace back of products in the event of a food safety incident. Furthermore, several companies have added elements of marketing to traceability in order to stress attributes that can add value to their products (Morrissey & DeWitt, 2014). Nevertheless, the implementation of traceability systems increases production costs and may push up market price. Therefore, understanding consumers' perception and willingness to pay is critical to ensure the viability of traceability and evaluate the differentiation strategies based on these systems.

Based on the results obtained in this thesis the following conclusions can be drawn. Most consumers look for and are willing to pay more for high-quality fish, especially for those differentiated by their origin and, to a lesser extent, by their species. Furthermore, there is a clear preference for domestic products. Consumers believe these products are of higher quality in general, but also have a better taste and are fresher. Consumers are interested in fish labels differentiating high quality products, especially those consumers who look for differentiated products and those who are willing to pay a price premium for higher quality products. Not only labels are important for consumers but also the information portrayed on them. The most relevant labelling attributes are those related to safety issues. Nonetheless, different groups of consumers exist according to the importance attached to the different types of labelling information. These groups also differ in their fish purchase motives.

Consumers' knowledge on traceability is generally low. They associate traceability to safety but also to quality. Nevertheless, once informed, consumers believe its implementation in fish value chains is necessary. The effect of information on the perceived desirability of traceability is associated to the pre-existing knowledge of consumers. Consumers perceive traceability is valuable as a means to know the origin of the fish and all the ingredients of the product, to allocate liability, to manage food scares and recall infected products and to verify the information on the label. However, only a small proportion of consumers would be willing to pay a price premium which would be small. The majority of these consumers belong to the group that would also pay more for higher quality fish products.

6.3. Implications

6.3.1. Implications for authorities

First, fish labels are used by consumers to find the information they demand. Therefore, they are an important tool that should be used by policy makers to highlight important issues related to the product and also modify behaviours. Second, for labels to be effective means of communication with consumers, the information they contain must be closely monitored. Consumers are especially interested in information regarding safety issues and, therefore, it must appear on labels. Third, relevant information such as scientific names do not seem to receive enough attention despite conditioning many fish attributes. Education and information campaigns are needed to increase consumer awareness. Fourth, to address consumers' demands, the implementation of traceability systems in all categories of fishery products is recommended. Fifth, to promote the acceptance of traceable fishery products, it is critical to familiarize consumers with traceability. Education and information campaigns should be designed and carried out considering that they have a progressive effect on consumers' perception of traceability and, thus, these actions should be maintained over time to take effect.

6.3.2. Implications for producers and marketers

First, producers could differentiate higher quality products by their origin and species which would allow them to increase the price of fish products. They should highlight the origin especially in the case of domestic products. Second, producers should use labels to differentiate their products, by including the origin, species or cues related to freshness and health issues, but they should also contain safety-related information. The determinants of and influences on the purchase of products should be considered to provide targeted label information. Third, labels should be accompanied with credible certifications and traceability indicators allowing consumers to verify label information which would increase consumer trust. To this end, the use of internet links or QR codes on the label or package is advised as well as to deliver personalised information to consumers which would help to avoid overwhelming them with extensive information. Fourth, traceability information should be communicated to consumers in a simple way. Fifth, producers could take advantage of traceability to differentiate a product by its origin and ingredients, but they should also

communicate the benefits traceability systems report as a quality assurance and once a food scare has taken place. Sixth, they should not expect the majority of consumers to pay more for traceability by itself. Only a small proportion of consumers willing to pay a price premium for higher quality would also be willing to pay more for traceable fish products. Therefore, if they want to obtain a greater profit, they should target this share of consumers.

6.4. Limitations and future research

This thesis has some limitations that should be considered when interpreting results. First, the fieldwork for this thesis was carried out in just one country, Spain. Furthermore, Spaniards are considered to be heavy consumers of fish. Therefore, it is suggested to replicate this study in other countries to evaluate the influence of culture and consumption differences on the findings presented here. Second, data used in this research was collected with a questionnaire. Consumers' actual behaviour may deviate from self-reported behaviour. Therefore, further research conducted on real consumers' purchase behaviour of traceable fishery products by observation or auction experiments are recommended. Furthermore, it is recommended to investigate consumers' preferences on the carriers of traceability information in fishery products. Finally, changes in behaviour and consumption have occurred during the COVID-19 pandemic and lockdown. Future research could investigate the nature and scale of these changes.

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APPENDIXES

Appendix A. Extensive summary in Spanish

El consumo mundial de pescado ha crecido de manera constante desde 1961, dos veces más rápido que la población mundial. Este rápido crecimiento ha sido impulsado por una serie de factores como el aumento de la producción, los avances tecnológicos en el transporte y la distribución; el aumento de los ingresos y de la conciencia de los consumidores sobre los beneficios para la salud del consumo de pescado. Al contrario que el consumo a nivel mundial, el consumo aparente y el consumo per cápita de productos pesqueros en la Unión Europea ha disminuido de 2017 a 2018 siendo en este último año de 12,48 millones de toneladas y 24,36 kg/per cápita, respectivamente. No obstante, el gasto en pescado de los hogares ha aumentado hasta los 59300 millones de € (1%) para el total de la Unión Europea, pero también de manera individual en casi todos los países, debido a la inflación. El gasto de los hogares en Italia (11679 millones €) y España (10569 millones €) es el más alto entre los países europeos. Además, España registró el mayor crecimiento entre estos dos años (400 millones €, lo que representa un 4%). Si bien existe una tendencia decreciente en el consumo y gasto de pescado fresco en los últimos años, el pescado fresco ostenta la mayor parte del gasto en pescado de los hogares en la Unión Europea. Esta tendencia negativa se explica por la disminución del consumo de merluza, bacalao y sardina en los principales consumidores, concretamente España, Italia y Francia.

La calidad es un criterio clave para que los consumidores decidan qué producto comprar. Sin embargo, la globalización e internacionalización de los mercados de alimentos y la industrialización de la producción han aumentado la complejidad de las cadenas alimentarias y la disponibilidad y variedad de productos alimenticios en los puntos de venta. Los consumidores asocian la calidad del pescado principalmente a la frescura, pero también a la salud, el sabor y el valor nutricional. Los productos pesqueros son particularmente frágiles y su calidad y frescura están influidas por diversos factores intrínsecos, como las características biológicas de la especie o individuo, así como por las condiciones previas a la captura, durante la captura y tras la captura, como son los métodos de captura, manipulación, procesamiento y técnicas de almacenamiento.

El conocimiento de los consumidores sobre la calidad del pescado es bajo y estos encuentran dificultades para evaluarla y formar expectativas a través de sus propiedades físicas, como el

contenido en grasa, la apariencia o el olor. Por lo tanto, las etiquetas se convierten en fuentes de información importantes para los consumidores en el momento de la compra de pescado. El etiquetado reduce los costes de búsqueda y corrige las asimetrías de la información, ayuda a los productores a diferenciar los productos y aumenta el valor percibido de los productos. No obstante, la información mostrada en las etiquetas debe elegirse cuidadosamente. Los consumidores no son todos iguales y el simple hecho de proporcionarles más información no es suficiente para reducir las asimetrías de información y la incertidumbre. Además, el fraude alimentario ha erosionado la confianza de los consumidores en los productores y están preocupados por el fraude de origen, calidad y seguridad alimentaria.

Aunque las etiquetas se consideran necesarias para garantizar la seguridad en los mercados de pescado, el sistema de etiquetado por sí solo no puede garantizar que los alimentos sean seguros, de buena calidad y auténticos. Para satisfacer las demandas de los consumidores de información fiable y relevante, así como de garantías, en diferentes países han surgido distintas iniciativas de trazabilidad voluntarias y obligatorias. Los sistemas de trazabilidad pueden aumentar la confianza del consumidor al reducir la vulnerabilidad a la contaminación de las cadenas alimentarias. La complejidad de la cadena de suministro de productos pesqueros facilita la existencia de pesca ilegal, no declarada y no reglamentada, y conlleva un mayor riesgo de fallos en el control de calidad, como parásitos, contaminantes o metales pesados que pueden afectar a la calidad y ser un peligro para la seguridad, así como el fraude de productos pesqueros como etiquetado incorrecto o sustitución de productos. La trazabilidad satisface las crecientes demandas de información de los consumidores sobre el contenido, el origen y el proceso de los productos alimenticios. Estos atributos no se pueden descubrir ni siquiera tras el consumo del producto. Además, diversas compañías han agregado elementos de marketing a la trazabilidad para destacar atributos que pueden añadir valor a sus productos. Por lo tanto, la trazabilidad surge como una herramienta necesaria para que las empresas alimentarias etiqueten con precisión, respalden las afirmaciones de marketing e informen a los consumidores sobre atributos del producto que de otra forma no podrían conocer.

A pesar del innegable valor que tienen el etiquetado y la trazabilidad para los diferentes agentes de la cadena de valor, las percepciones y expectativas de los consumidores a menudo difieren de las de los expertos. Dado que los consumidores se encuentran en ambos extremos

de la cadena de valor, es necesario comprender su percepción sobre la información que aparece y pudiera aparecer en el etiquetado para evaluar la eficiencia de la información obligatoria y adaptar la información voluntaria. Asimismo, la implementación de sistemas de trazabilidad aumenta los costes de producción y puede elevar el precio de mercado. Comprender la percepción de los consumidores y su disposición a pagar es fundamental para garantizar la viabilidad de la trazabilidad. Por tanto, conocer la percepción del consumidor de la calidad de los productos pesqueros y su aseguramiento a lo largo de la cadena alimentaria así como del etiquetado; investigar el conocimiento que tiene de la trazabilidad y averiguar la disposición a pagar por productos de mayor calidad y garantías son retos a los que se enfrentan las autoridades y la industria pesquera.

Por ello, el objetivo general de esta tesis es analizar la señalización y garantías de calidad de los productos pesqueros desde el punto de vista del consumidor. Para alcanzar este objetivo principal, se han establecido los siguientes objetivos específicos (i) evaluar la importancia relativa para los consumidores de la información que muestran y podrían mostrar los etiquetas de productos pesqueros e identificar segmentos de consumidores de acuerdo con la importancia percibida de los diferentes tipos de información, (ii) explorar el conocimiento de los consumidores sobre la trazabilidad y las asociaciones a ese término, así como la necesidad percibida de su implementación en el mercado pesquero y los beneficios esperados de ella, (iii) investigar la disposición de los consumidores a pagar más por productos pesqueros de mayor calidad así como por productos con las garantías de calidad que proporciona la trazabilidad.

Para alcanzar los objetivos de esta tesis se ha empleado la siguiente metodología centrada en el uso de técnicas de investigación cuantitativa, teniendo como base una investigación de mercados realizada a consumidores de productos pesqueros en España. Los datos usados en esta investigación se recopilaron en seis ciudades del noroeste, noreste, centro, este y sur de España peninsular: A Coruña y Ourense, Zaragoza, Madrid, Valencia y Sevilla, respectivamente. El trabajo de campo se llevó a cabo durante los meses de septiembre y octubre de 2013. La recogida de datos se realizó mediante cuestionarios en el hogar del participante. La unidad muestral fue el hogar y el encuestado la persona responsable de la compra de alimentos en el hogar. Los sujetos que compraron productos pesqueros menos de una vez al año fueron excluidos. Los hogares fueron seleccionados al azar en las ciudades

previamente mencionadas y se recogieron un total de 295 observaciones. Antes de comenzar con la recogida de datos, se realizó un pre-test con ocho consumidores en A Coruña para evaluar la claridad, la comprensibilidad y extensión del cuestionario. La base de datos principal se dividió en tres subconjuntos de variables que se analizaron en cada uno de los tres estudios que componen esta tesis y las variables se codificaron o recodificaron cuando fue necesario para el análisis. Para estas submuestras, se realizó una depuración de los tres subconjuntos de datos para detectar y excluir observaciones con valores perdidos y valores atípicos que podrían sesgar análisis posteriores. Una vez depurados los subconjuntos de cada estudio, quedaron 214, 216 y 215 observaciones, respectivamente, para el análisis. Los análisis realizados en esta tesis se pueden clasificar en dos tipos, de agrupación (Capítulo 3) y de asociación entre variables o diferencias entre grupos (Capítulos 3, 4 y 5). Para agrupar variables y observaciones se usaron análisis de componentes principales y clúster, respectivamente. Para evaluar asociaciones entre variables categóricas y diferencias entre grupos de variables ordinales respecto a variables categóricas, se realizó Fishers' exact test y Chi-cuadrado. Para evaluar diferencias entre grupos de variables categóricas/ordinales respecto a variables ordinales se utilizó Kruskal-Wallis (*post hoc* Dunn's test) y Welch's t-test. Para evaluar diferencias entre grupos en función de un conjunto de variables se usó el análisis Permanova. Para calcular el tamaño del efecto de cada asociación y diferencia entre grupos, se calculó el tamaño del efecto más adecuado para cada caso (Cliff's delta, Cramer's V, Phi, odds ratio o Epsilon-squared). Todos los análisis y cálculos realizados para alcanzar los objetivos de esta tesis se realizaron usando *IBM SPSS Statistics* y *R* con diferentes paquetes para cada función. Adicionalmente, para la elaboración de esta tesis, se consultaron fuentes de datos secundarios para contextualizar la investigación y bases de datos bibliográficas, como *Scopus* o *Web of Science*, de donde se extrajo la bibliografía necesaria.

Los capítulos del 3 al 5 recogen los tres estudios experimentales incluidos en esta tesis. En el capítulo 3 se analiza la importancia relativa que los consumidores confieren a la información contenida y que puedan incluir las etiquetas de bacalao e identifican segmentos de consumidores de acuerdo con la importancia percibida de los diferentes tipos de información. Los resultados muestran que la importancia que se le confiere a la información de las etiquetas está relacionada con las características sociodemográficas de los consumidores como el género, el tipo de hogar, los ingresos del hogar y el lugar de residencia. La información

relacionada con la seguridad, como consumo preferente y si el producto ha pasado por un control sanitario, es considerada como la más importante. Además, estos resultados indican la existencia de cuatro grupos de consumidores en base a la importancia percibida de la información de la etiqueta: *tradicionales*, *preocupados por la seguridad*, *enfocados a la calidad* y *entusiastas*. El segmento *tradicional* es el más grande y comprende a los consumidores que atribuyen menor importancia a la información que figura en la etiqueta. No obstante, estos consumidores consideran que los atributos relacionados con la salud y la seguridad son los más relevantes. Adicionalmente, se encontraron diferencias significativas en los motivos de compra entre estos cuatro segmentos.

El capítulo 4 evalúa el conocimiento y explora las asociaciones que los consumidores hacen al concepto de trazabilidad, analiza la necesidad percibida de productos pesqueros trazables y el efecto de la provisión de información, de acuerdo con sus conocimientos previos y características socioeconómicas. Finalmente, se examina la necesidad de la trazabilidad basada en sus funciones. Los resultados muestran que los consumidores tienen un bajo nivel de conocimiento sobre el término trazabilidad, asociándola de forma espontánea al origen del producto y a todo el proceso que siguen los productos pesqueros desde su captura. Además, la mayoría de los consumidores perciben la trazabilidad de los productos pesqueros como necesaria, pero su escaso conocimiento podría actuar como una barrera a su aceptación. Asimismo, existe una asociación significativa entre el tipo de hogar y la necesidad percibida. Los consumidores valoran la trazabilidad como un medio para conocer el origen, los ingredientes y verificar que las afirmaciones del productor sean verdaderas. Finalmente, la trazabilidad es importante para asignar responsabilidades y gestionar una crisis alimentaria.

En el capítulo 5 se investiga la disposición de los consumidores a pagar más por productos pesqueros de mayor calidad, así como por productos con garantías de calidad proporcionadas por la trazabilidad. Los resultados de este estudio indican que la mayoría de los consumidores buscan productos pesqueros de alta calidad diferenciados por su origen y, en menor medida, por la especie y están dispuestos a pagar hasta un 10% más por ellos. Además, los consumidores están interesados en que estos atributos se documenten en las etiquetas. Finalmente, los consumidores, una vez que se les proporciona información sobre la trazabilidad, la asocian principalmente al origen y seguridad del producto, a la gestión de las crisis alimentarias y al control de calidad. Sin embargo, solo una pequeña proporción de

consumidores pagaría más por productos pesqueros trazables, lo que corresponde a una fracción de aquellos que también pagarían un precio más alto por un producto de mayor calidad.

De los resultados obtenidos en esta tesis se pueden extraer las siguientes conclusiones. La mayoría de los consumidores buscan y están dispuestos a pagar más por pescado de alta calidad, especialmente aquellos diferenciados por su origen y, en menor medida, por su especie. Además, existe una clara preferencia por los productos locales y nacionales. Los consumidores consideran que, en general, estos productos son de mayor calidad, pero que además tienen mejor sabor y son más frescos. Los consumidores están interesados en que las etiquetas de pescado permitan diferenciar productos pesqueros de alta calidad, especialmente aquellos consumidores que buscan este tipo de productos y aquellos que están dispuestos a pagar un precio superior por ellos. No solo las etiquetas son importantes para los consumidores, sino que también lo es la información que contienen. Los atributos de etiquetado más relevantes son los relacionados con cuestiones de seguridad. No obstante, existen diferentes grupos de consumidores según la importancia que se concede a los diferentes tipos de información de etiquetado. Estos grupos también difieren en sus motivos de compra de pescado.

El conocimiento de los consumidores sobre la trazabilidad es generalmente bajo. Asocian la trazabilidad a la seguridad, pero también a la calidad. Sin embargo, una vez informados, los consumidores creen que su implementación en las cadenas de valor del pescado es necesaria. El efecto de la información sobre la conveniencia percibida de la trazabilidad está asociado al conocimiento preexistente de los consumidores. Los consumidores perciben que la trazabilidad es valiosa como un medio para conocer el origen del pescado y todos los ingredientes del producto, asignar responsabilidades, gestionar las crisis alimentarias y retirar productos infectados y verificar la información en la etiqueta. Sin embargo, solo una pequeña proporción de consumidores estaría dispuesta a pagar un sobreprecio que sería pequeño. La mayoría de estos consumidores pertenecen al grupo que también pagaría más por productos pesqueros de mayor calidad.

Los resultados de esta tesis podrían tener implicaciones para las autoridades. En primer lugar, los consumidores utilizan las etiquetas de pescado para encontrar la información en la que

están interesados. Por lo tanto, son una herramienta importante que las autoridades deben utilizar para resaltar cuestiones importantes relacionadas con el producto y también para modificar comportamientos. En segundo lugar, para que las etiquetas sigan siendo un medio eficaz de comunicación con los consumidores, la información que contienen debe ser supervisada. Los consumidores están cada vez más interesados en información sobre temas de seguridad, de ahí que este tipo de información deba aparecer en las etiquetas. En tercer lugar, existe información relevante, como los nombres científicos, que no parece recibir suficiente atención a pesar de condicionar muchas características del pescado. Es necesario llevar a cabo campañas de educación y concienciación para aumentar el conocimiento de los consumidores. En cuarto lugar, para atender las demandas de los consumidores, se recomienda la implementación de sistemas de trazabilidad en todas las categorías de productos pesqueros. En quinto lugar, para promover la aceptación de productos pesqueros trazables, es fundamental familiarizar a los consumidores con la trazabilidad. Las campañas de educación e información deben diseñarse y realizarse teniendo en cuenta que tienen un efecto progresivo en los consumidores y, por lo tanto, para que sean efectivas, estas acciones deben mantenerse en el tiempo.

Asimismo, los resultados presentados en esta tesis podrían tener implicaciones para los productores y distribuidores. Primero, los productores podrían diferenciar productos de mayor calidad por su origen y especie, lo que les permitiría incrementar el precio de los productos pesqueros. Se debería hacer especial hincapié en el origen, particularmente en el caso de productos locales y nacionales. En segundo lugar, las etiquetas podrían contribuir a la diferenciación de los productos pesqueros, indicando el origen, especie o incluyendo señales de calidad relacionadas con la frescura y la salud, pero también deberían contener información relacionada con la seguridad. No obstante, los determinantes e influencias en la compra deben tenerse en cuenta para proporcionar información adecuada en la etiqueta. En tercer lugar, las etiquetas deben ir acompañadas de certificaciones creíbles e indicadores de trazabilidad que permitan a los consumidores verificar la información que figura en las etiquetas, lo cual aumentaría la confianza del consumidor. Para ello, se aconseja el uso de enlaces de internet o códigos QR en la etiqueta o paquete lo que contribuiría a evitar sobrecargarlos con demasiada información. En cuarto lugar, la información proporcionada por la trazabilidad debe comunicarse a los consumidores de forma sencilla. En quinto lugar,

los productores podrían usar la trazabilidad para diferenciar un producto por su origen e ingredientes, pero también deberían comunicar los beneficios que reportan los sistemas de trazabilidad como garantía de calidad, así como en el caso de que se produzca una crisis alimentaria. En sexto lugar, no se debe esperar que los consumidores paguen más por productos trazables. Solo una pequeña proporción de aquellos consumidores que están dispuestos a pagar un sobreprecio por una calidad superior también lo estarían por productos pesqueros trazables. Por tanto, si quieren obtener un beneficio mayor, deberían de dirigir estos productos a ese grupo de consumidores.

Esta tesis tiene limitaciones que pueden inspirar futuras investigaciones. En primer lugar, el trabajo de campo se llevó a cabo en un solo país, España, y los españoles están considerados como grandes consumidores de pescado. Por lo tanto, sería conveniente replicar este estudio en otros países para evaluar la influencia tanto de las diferencias culturales como de la cantidad de consumo de pescado en los hallazgos aquí presentados. En segundo lugar, los datos utilizados en esta investigación se recopilaron mediante un cuestionario. El comportamiento real de los consumidores puede ser diferente del comportamiento reportado por ellos mismos. Por lo tanto, se recomienda realizar futuras investigaciones sobre el comportamiento de compra de productos pesqueros trazables mediante experimentos de observación o subasta. Además, sería recomendable investigar las preferencias de los consumidores por los soportes que pueden reflejar la información que proporciona la trazabilidad de los productos pesqueros (p. ej., códigos QR, códigos de barras). Finalmente, durante la pandemia de la COVID-19 y confinamiento se han producido diversos cambios en el comportamiento y el consumo. Estudios futuros podrían investigar la naturaleza y la escala de estos cambios.

Appendix B. Survey questions used in this thesis

0. Are you responsible for household purchases?   1. Yes ☐   2. No ☐   → *END*

1. Please indicate if you are a buyer of the following categories of fish and how often you buy them. (For each category, check the corresponding frequency with a cross).

	1 5 times a week or more	**2** 4 times a week	**3** 3 times a week	**4** Twice a week	**5** Once a week	**6** Once or twice a month	**7** 3-5 times every 6 months	**8** Once or twice every 6 months	**9** Once or twice a year	**10** Less or never
1. Fresh fish	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2. Frozen fish	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
3. Frozen precooked fish	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4. Chilled precooked fish	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
5. Canned	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

END

2. Please indicate if you are a buyer of the following categories of cod and how often you buy them. (For each category, check the corresponding frequency with a cross).

	1 5 times a week or more	**2** 4 times a week	**3** 3 times a week	**4** Twice a week	**5** Once a week	**6** Once or twice a month	**7** 3-5 times every 6 months	**8** Once or twice every 6 months	**9** Once or twice a year	**10** Less or never
1. Fresh cod	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2. Frozen cod	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
3. Dry or salted cod	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4. Chilled Precooked cod dishes	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

> *Interviewer: if P2.1 = 1 to 9, do P3.1; if P2.2 = 1 to 9, do P3.2; if P2.3 = 1 to 9, do P3.3*
> *If in all P2.1, P2.2 and P2.3 code 10 is marked, go to P.7.1.*

3. Imagine that you are at the sale point and you are going to buy the product. Tell us, what aspects do you consider, and their order of importance, when buying FRESH/FROZEN/DRY OR SALTED COD?

First attribute: ....

Second attribute: ....

Third attribute: ....

Fourth attribute: ....

4. Please list the reasons you usually purchase FRESH/FROZEN/DRY COD for your family or yourself.
(In all columns it you can check more than one).

1. SENSORY	2. CONVENIENCE	3. HEALTH	4. PRICE	5. SOCIO-CULTURAL
☐ *1. It is a tasty product*	☐ *1. It is available the whole year*	☐ *1. It is a food that contributes to a healthy diet*	☐ *1. It has an affordable price*	☐ *1. It is a product that I usually prepare on special dates*
☐ *2. Other* ……………….	☐ *2. it is convenient since I always have it at hand in the freezer/shelf*	☐ *2. It is a food that has good nutrients for health*	☐ *2. Other* ……………….	☐ *2. Other* ……………….
	☐ *3. I get home from work and prepare it in no time*	☐ *3. It is a natural product*		
	☐ *4. It is accepted by all members of the household*	☐ *4. It is easy to digest*		
	☐ *6. Other* ……………….	☐ *5. Other* ……………….		

5. Traceability refers to…

....

6. Traceability is understood as *"the ability to follow, at any given time, the path of a fishery product or lot of fishery products through the supply chain".* **Below, you will find some propositions in relation to this term. Please indicate your degree of agreement or disagreement for each of them.**

Traceability is associated with …	1. Totally disagree	2. Somewhat disagree	3. Neither agree nor disagree	4. Somewhat agree	5. Totally agree
1. Quality of fish products	☐	☐	☐	☐	☐
2. Food safety	☐	☐	☐	☐	☐
3. It is a tool for achieving authenticity of fishery products	☐	☐	☐	☐	☐
4. It is a tool that enables you to verify the information provided by suppliers	☐	☐	☐	☐	☐
5. It has to do with the origin of the product	☐	☐	☐	☐	☐
6. It is a kind of quality control of fishery products	☐	☐	☐	☐	☐
7. It is a tool to address a food scare and identify and recall contaminated food	☐	☐	☐	☐	☐

7. Below, you will find some statements regarding the benefits you would expect to get when you buy traceable fish products. Please indicate your degree of agreement or disagreement for each of them.

The benefits that could be obtained from traceability are ...	1. Totally disagree	2. Somewhat disagree	3. Neither agree nor disagree	4. Somewhat agree	5. Totally agree
1. Being able to know the product origin	☐	☐	☐	☐	☐
2. To know the product quality	☐	☐	☐	☐	☐
3. To make sure the product is safe and risk-free	☐	☐	☐	☐	☐
4. To make sure the product has undergone a hygiene control	☐	☐	☐	☐	☐
5. To know if the product has undergone a quality control	☐	☐	☐	☐	☐
6. To know if it is a sustainable fish product	☐	☐	☐	☐	☐
7. To know who to complain to in case the product is in poor condition	☐	☐	☐	☐	☐
8. To know the fish processing method	☐	☐	☐	☐	☐
9. To know all the ingredients that are present in the product	☐	☐	☐	☐	☐
10. Allows to manage a food crisis and identify and remove food that is affected or in bad condition	☐	☐	☐	☐	☐
11. It is a tool that allows to verify that the information that appears on the label is correct	☐	☐	☐	☐	☐
12. It is a tool that allows to get authenticity in fish products	☐	☐	☐	☐	☐

8. There may be differences in the quality of fish due to its origin, species, conservation method or processing. In your usual purchase, do you worry about looking for a differentiated fish product by any particular characteristic?

………

……

………………………………

9. Could you tell us any reason or motive why you look for or buy a fish product with these characteristics?

………

……..

…………………………………

10. There may be differences in fish quality due to origin and/or species. Would you be interested in having the origin and species identified on the labelling of fish products?

☐ 1. Not interested at all   ☐ 2. Some interested   ☐ 3. Quite interested

☐ 4. Very interested   ☐ 5. Totally interested

11. Some characteristics or attributes, such as a specific geographical origin, or specific species give the product a superior quality. Are you willing to pay for that superior quality?

☐ 1. Yes → P. 7.5   ☐ 2. No → P. 7.6

12. In the previous case, assuming that it is cod from a specific region and a certain species that give the product a superior quality, tell us, for a reference price of 10€/kg, the premium that you would be willing to pay for a product that has those best characteristics.

☐ 1. From 0.01 to 0.50€/Kg ☐ 2. From 0.51 to 1€/Kg ☐ 3. From 1.01 to 1.50€/Kg ☐ 4. From 1.51 to 2€/Kg ☐ 5. From 2.01 to 2.50€/Kg ☐ 6. From 2.51 to 3€/Kg ☐ 7. More than 3€/Kg

13. To ensure that the product is in good condition its necessary to certify its quality. Quality certification consists of a control by an external body ensuring that the product complies with certain properties. To achieve this quality guarantee, it is necessary to implement a traceability system, which would entail an additional cost. Regardless of who should bear this additional cost, do you agree that it would be necessary to implement a traceability system?

☐ 1. Yes   ☐ 2. No

14. Would you be willing to pay this premium for the implementation of a traceability system which would imply a higher quality assurances?

☐ 1. Yes, I would be willing to pay a premium for the implementation of a traceability system.
→ P. 7.8

☐ 2. No, it must be assumed by the agents involved in the distribution and commercialization. → P. 8

15. For a reference price of 10€/kg, indicate the premium you would be willing to pay for a product with a higher quality guarantee.

☐ 1. From 0.01 to 0.25€/Kg ☐ 2. From 0.26 to 0.50€/Kg ☐ 3. From 0.51 to 0.75€/Kg

☐ 4. From 0.76 to 1€/Kg ☐ 5. More than 1€/Kg

16. Below, you can find different items that may be of interest for the product commercialization, as well as for the consumer, and that could appear on the labelling of fresh, frozen and dry or salted cod. For each of them, please indicate how important it is to you.

	1. Not important	2. Slightly important	3. Medium importance	4. Quite important	5. Very important
1. Catch date	☐	☐	☐	☐	☐
2. Packaging date	☐	☐	☐	☐	☐
3. Best before	☐	☐	☐	☐	☐
4. Fisherman's name	☐	☐	☐	☐	☐
5. Commercial designation or common name	☐	☐	☐	☐	☐
6. Scientific name of the species	☐	☐	☐	☐	☐
7. Storage conditions	☐	☐	☐	☐	☐
8. Origin or FAO area where the product was caught	☐	☐	☐	☐	☐
9. Production and catch method (wild/farmed & fishing gear)	☐	☐	☐	☐	☐
10. Health control	☐	☐	☐	☐	☐
11. Name of the company that processed the cod	☐	☐	☐	☐	☐
12. Processing method (fresh/frozen/salted/precooked)	☐	☐	☐	☐	☐
13. If it is a protected or in danger species	☐	☐	☐	☐	☐
14. How cod was transported and stored	☐	☐	☐	☐	☐
15. Nutritional information	☐	☐	☐	☐	☐
16. Health claims	☐	☐	☐	☐	☐
17. Seller's name	☐	☐	☐	☐	☐

17. Household type

☐ 1. Independent young person (<35 years old)

☐ 2. Independent adult (≥35 years old)

☐ 3. Single-parent

☐ 4. Household < 65 years old with small children under their care

☐ 5. Household < 65 years old with teenagers under their care

☐ 6. Household < 65 years old with older children under their care

☐ 7. Household < 65 years old with small children not under their care

☐ 8. Household (young couple) without children

☐ 9. Household (adult couple) without children

☐ 10. Retired (household >65 years old with or without dependent children)

18. Gender

☐ 1. Male   ☐ 2. Female

19. Age

………………………………

20. Could you please indicate which is your household disposable income on the following scale?

☐ 1. Less than 1000 €/month

☐ 2. Between 1000 and 2000 €/month

☐ 3. Between 2001 and 3000 €/month

☐ 4. Between 3001 and 4000 €/month

☐ 5. Between 4001 and 5000 €/month

☐ 6. More than 5000 €/month

☐ 7. No response

21. Size of residence area (No. of habitants)

☐1. < 2,001   ☐2. 2,001-10,000   ☐3. 10,001-100,000

☐4. 100,001 -500,000   ☐5. More than 500,000

22. Nationality

☐1. Spanish. Area:_____

☐2. Other. Country:_____

23. Level of studies

No studies		1
Incomplete primary school (Preschool)	More or less until 10 years old	2
First level education (EGB first cycle, etc.)		3
Secondary Education Graduate qualification/1st cycle (EGB second cycle, etc.)	More or less until 14 years old	4
Secondary Education Graduate qualification /2nd cycle (University access, etc.)	More or less until 18 years old	5
Middle third level education (Three year degree, etc.)		6
Higher third grade education		7
Other (specify):_____		8

Appendix C. Relationship between importance attached to labelling and sociodemographic characteristics

Table C1. Importance attached to labelling attributes by gender

	Total	Gender		p	E^2
		Male	Female		
Catch date	4 [4 to 5]	4.5 [4 to 5]	4 [4 to 5]	0.278	0.01
Packaging date	4 [4 to 5]	4 [4 to 5]	4 [4 to 5]	0.681	0.00
Best before	5 [4 to 5]	5 [4 to 5]	5 [4 to 5]	0.037*	0.02
Fisherman name	3 [2 to 4]	3 [3 to 4]	3 [2 to 4]	0.894	0.00
Commercial designation	4 [3 to 5]	4 [3 to 5]	4 [3 to 5]	0.715	0.00
Scientific name	3 [1 to 4]	3 [2 to 4]	3 [1 to 4]	0.046*	0.02
Storage conditions	4 [4 to 5]	4 [4 to 5]	4 [4 to 5]	0.944	0.00
Origin	4 [3.25 to 5]	4 [3.75 to 5]	4 [3.25 to 5]	0.681	0.00
Production method	4 [2.25 to 4]	4 [3 to 5]	4 [2 to 4]	0.047*	0.02
Health control	5 [4 to 5]	5 [4 to 5]	5 [4 to 5]	0.264	0.01
Processing company	4 [3 to 5]	4 [3.75 to 5]	4 [3 to 5]	0.141	0.01
Processing method	4 [4 to 5]	4 [4 to 5]	4 [3 to 5]	0.208	0.01
Protected species	4 [3 to 5]	4 [3 to 5]	4 [3 to 5]	0.986	0.00
Transport information	4 [4 to 5]	4 [4 to 5]	4 [4 to 5]	0.527	0.00
Nutritional information	5 [4 to 5]	5 [4 to 5]	5 [4 to 5]	0.865	0.00
Health claims	4 [4 to 5]	4 [4 to 5]	4 [4 to 5]	0.746	0.00

Note: Data are presented as median [interquartile range]. Differences are tested statistically using Kruskal-Wallis. Signif. code: * = $p < 0.05$. Effect size is computed as epsilon-squared.

Table C2. Importance attached to labelling attributes by age

	Total	Age <29	30-39	40-49	50-59	>60	p	E^2	1-2	1-3	1-4	1-5	3-5
Catch date	4 [4 to 5]	4 [3.25 to 5]	4 [4 to 5]	4 [4 to 5]	4 [4 to 5]	4 [4 to 5]	0.828	0.01					
Packaging date	4 [4 to 5]	4 [4 to 4.75]	4 [4 to 5]	5 [4 to 5]	5 [4 to 5]	5 [4 to 5]	0.558	0.01					
Best before	5 [4 to 5]	5 [4.25 to 5]	5 [4 to 5]	5 [4 to 5]	5 [4 to 5]	5 [4 to 5]	0.768	0.01					
Fisherman	3 [2 to 4]	3 [2.25 to 4]	4 [3 to 5]	3 [2 to 4]	3 [2 to 4]	3 [2 to 4]	0.439	0.02					
Commercial designation	4 [3 to 5]	3 [3 to 4]	4 [3 to 5]	4 [3 to 5]	4 [4 to 5]	4 [4 to 5]	0.124	0.03					
Scientific name	3 [1 to 4]	2 [1 to 4]	3 [2 to 4]	3 [1.75 to 4]	3 [1 to 4]	3 [1 to 4]	0.406	0.02					
Storage conditions	4 [4 to 5]	4 [4 to 5]	4 [4 to 5]	5 [4 to 5]	4 [4 to 5]	4 [4 to 5]	0.676	0.01					
Origin	4 [3.25 to 5]	3.5 [3 to 4]	4 [4 to 5]	4 [3 to 5]	4 [3 to 5]	4 [4 to 5]	0.059[†]	0.04	0.093[†]	0.095[†]	0.018*	0.004**	0.097[†]
Production method	4 [2.25 to 4]	3 [1 to 5]	4 [3 to 5]	4 [3 to 4]	4 [3 to 5]	3.5 [3 to 4]	0.719	0.01					
Health control	5 [4 to 5]	5 [4 to 5]	5 [4 to 5]	5 [4 to 5]	5 [4 to 5]	5 [4 to 5]	0.917	0.00					
Processing company	4 [3 to 5]	3 [3 to 4]	4 [4 to 5]	4 [3 to 5]	4 [4 to 5]	4 [3 to 4.75]	0.131	0.03					
Processing method	4 [4 to 5]	3.5 [3 to 4.75]	4 [4 to 5]	4 [4 to 5]	4 [3 to 5]	4 [3 to 5]	0.302	0.02					
Protected species	4 [3 to 5]	4 [2.25 to 4.75]	4 [4 to 5]	4 [4 to 5]	4 [3 to 5]	4 [3.25 to 5]	0.520	0.02					
Transport information	4 [4 to 5]	4 [3.25 to 4]	4 [4 to 5]	4 [4 to 5]	4 [3 to 5]	4 [4 to 5]	0.622	0.01					
Nutritional information	5 [4 to 5]	4 [3.25 to 5]	4 [4 to 5]	4.5 [4 to 5]	5 [4 to 5]	5 [4 to 5]	0.186	0.03					
Health claims	4 [4 to 5]	4 [4 to 5]	4 [4 to 5]	4 [4 to 5]	4 [3 to 5]	4 [4 to 5]	0.655	0.01					

Note: Data are presented as median [interquartile range]. Differences are tested statistically using Kruskal-Wallis and Dunn's *post hoc* tests. Signif. codes: ** = $p < 0.01$, * = $p < 0.05$, [†] = $p < 0.10$. Effect size is computed as epsilon-squared.

Table C3. Importance attached to labelling attributes by level of education

| | Total | Level of education | | | | p | E^2 | 2-3 | 2-4 | 2-5 |
		Primary	Junior High School	High School	University					
Catch date	4 [4 to 5]	4 [3 to 4]	5 [4 to 5]	4 [3.5 to 5]	5 [4 to 5]	0.072†	0.03	0.068†	0.026*	0.043*
Packaging date	4 [4 to 5]	4 [4 to 5]	4 [4 to 5]	5 [4 to 5]	5 [4 to 5]	0.238	0.02			
Best before	5 [4 to 5]	4 [4 to 5]	5 [4 to 5]	5 [4 to 5]	5 [4 to 5]	0.563	0.01			
Fisherman	3 [2 to 4]	3 [3 to 4]	3 [2 to 4]	3 [2 to 4]	4 [3 to 4]	0.608	0.01			
Commercial designation	4 [3 to 5]	4 [4 to 4]	4 [3 to 5]	4 [3 to 5]	4 [3 to 5]	0.817	0.00			
Scientific name	3 [1 to 4]	3 [2 to 4]	3 [2 to 4]	3 [1 to 4]	2 [1 to 4]	0.503	0.01			
Storage conditions	4 [4 to 5]	4 [4 to 5]	4 [4 to 5]	5 [4 to 5]	4 [4 to 5]	0.192	0.02			
Origin	4 [3.25 to 5]	4 [4 to 4]	4 [4 to 5]	4 [3 to 5]	4 [3 to 5]	0.464	0.01			
Production method	4 [2.25 to 4]	3 [3 to 4]	3 [3 to 4]	4 [3 to 4]	4 [2 to 5]	0.441	0.01			
Health control	5 [4 to 5]	5 [4 to 5]	5 [4 to 5]	5 [4 to 5]	5 [4 to 5]	0.805	0.00			
Processing company	4 [3 to 5]	4 [3 to 5]	4 [3 to 5]	4 [3 to 5]	4 [4 to 5]	0.825	0.00			
Processing method	4 [4 to 5]	4 [2 to 4]	4 [3 to 5]	4 [4 to 5]	4 [4 to 5]	0.184	0.02			
Protected species	4 [3 to 5]	4 [4 to 4]	4 [4 to 5]	4 [4 to 5]	4 [3 to 5]	0.973	0.00			
Transport information	4 [4 to 5]	4 [3 to 4]	4 [4 to 5]	4 [4 to 5]	4 [3 to 5]	0.400	0.01			
Nutritional information	5 [4 to 5]	5 [4 to 5]	5 [4 to 5]	5 [4 to 5]	4 [4 to 5]	0.733	0.01			
Health claims	4 [4 to 5]	4 [4 to 5]	4 [4 to 5]	4 [4 to 5]	4 [3 to 5]	0.602	0.01			

Note: Data are presented as median [interquartile range]. Differences are tested statistically using Kruskal-Wallis and Dunn's *post hoc* tests. Signif. codes: * = $p < 0.05$, † = $p < 0.10$. Effect size is computed as epsilon-squared.

Table C4. Importance attached to labelling attributes by household type

	Total	Household type[a]					p	E²	1-2	1-3	1-4	1-5	2-3	2-4	2-5	3-4	3-5	4-5
		1	2	3	4	5												
Catch date	4 [4 to 5]	4 [3 to 5]	5 [4 to 5]	4 [3.5 to 5]	5 [5 to 5]	4 [4 to 5]	0.025*	0.05	0.052†		0.010*		0.052†		0.085†	0.010*		0.016*
Packaging date	4 [4 to 5]	4 [4 to 5]	5 [4 to 5]	4 [4 to 5]	5 [5 to 5]	4 [4 to 5]	0.001***	0.08			0.004**		0.008**	0.086†	0.059†	<0.001***		0.002**
Best before	5 [4 to 5]	5 [4 to 5]	5 [4 to 5]	5 [4 to 5]	5 [5 to 5]	4 [4 to 5]	0.204	0.03										
Fisherman	3 [2 to 4]	3 [2 to 4]	3.5 [2 to 4]	3 [2 to 4]	3 [2 to 4]	3 [2 to 4]	0.818	0.01										
Commercial designation	4 [3 to 5]	4 [3 to 5]	4 [3 to 5]	4 [3 to 4]	5 [4 to 5]	4 [4 to 5]	0.017*	0.06		0.061†		0.069†			0.052†	0.020**	0.002**	
Scientific name	3 [1 to 4]	3 [2 to 4]	3 [1 to 4]	2 [1 to 3]	3 [2 to 4]	3 [1 to 3]	0.057†	0.04		0.006**			0.082†			0.072†		
Storage conditions	4 [4 to 5]	5 [4 to 5]	5 [4 to 5]	4 [4 to 5]	4 [4 to 5]	4 [4 to 5]	0.122	0.03										
Origin	4 [3.25 to 5]	4 [4 to 5]	4 [3 to 5]	4 [3 to 4.5]	4 [4 to 5]	4 [4 to 5]	0.169	0.03										
Production method	4 [2.25 to 4]	4 [3 to 4]	4 [2 to 5]	3 [2 to 4]	4 [3 to 4]	3 [3 to 4]	0.597	0.01										
Health control	5 [4 to 5]	5 [4 to 5]	5 [4.75 to 5]	5 [4 to 5]	5 [4 to 5]	5 [4 to 5]	0.737	0.01										
Processing company	4 [3 to 5]	4 [3 to 5]	4 [3 to 5]	4 [3 to 5]	5 [3 to 5]	4 [4 to 5]	0.809	0.01										
Processing method	4 [4 to 5]	4 [4 to 5]	4 [4 to 5]	4 [3 to 5]	4 [4 to 5]	4 [3 to 5]	0.136	0.03										
Protected species	4 [3 to 5]	4 [4 to 5]	4 [3 to 5]	4 [3 to 5]	5 [3 to 5]	4 [4 to 5]	0.769	0.01										
Transport information	4 [4 to 5]	4 [4 to 5]	4 [4 to 5]	4 [3 to 5]	4 [4 to 5]	4 [4 to 5]	0.598	0.01										
Nutritional information	5 [4 to 5]	5 [4 to 5]	4 [4 to 5]	4 [4 to 5]	5 [4 to 5]	5 [4 to 5]	0.325	0.02										
Health claims	4 [4 to 5]	4 [4 to 5]	4 [4 to 5]	4 [4 to 5]	5 [4 to 5]	4 [3 to 5]	0.328	0.02										

Note: Data are presented as median [interquartile range]. Differences are tested statistically using Kruskal-Wallis and Dunn's *post hoc* tests. Signif. codes: *** = p < 0.001, ** = p < 0.01, * = p < 0.05, † = p < 0.10. Effect size is computed as epsilon-squared. [a](1) Household without children under their care, (2) Independent person without children, (3) Household without children under their care, (4) Single parent, (5) Other.

Table C5. Importance attached to labelling attributes by monthly household income ($n = 174$)

	Total	Household monthly income				p	E^2	1-4	2-4	3-4
		<1001	1001-2000	2001-3000	>3000					
Catch date	4 [4 to 5]	5 [4 to 5]	4 [4 to 5]	4 [3 to 5]	4 [3.25 to 4.75]	0.106	0.04			
Packaging date	4 [4 to 5]	5 [4 to 5]	5 [4 to 5]	4 [4 to 5]	4 [4 to 4.75]	0.202	0.04			
Best before	5 [4 to 5]	5 [4 to 5]	5 [4 to 5]	5 [4 to 5]	5 [4 to 5]	0.584	0.04			
Fisherman	3 [2 to 4]	3 [2 to 4]	4 [3 to 4]	3 [2 to 4]	3 [3 to 3]	0.255	0.04			
Commercial designation	4 [3 to 5]	4 [3 to 5]	4 [4 to 5]	4 [3 to 5]	4 [3.25 to 4]	0.788	0.04			
Scientific name	3 [1 to 4]	3 [1 to 4]	3 [2 to 4]	3 [1.5 to 4]	1 [1 to 3]	0.050*	0.04	0.077†	0.007**	0.023*
Storage conditions	4 [4 to 5]	4 [4 to 5]	4 [4 to 5]	4 [4 to 5]	4 [3 to 4]	0.049*	0.04	0.016*	0.006**	0.023*
Origin	4 [3.25 to 5]	4 [3.75 to 5]	4 [3 to 5]	4 [3.5 to 5]	4 [3.25 to 4]	0.553	0.04			
Production method	4 [2.25 to 4]	4 [2.75 to 5]	4 [3 to 4]	4 [2.5 to 5]	3 [2 to 4]	0.501	0.04			
Health control	5 [4 to 5]	5 [4.75 to 5]	5 [4 to 5]	5 [4 to 5]	5 [4.25 to 5]	0.749	0.04			
Processing company	4 [3 to 5]	4 [3 to 5]	4 [4 to 5]	4 [4 to 5]	3.5 [3 to 4]	0.495	0.04			
Processing method	4 [4 to 5]	4 [3 to 5]	4 [4 to 5]	4 [4 to 5]	3.5 [2.25 to 4]	0.046*	0.04	0.096†	0.014*	
Protected species	4 [3 to 5]	4 [3 to 5]	4 [4 to 5]	4 [4 to 5]	3.5 [1.25 to 5]	0.522	0.04			
Transport information	4 [4 to 5]	4 [4 to 5]	4 [4 to 4.5]	4 [4 to 4.5]	4 [2.25 to 4]	0.312	0.04			
Nutritional information	5 [4 to 5]	5 [4 to 5]	5 [4 to 5]	5 [4 to 5]	4 [4 to 5]	0.389	0.04			
Health claims	4 [4 to 5]	4 [3 to 5]	4 [4 to 5]	4 [4 to 5]	4 [3 to 4]	0.342	0.04			

Note: Data are presented as median [interquartile range]. Differences are tested statistically using Kruskal-Wallis and Dunn's *post hoc* tests. Signif. codes: ** = $p < 0.01$, * = $p < 0.05$, † = $p < 0.10$. Effect size is computed as epsilon-squared.

Table C6. Importance attached to labelling attributes by the place of residence

	Total	Place of residence (No. of habitants)				p	E^2	1-3	2-3	2-4	3-4
		Rural area	Small city	Medium city	Big city						
Catch date	4 [4 to 5]	5 [5 to 5]	4.5 [4 to 5]	4 [3 to 5]	4 [4 to 5]	0.150	0.03				
Packaging date	4 [4 to 5]	5 [4.5 to 5]	4.5 [4 to 5]	5 [4 to 5]	4 [4 to 5]	0.924	0.00				
Best before	5 [4 to 5]	5 [4.75 to 5]	5 [5 to 5]	5 [4 to 5]	5 [4 to 5]	0.066†	0.03		0.023*		
Fisherman	3 [2 to 4]	4 [3.75 to 4.25]	4 [2.75 to 4]	3 [2 to 4]	3 [2 to 4]	0.197	0.02				
Commercial designation	4 [3 to 5]	3 [3 to 3.25]	4 [3 to 5]	4 [4 to 5]	4 [3 to 5]	0.011*	0.05	0.015*			0.006**
Scientific name	3 [1 to 4]	3 [2.5 to 3.25]	3 [2 to 4]	1 [1 to 4]	3 [2 to 4]	0.088†	0.03		0.054†		0.011*
Storage conditions	4 [4 to 5]	5 [4.75 to 5]	4 [4 to 5]	5 [4 to 5]	4 [4 to 5]	0.134	0.03				
Origin	4 [3.25 to 5]	5 [4 to 5]	4 [3 to 5]	4 [4 to 5]	4 [3 to 5]	0.122	0.03				
Production method	4 [2.25 to 4]	2.5 [1.75 to 3.25]	3 [2 to 4]	4 [3 to 5]	4 [2.5 to 4]	0.021*	0.05	0.030*	0.010*	0.023*	0.013*
Health control	5 [4 to 5]	5 [5 to 5]	5 [4 to 5]	5 [4 to 5]	5 [4 to 5]	0.279	0.02				
Processing company	4 [3 to 5]	2 [1 to 3.5]	4 [3 to 5]	4 [3.5 to 5]	4 [3 to 5]	0.355	0.02				
Processing method	4 [4 to 5]	4.5 [3.5 to 5]	4 [3 to 5]	4 [3.5 to 5]	4 [4 to 5]	0.890	0.00				
Protected species	4 [3 to 5]	4 [3.75 to 4.25]	4 [3.75 to 5]	4 [3.5 to 5]	4 [3 to 5]	0.790	0.00				
Transport information	4 [4 to 5]	5 [4.5 to 5]	4 [3 to 5]	4 [3 to 5]	4 [4 to 5]	0.459	0.01				
Nutritional information	5 [4 to 5]	4 [3.75 to 4.25]	4.5 [4 to 5]	5 [4 to 5]	5 [4 to 5]	0.706	0.01				
Health claims	4 [4 to 5]	4 [3.75 to 4.25]	4 [4 to 5]	4 [3 to 5]	4 [4 to 5]	0.587	0.01				

Note: Data are presented as median [interquartile range]. Differences are tested statistically using Kruskal-Wallis and Dunn's *post hoc* tests. Signif. codes: ** = $p < 0.01$, * = $p < 0.05$, † = $p < 0.10$. Effect size is computed as epsilon-squared.