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The role of objective and subjective knowledge on the attitude and intention of Italian consumers to purchase farmed and wild fish

Davide Menozzi[1], Rungsaran Wongprawmas[1], Giovanni Sogari[1*], Francesco Gai[2], Giuliana Parisi[3] and Cristina Mora[1]

*Correspondence:
giovanni.sogari@unipr.it

[1] Department of Food and Drug, University of Parma, Parco Area delle Scienze 45, 43124 Parma, Italy
[2] Institute of Sciences of Food Productions, National Research Council, Largo Paolo Braccini 2, 10095 Grugliasco, Italy
[3] Department of Agriculture, Food, Environment and Forestry, University of Florence, Via delle Cascine 5, 50144 Florence, Italy

Abstract

In general, consumers have very little knowledge about production methods employed in the fish sector, and this lack of information contributes to skepticism and confusion when they choose and purchase fish. In our study, we tested the effect of beliefs and objective and subjective knowledge on consumers' attitude and their intention to purchase farmed and wild fish, both in a control and an informed group. Furthermore, we explored the effect of the intention to purchase farmed or wild fish on fish purchasing frequency. An online survey was conducted in Italy (n = 776) in 2020. The results showed that both objective and subjective knowledge affected the attitudes toward wild and farmed fish; however, only subjective knowledge had an impact on the intention to purchase wild fish. Moreover, the intention to purchase was correlated with fish purchasing frequency, and information about production methods affected consumers' attitudes but did not directly influence their purchasing intentions. This study provides insights that could be considered by policymakers and producer associations/industries to develop and support communication campaigns on fish production methods in terms of safety, healthiness, control, and quality. Thus, our research could help to increase the transparency of information about fish and improve the acceptance and consumption of aquaculture products.

Keywords: Consumer behavior, Fish consumption, Aquaculture, Italian consumers, Objective and subjective knowledge, Purchasing intention

Introduction

The European Union (EU) is the world's largest market for fishery and aquaculture products (FAPs) in nominal terms (FAO 2023). In 2021, the EU's imports amounted to 25.8 billion euros and 6.2 million metric tons, thereby representing an increase of 6% in value and 1% in volume in comparison to the previous year. The imports covered around 70% of the total supply in the EU (EUMOFA 2022). Given the importance of the fish sector, the EU authorities and policymakers decided to enact measures—such as "A Pact for

Fisheries and Oceans" (European Commission 2023)—to improve the sustainability and resilience of the EU's fisheries and aquaculture sector. In addition, the EU authorities are now monitoring the behavior and attitudes of consumers, and analyzing whether or not the implementation of EU policies and regulations could improve the market environment (Cantillo et al. 2021a, b).

Despite European consumers usually associate positive thoughts with fish consumption (Verbeke et al. 2007b), previous studies indicated that they perceive farmed fish as generally being of lower quality than wild fish (Verbeke et al. 2005, 2007b; Claret et al. 2014; López-Mas et al. 2021). Preconceived ideas, such as beliefs or attitudes about the characteristics of farmed fish and the way they are produced, have a relevant effect on the consumers' perception (Claret et al. 2014). Even though fish farming has always been considered an alternative to the more traditional practice of fishing (Claret et al. 2014, 2016), consumers' preferences for wild fish, compared to the same farmed species, remain strong in several countries, including Italy (Gaviglio and Demartini 2009; Menozzi et al. 2020). Moreover, there is still ambiguity linked to sustainability of farmed fish production; for instance, fish meals for carnivorous fish contain wild forage fish, and this has resulted in concerns about overfishing, aquatic food web disruption, food instability, and a potential net loss of seafood fit for human consumption (Naylor et al. 2009; Fry et al. 2016).

As a result, the production method (wild or farmed) is used to determine the expectations of the fish characteristics, such as taste, safety, and freshness (Gaviglio and Demartini 2009; Claret et al. 2016). For example, farmed fish are usually perceived as more sustainable and recommended for animal welfare, whereas wild fish are preferred in terms of healthiness and nutritional value (Verbeke et al. 2007a; Claret et al. 2014; Rickertsen et al. 2017). Claret et al. (2014) observed that consumers consider wild fish to contain fewer antibiotics, be fresher, and be less handled than farmed fish. Moreover, wild fish is also perceived as being tastier, especially among heavy fish consumers (Verbeke et al. 2007b; Gaviglio and Demartini 2009; Tomić et al. 2017). According to Claret et al. (2016), this prejudice (i.e., the consumers' perception of wild fish as having a better taste and being of better quality) is not based on real sensory properties but rather on the negative image linked to aquaculture. As a result of the above-mentioned considerations, even though preferences on the production method (i.e., wild-caught fish vs. farm-raised fish) may vary across cultures and fish species (Gaviglio et al. 2014; Menozzi et al. 2020), consumers generally prefer wild fish over farm-raised fish due to the lower quality perception associated with the latter, which could be also linked to their lower price (Claret et al. 2014).

However, the public has very little knowledge of the aquaculture sector; one reason is that most of the production sites are far away from urban areas (Kaiser and Stead 2002). This lack of information contributes to consumers' skepticism, doubts, and suspicions about the real production methods (wild or farmed), which can lead to confusion and non-informed and conscious choices (Güney 2019; Hoque and Alam 2020; Pulcini et al. 2020).

Another factor that could influence consumers' perception of food products is their knowledge about the product (Pieniak et al. 2010b). Knowledge can be distinguished

into two constructs: objective and subjective (Brucks 1985). Objective knowledge refers to accurate information about the product stored in the consumer's long-term memory, whereas subjective knowledge indicates people's impressions of what or how much they know about a product, based on their subjective interpretation (e.g., Padel and Foster 2005; Pieniak et al. 2010a; Aertsens et al. 2011; Aqueveque 2018; Hoque and Alam 2020; Demartini et al. 2021). Several studies have focused on objective and subjective knowledge, and how these factors influence consumers' preference for wild vs. farmed fish. For instance, Verbeke et al. (2007a, b, c) remarked how the refusal to consume farmed fish is more influenced by erroneous beliefs than by the current scientific evidence. Pieniak et al. (2010b) surveyed European consumers and found that participants strongly believed that eating fish is healthy. However, they also showed that the consumers' objective fish-related nutrition knowledge positively influenced the frequency of fish consumption only weakly, whereas subjective knowledge was a stronger predictor of fish consumption. Perez Cueto Eulert et al. (2011) measured the intention to eat fish in Spain in 2004 and 2008, and found that providing information regarding fish increased increased consumers' objective knowledge and their intention to purchase fish as measured in 2008. Hoque and Alam (2020) showed that subjective and objective knowledge had a dissimilar effect on both attitude and purchase intention toward farmed fish. The authors suggested that individuals may have less knowledge than they perceive, or that they may underestimate their actual level of knowledge. The study of Wongprawmas et al. (2022) stressed that subjective knowledge affected consumers' purchasing intention for farmed and wild fish, whereas objective knowledge only influenced their attitude toward—but not their purchasing intention for—these products.

The above-mentioned literature highlights that addressing consumers' misconceptions of farmed fish is a challenging task, and more investigations on accurate communication contents are required. Thus, we here expand the state of the art, compared to the current literature, by measuring the impact of more detailed objective knowledge and how providing this information could influence the purchase intention of consumers of both farmed and wild fish. The following definition of fish has been considered in this study: "*Fish refers to finfish of saltwater and freshwater origin. In this survey, we have not considered mollusks, cephalopods, or crustaceans*". In particular, we considered the most common species of the Italian market, i.e., gilthead seabream, salmon, and European seabass, which are largely sold and represent the three main species consumed in Italy (18.7%, 10%, and 9.2%, respectively) (BMTI 2021).

Compared to previous studies that investigated the knowledge gaps about the health benefits and safety risks of consuming fish in general (e.g., Verbeke et al. 2005) or shellfish (Boase et al. 2019), we intended to measure how providing information on wild versus farmed fish could influence consumers' attitudes and intentions. Our research questions were: (1) how do beliefs about fish affect the attitude toward and intention to purchase farmed and wild fish?; (2) how does objective and subjective knowledge about fish impact the attitude toward and intention to purchase farmed and wild fish?; and (3) what role does information play in moderating the previous factors that can influence the purchasing frequency of fish?

Theoretical framework

Consumers' food choices are complex. Certain preconceived ideas of consumers, such as beliefs about a product's properties and its production method, can markedly influence their perception and acceptance (Schifferstein 2001; Claret et al. 2014). Product beliefs refer to the information consumers possess about a product. They are stored in memory in the form of a network of associative knowledge that can be retrieved when needed (Fishbein and Ajzen 1975; Schifferstein 2001). In the process of belief formation, individuals have performed an antecedent evaluation of attributes that later become linked to the evaluated product. Such attribute evaluations are then associated with an attitude toward the product (Fishbein and Ajzen 2010). The formation of product beliefs is a dynamic process that can be developed employing direct experience, from the information received from external sources (family, friends, doctors, media, etc.), and by inferences from previously acquired experience and knowledge. Therefore, beliefs can be influenced by several aspects at the same time, and can determine the attitudes, buying intentions, and preferences of consumers (Fishbein and Ajzen 1975; Hall and Amberg 2013; Claret et al. 2014). Furthermore, the newly available information may alter a person's beliefs and, consequently, other constructs (Menozzi et al. 2023). In this study, we measured the effect of beliefs and information on consumers' attitudes toward farmed and wild fish.

H1: Beliefs have significant effects on the consumers' attitude toward farmed and wild fish.

H2: Information affects the way a consumer's beliefs influence their attitude toward farmed and wild fish.

However, consumers' behaviors might not be consistent with their attitudes and preferences. In some cases, although consumers have a positive attitude toward a product, they might act inversely. For instance, consumers might perceive fish as healthy food and prefer consuming it but act inversely when it comes to behaviors. In this case, knowledge could be an important factor as it can reshape consumers' attitudes (Padel and Foster 2005; Hoque and Alam 2020).

Since what individuals think they know (subjective knowledge) and what they actually know (objective knowledge) are often divergent—the so-called "Dunning–Kruger effect" (Kruger and Dunning 1999)—several studies have analyzed the relationships between objective and subjective knowledge and consumers' attitudes and preferences toward food products. For instance, Pieniak et al. (2010a) investigated the effect of objective and subjective knowledge on explaining organic vegetable consumption and found that subjective knowledge is an important factor in explaining its consumption, whereas objective knowledge is only indirectly related. Aertsens et al. (2011) explored the relationship between objective and subjective knowledge and consumer attitudes and motivations toward organic food and its consumption. They found that higher levels of objective and subjective knowledge concerning organic food were positively related to a more positive attitude toward organic food; however, only subjective knowledge significantly and positively influenced the likelihood of consuming organic vegetables. Demartini et al. (2021) conducted a survey to examine the effect of objective and subjective knowledge

of hunting and farming on consumers' preferences for hunted and farmed meat. They found that objective knowledge has a mixed effect on consumers' preferences. The more consumers knew about hunting, the more they appreciated hunted meat; on the contrary, the more they knew about farming, the less they liked farmed meat. On the other hand, subjective knowledge was not related to consumers' preferences for the products.

Hence, in this study, we introduced hypotheses to test the relationships between both types of knowledge (i.e., subjective and objective), attitude, and intention to purchase fish:

H3: Subjective knowledge affects consumers' attitudes toward farmed and wild fish.
H4: Subjective knowledge affects consumers' intention to purchase farmed and wild fish.
H5: Objective knowledge affects consumers' attitudes toward farmed and wild fish.
H6: Objective knowledge affects consumers' intention to purchase farmed and wild fish.

In addition, the literature on marketing and consumer research suggests that consumers' attitudes toward food are important factors that influence food consumption behaviors in general (Homer and Kahle 1988; Hearty et al. 2007; Verbeke 2008; Pieniak et al. 2010a), as well as fish consumption (Verbeke et al. 2005; Pieniak et al. 2010b; Menozzi et al. 2023). Therefore, we included hypotheses to test the relationship between attitude toward fish, intention, and purchasing behaviors. It should be noted that we measured behaviors using observed self-reported variables for different fish species.

H7: Attitude affects consumers' intention to purchase farmed and wild fish.
H8: Consumers' intention to purchase farmed and wild fish affects their fish purchasing frequency.
H9: Consumers' intention to purchase farmed and wild fish affects the purchasing frequency of salmon, seabass, and seabream.

Since previous studies (Hoque and Alam 2020; Wongprawmas et al. 2022) showed that information influences objective knowledge and attitude toward farmed and wild fish, we also tested the effect of information as a moderator among objective knowledge, attitude toward, and intention to purchase farmed and wild fish.

Methodology

Design

A between-subject design was used to test the effect of information provision on the objective knowledge, attitude, and purchasing intention of consumers. The design comprised one control group (no information) and one treatment group (with information).

An online questionnaire was provided to participants. In the objective knowledge section, consumers answered nine questions related to the most common misconceptions of wild and farmed fish (Table 4). Participants in the control group were only shown one question, which they answered, and then moved on to the next question, without receiving any feedback on whether the response was correct or not. Participants in the

treatment group received correct information and an explanation as feedback for each question, regardless of whether their response was correct or not.

Data collection and selection of participants

An online survey was conducted in Italy during the Summer of 2020 using Qualtrics® (Qualtrics 2022). A convenient sampling method was applied. The online survey link was distributed through advertisements on social media platforms and food websites. The selection criteria were: (1) the participant had to be at least 18 years old; (2) the participant had to be the primary food shopper; and (3) the participant had to have purchased fish in the last 12 months. Overall, 804 individuals participated in the survey. We excluded participants who took less than 8 min or more than 60 min to complete the survey as they may have not been serious in filling in the questionnaire (Zhang and Conrad 2014; Lugtig and Toepoel 2015; Boase et al. 2019). The final sample comprised 776 valid respondents. Participants were randomly allocated to either the control group ($n=389$) or the treatment group ($n=387$).

The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Research Ethics and Integrity Committee of the Italian National Research Council (Protocol Number: 0029841). At the beginning of the questionnaire, participants were asked to provide their informed consent to participate in the survey before proceeding.

Table 5 displays the sample's characteristics. The sample was roughly representative of the Italian population, in terms of gender, age, and household income, and it was slightly overrepresented by respondents from higher educational classes. Sixty-eight percent (68%) of the participants used to purchase fish 1–2 times per week, which is slightly higher than the 59% reported in a national survey conducted by the IPSOS marketing company in 2019 (Statista 2021), and the 62% reported in another national survey (Menozzi et al. 2023).

The socio-demographic and fish purchasing habits of the control and treatment groups were equivalent, except for aspects related to their diet and habits of purchasing fish directly from fishermen. A higher percentage of participants in the treatment group were flexitarians (23%) over the control group (17%). More participants (7%) bought fish directly from fishermen in the treatment group than in the control group (3%).

Measures

A structured questionnaire was developed by the authors and experts in the fishery field. The survey was pretested for clarity of content, language/wording, and overall understanding ($n=30$). The survey comprised several sections, seven of which are the most pertinent for the present work (i.e. reporting the fish purchasing frequency, beliefs, subjective knowledge, objective knowledge, attitudes, purchasing intention for farmed and wild fish, and socio-demographics of the consumers). The individual items, types of scales, and sources are provided in Table 4.

The first section comprised self-reported purchasing frequency of fish in general, salmon, seabass, and seabream. The definition of fish adopted in this study was provided to participants at the beginning of the survey. The participants were asked to indicate how often they purchased salmon, seabass, and seabream fish (fresh, frozen, canned,

smoked, ready to eat, etc.)—before the Covid-19 emergency—from "Never" (0) to "Almost every day" (6).

The second section examined participants' beliefs about farmed and wild fish with reference to various aspects—safety, quality, control, and the moment of purchase; using 21 statements adapted from Claret et al. (2014) and Hall & Amberg (2013).

The third section included a scale to measure participants' subjective knowledge of farmed and wild fish (Verbeke et al. 2007b; Perez Cueto Eulert et al. 2011; Claret et al. 2014). In both the second and third sections, participants were asked to what extent they agreed with certain statements. Each statement was scored on a 7-point scale, ranging from "Totally disagree" (1) to "Totally agree" (7).

The fourth section included nine statements to measure consumers' objective knowledge of farmed and wild fish. The statements and the information provided to the treatment group were developed by the authors and two technical experts in the field of fish farming—for further details, see Wongprawmas et al. (2022)—based on the current scientific evidence. Three topic categories of scientific evidence, related to wild and farmed fish, were included: healthiness (nutrition) and quality, safeness and quality, and animal welfare. Each category had three statements, for a total of nine questions. Five-item scales (i.e., "false", "could be false", "do not know", "could be true", and "true") were used to measure objective knowledge (adapted from Boase et al. 2019). To establish whether the responses were correct, false, or the consumers did not know the answers, "could be false" was recorded as "false" and "could be true" was recorded as "true". If participants answered "true" for a true statement, or "false" for a false statement, their response was rated as "correct" (1). If participants responded "true" for a false statement, or "false" for a true statement, their response was rated as "incorrect" (0). The response "do not know" was rated as "0".

The fifth section included six items to measure consumers' attitude toward farmed and wild fish (adapted from Perez Cueto Eulert et al. 2011; Verbeke et al. 2007a, b, c). Six 7-point semantic differential scales were used to measure attitudes in response to the following statements: "Eating wild fish is…" and "Eating farmed fish is…". The six scales used the following endpoints: unhealthy/healthy; not nutritious/nutritious; unfavorable/favorable; unethical/ethical; unsafe/safe; and expensive/cheap.

The sixth section included three items to measure the purchase intention of farmed and wild fish (adapted from Banovic et al. 2019; Boase et al. 2019).

In the final section, participants were asked about their demographic characteristics—i.e., gender, age, education, study area, employment status, household income, and area of residence, including their region of residence, living environment, and living near the coastline.

Data analysis

Descriptive statistics were used to report the percentages, median, means, and standard deviations. The Student T-test, Pearson Chi-square, and Mann–Whitney U tests for independent samples were performed to determine the existence of significant differences between the control and treatment groups regarding their socio-demographic data, fish purchasing frequency, and point of purchase. Spearman's rank-order

correlations (ρ) were used to examine the contribution of the consumers' beliefs to the overall attitude and intention to perform behaviors (Fishbein and Ajzen 2010).

A structural equation model (SEM) was employed to test the hypotheses and the theoretical model shown in Fig. 1. SEM specifies the model structure with both observed and latent variables; the latter is abstract phenomena that are analyzed through confirmatory factor analysis (CFA) (Byrne 2010). CFA, which is often referred to as the measurement model, is based on the previous knowledge or hypothesis of the researcher about the underlying latent variable structure. Latent variables are displayed with ellipses in Fig. 1, whereas rectangles represent observed variables (e.g., the objective knowledge score). The convergent validity of the model variables was assessed by referring to the average variance extracted (AVE), Cronbach's α coefficient, and Composite Reliability (CR). The discriminant validity was tested by comparing the squared root of the AVE of each construct with an inter-construct correlation (Bagozzi and Yi 2012). Relations between the latent variables identify the structural model. A multi-group analysis was also conducted to test the differences between the control and treatment groups (Byrne 2008). Different goodness-of-fit indices were applied to test how well the observed data fit the model: χ^2 and their degrees of freedom (df), the comparative fit index (CFI), the Tucker–Lewis Index (TLI), the standardized root mean square residual (SRMR), and the root mean square error of approximation (RMSEA) with its 90% confidence interval. The coefficient of determination R-square was used to measure the explained variance of the endogenous variables in the model (e.g., intention to purchase wild fish). We assessed the invariance of the measurement across groups through configural and metric invariance (equal factor loadings) based on changes in the model fit, i.e., $\Delta\chi^2$ and ΔCFI. The obtained data were analyzed using the Statistical Package for Social Sciences, SPSS® 27.0, and the model was estimated using maximum likelihood procedures with IBM® SPSS® Amos™ 27.0.

Results

Effect of consumers' beliefs and information on their attitude toward farmed and wild fish

Table 1 shows Spearman's rank-order correlations (ρ) between each of the behavioral beliefs on attitudes toward and intention to purchase farmed and wild fish within the control and information treatment groups. This allows us to obtain insights into their main determinants; it has been suggested that the contribution of a given belief to the overall attitude or intention, and its ability to account for variation in the relative constructs, can be discerned by examining the correlation with the overall attitude or intention (Fishbein and Ajzen 2010).

Intermediate correlation levels ($\rho = 0.4$–0.6 in absolute) were obtained for the association between behavioral beliefs with attitude toward and intention to purchase farmed fish in the control and information treatment groups. In particular, results indicate respondents with a more negative attitude toward farmed fish are more likely to believe that wild fish provides more guarantees ($\rho = -0.57$), is healthier ($\rho = -0.55$), safer ($\rho = -0.53$), and of higher quality ($\rho = -0.52$) than farmed fish. Moreover, a negative attitude toward farmed fish is also associated with beliefs that wild fish have a

Table 1 Spearman's rank-order correlations (ρ) between beliefs and attitude/intention

Beliefs	Control (n = 389)								Information treatment (n = 387)							
	Farmed				Wild				Farmed				Wild			
	Attitude		Intention		Attitude		Intention		Attitude		Intention		Attitude		Intention	
	ρ	Sig	ρ	Sig	ρ	Sig	ρ	Sig	ρ	Sig	ρ	Sig	ρ	Sig	ρ	Sig
Safety	−0.533	***	−0.477	***	0.294	***	0.300	***	−0.458	***	−0.390	***	0.233	***	0.265	***
Marine pollution (R)	−0.275	***	−0.208	***	0.204	***	0.130	**	−0.391	***	−0.349	***	0.276	***	0.330	***
Antibiotics (R)	−0.143	**	−0.112	*	0.194	***	0.207	***	−0.193	***	−0.141	**	0.130	*	0.182	***
Heavy metals (R)	−0.248	***	−0.238	***	0.210	***	ns		−0.242	***	−0.230	***	0.189	***	0.205	***
Parasites (R)	−0.258	***	−0.239	***	0.177	***	0.122	*	−0.286	***	−0.288	***	0.171	**	0.253	***
Healthy animal diet	−0.495	***	−0.433	***	0.305	***	0.295	***	−0.490	***	−0.464	***	0.376	***	0.407	***
Healthiness	−0.551	***	−0.524	***	0.389	***	0.358	***	−0.469	***	−0.351	***	0.360	***	0.394	***
Quality	−0.524	***	−0.503	***	0.427	***	0.384	***	−0.441	***	−0.340	***	0.350	***	0.429	***
Freshness	−0.317	***	−0.236	***	ns		0.153	**	−0.296	***	−0.301	***	0.126	*	0.113	*
Nutritional values	−0.448	***	−0.357	***	0.189	***	0.309	***	−0.297	***	−0.223	***	0.159	**	0.197	***
Fat	0.141	**	0.119	*	−0.101	*	−0.152	**	0.099	0.052	ns		−0.149	**	−0.132	*
Taste	−0.440	***	−0.394	***	0.346	***	0.363	***	−0.295	***	−0.281	***	0.301	***	0.322	***
Consistency	−0.366	***	−0.339	***	0.324	***	0.382	***	−0.322	***	−0.324	***	0.280	***	0.307	***
Control	−0.434	***	−0.378	***	0.119	*	0.230	***	−0.297	***	−0.236	***	0.146	**	0.208	***
Handling (R)	−0.178	***	−0.156	**	0.230	***	0.164	**	−0.124	0.015	−0.141	**	0.125	*	0.184	***
Artificiality (R)	−0.165	**	−0.149	**	0.227	***	0.154	**	−0.054	0.288	ns		0.182	***	0.155	**
Guarantee	−0.572	***	−0.489	***	0.290	***	0.302	***	−0.409	***	−0.362	***	0.220	***	0.294	***
Wild fish availability	ns		ns		ns		ns		ns		ns		ns		ns	
Price	ns		ns		ns		ns		ns		ns		ns		ns	
Farmed fish affordable (R)	−0.333	***	−0.312	***	ns		ns		−0.326	***	−0.300	***	ns		0.111	*
Farmed fish availability (R)	−0.348	***	−0.377	***	ns		ns		−0.295	***	−0.324	***	ns		ns	

(R), Items reversed in the questionnaire; ns, Not significant

***Significant at $p < 0.001$; **Significant at $p < 0.01$; *Significant at $p < 0.05$

healthier diet ($\rho = -0.49$), are of higher nutritional quality ($\rho = -0.45$), and taste better ($\rho = -0.44$) than the farmed alternative. Therefore, respondents were less willing to purchase farmed fish since they believed wild fish are healthier ($\rho = -0.52$), of higher quality ($\rho = -0.50$), are more guaranteed ($\rho = -0.49$), and safer ($\rho = -0.48$) than farmed fish. The consumers' attitude toward wild fish is only moderately correlated with the belief in higher quality ($\rho = 0.43$); in other words, the belief that linked wild fish with the product quality made the greatest contribution to the consumers' attitude toward purchasing wild fish. Significant but weaker correlations were found between the intention to purchase wild fish and the fish quality ($\rho = 0.38$), consistency ($\rho = 0.38$), healthiness ($\rho = 0.36$), and taste ($\rho = 0.36$).

Although the belief measurements were collected before the respondents had been provided with the information, the consumers' attitude and intention were significantly affected by the information (Wongprawmas et al. 2022). This explains why a similar but weaker pattern was found for the association of behavioral beliefs with attitude toward and intention to purchase farmed fish in the treatment group. The beliefs that strongly (and negatively) impacted the attitude toward farmed fish all linked wild fish to more positive valued outcomes than farmed fish: having a healthier diet ($\rho = -0.49$), being healthier ($\rho = -0.47$), safer ($\rho = -0.46$), of higher quality ($\rho = -0.44$), and more guaranteed ($\rho = -0.41$). Similarly, the respondents' intention to purchase farmed fish was lower when participants believed wild fish had a healthier diet than farmed fish ($\rho = -0.46$). When information was provided, the respondents' intention to purchase wild fish increased and was significantly affected by beliefs related to wild fish being of higher quality ($\rho = 0.43$), having a healthier diet ($\rho = 0.41$), and being healthier ($\rho = 0.39$) than farmed fish. Only weaker correlations were found between attitude and the belief of wild fish having a healthier diet ($\rho = 0.38$), being healthier ($\rho = 0.36$), of higher quality ($\rho = 0.35$), and having a better taste ($\rho = 0.30$) than farmed fish.

Results of the structural equation model

Table 2 shows the statistics obtained for the latent and observable variables: the factor loadings of the variables items (λ) above 0.50, the CR values and Cronbach's α above 0.70, as well as AVE values above 0.50 show clear reliability, convergence, and discriminant validity of all the factors in the measurement model. Results show a moderately positive attitude toward farmed and wild fish (mean scores of 4.84 and 4.90, respectively), and a moderately positive (4.57) and a positive (5.03) intention to buy farmed and wild fish, respectively. Respondents indicated a median value of 6 correct answers out of 9 (i.e., objective knowledge), and a moderately positive subjective knowledge (mean score of 4.58). In general, participants used to purchase fish once or twice per week and reported a lower purchase frequency for seabass (a few times a year) than for seabream or salmon (once a month or less).

A structural equation model was constructed and multi-group analysis was performed on the control (Fig. 1a) and the treatment (Fig. 1b) group to study consumers' intention to purchase farmed and wild fish. The findings, shown in Table 3, indicated that there was a satisfactory fit between the hypothesized model and the data. A measurement invariance analysis first showed that the configural model was well fitting in its representation of the multi-groups (unconstrained model: χ^2 (df) = 758.72 (364); CFI = 0.966;

Table 2 Statistics obtained for the latent and observable variables of the total sample (n = 776)

	Median (IQR)	Mean (SD)	λ	CR	AVE	α
Attitude towards farmed fish	5.00 (3.80–6.00)	4.84 (1.52)		0.922	0.704	0.893
Unhealthy/healthy	5.00 (4.00–7.00)	5.01 (1.83)	0.901			
Not nutritious/nutritious	6.00 (4.00–7.00)	5.27 (1.61)	0.847			
Unfavorable/favorable	4.00 (3.00–6.00)	4.17 (1.98)	0.855			
Unethical/ethical	5.00 (4.00–6.00)	4.69 (1.91)	0.818			
Unsafe/safe	5.00 (4.00–7.00)	5.06 (1.73)	0.768			
Attitude towards wild fish	5.00 (4.20–5.80)	4.90 (1.22)		0.878	0.590	0.824
Unhealthy/healthy	5.00 (4.00–6.00)	5.11 (1.59)	0.812			
Not nutritious/nutritious	6.00 (5.00–7.00)	5.53 (1.41)	0.744			
Unfavorable/favorable	5.00 (4.00–7.00)	4.94 (1.75)	0.815			
Unethical/ethical	4.00 (4.00–6.00)	4.45 (1.70)	0.703			
Unsafe/safe	4.00 (4.00–5.00)	4.48 (1.47)	0.762			
Intention to purchase farmed fish	5.00 (3.00–6.00)	4.57 (1.84)		0.980	0.942	0.969
I am planning to purchase farmed fish in the near future	5.00 (3.00–6.00)	4.45 (1.91)	0.972			
I am expecting to purchase farmed fish in the near future	5.00 (3.00–6.00)	4.61 (1.89)	0.970			
I will try to purchase farmed fish in the near future	5.00 (4.00–6.00)	4.65 (1.90)	0.969			
Intention to purchase wild fish	5.00 (4.00–6.00)	5.03 (1.51)		0.973	0.924	0.959
I am planning to purchase wild fish in the near future	5.00 (4.00–6.00)	4.99 (1.57)	0.972			
I am expecting to purchase wild fish in the near future	5.00 (4.00–6.00)	5.01 (1.60)	0.956			
I will try to purchase wild fish in the near future	5.00 (4.00–6.00)	5.08 (1.54)	0.956			
Objective knowledge[a]	6.00 (4.00–7.00)	5.53 (1.99)				
Subjective knowledge[b]	4.50 (3.75–5.50)	4.58 (1.39)				
Fish purchasing frequency[c]	4.00 (3.00–4.00)	3.72 (0.81)				
Salmon purchasing frequency[d]	2.00 (1.00–3.00)	2.16 (1.26)				
Seabass purchasing frequency[d]	1.00 (1.00–3.00)	1.67 (1.27)				
Seabream purchasing frequency[d]	2.00 (1.00–3.00)	1.99 (1.26)				

Statistics are Median values (interquartile range—IQR) and the Mean (standard deviation—SD) of single items assessed on a 7-point *Likert* scale, factor loadings (λ), composite reliability (CR), average variance extracted (AVE) and Cronbach's α

[a] The consumers' objective knowledge was computed for each participant by summing the number of correct answers to nine statements (Table 4)

[b] The consumers were asked whether they agreed or disagreed with the subjective knowledge statements. They were then asked to respond according to a 7-point scale: 1 = Totally disagree; 7 = Totally agree

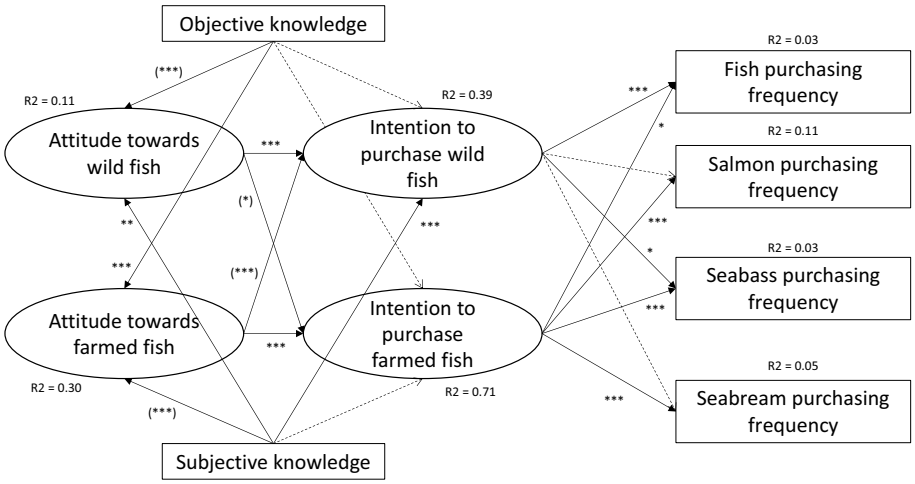
[c] 1 = A few times a year; 2 = Once a month or less; 3 = 2–3 times a month; 4 = 1 or 2 times a week; 5 = 3–4 times a week; 6 = Almost every day

[d] 0 = Never; 1 = A few times a year; 2 = Once a month or less; 3 = 2–3 times a month; 4 = 1 or 2 times a week; 5 = 3–4 times a week; 6 = Almost every day

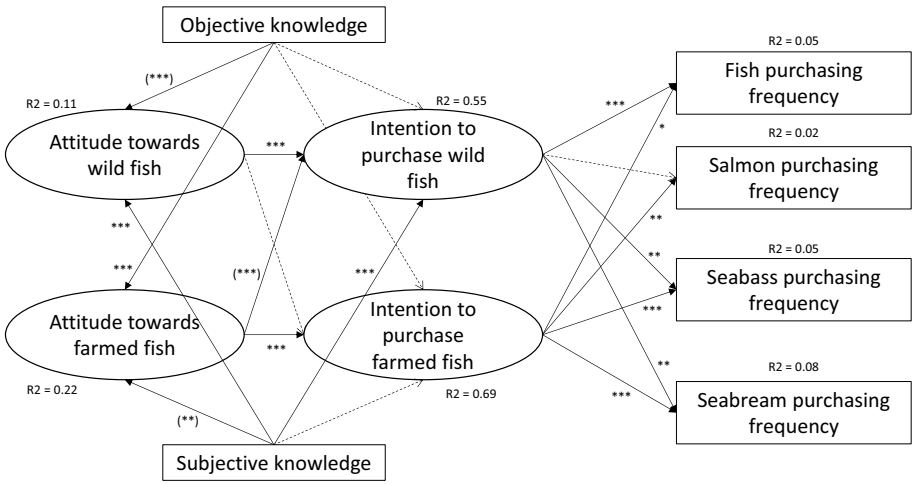
TLI = 0.957; RMSEA (90% CI) = 0.037 (0.034–0.041); SRMR = 0.069). The analysis also provided reasonable evidence to support the measurement invariance, thereby permitting a meaningful comparison between the groups, i.e., the control and treatment groups (factor loading invariance: $\Delta\chi^2$ (20) = 21.65, $p = 0.360$, ΔCFI = 0.000) (Byrne 2010).

Control group

Table 3 and Fig. 1a shows the model explained 71% of the variance in the purchase intention for farmed fish. Consumers' attitude toward farmed fish was the main



a. SEM multi-group model for the control group (n=389).



b. SEM multi-group model for the treatment group (n=387).

Fig. 1 **a** SEM multi-group model for the control group (n = 389). **b** SEM multi-group model for the treatment group (n = 387). *Note*: The model was used to predict consumers' attitudes toward farmed and wild fish, their intention to purchase farmed or wild fish, and the purchasing frequency of fish products. For simplicity, the correlations among the variables are not displayed. Sign: ***$p < 0.001$; **$p < 0.01$; *$p < 0.05$; Line: the full arrows indicate statistically significant effects; dotted arrows indicate insignificant effects; the brackets indicate negative parameters

predictor of intention ($\beta = 0.78$, $p < 0.001$), whereas their attitude toward wild fish only slightly and negatively affected their intention to purchase farmed fish ($\beta = -0.10$, $p = 0.011$). Subjective knowledge had a negative effect on the attitude toward farmed fish ($\beta = -0.17$, $p < 0.001$). The effect of objective knowledge on the intention to purchase farmed fish was mediated by consumers' attitudes toward farmed fish; indeed, we found a positive and significant effect of objective knowledge on the consumers' attitude toward farmed fish ($\beta = 0.52$, $p < 0.001$), whereas its direct effect on the intention was not significant. The intention to purchase farmed fish had a positive effect on the frequency of purchasing salmon, seabass, and seabream. In particular, the respondents' intention to consume farmed fish had a positive and significant effect on influencing the purchasing frequency of salmon ($\beta = 0.33$, $p < 0.001$), seabream

Table 3 SEM model results

Predictor		Endogenous variable	Control (n = 389)				Information treatment (n = 387)			
			Estimate	S.E	β	*p* value	Estimate	S.E	β	*p* value
Objective knowledge	→	Attitude toward wild fish	− 0.123	0.024	− 0.288	< 0.001	− 0.136	0.029	− 0.257	< 0.001
Subjective knowledge	→	Attitude toward wild fish	0.092	0.032	0.151	0.004	0.147	0.036	0.22	< 0.001
Objective knowledge	→	Attitude toward farmed fish	0.441	0.041	0.515	< 0.001	0.346	0.040	0.444	< 0.001
Subjective knowledge	→	Attitude toward farmed fish	− 0.214	0.057	− 0.174	< 0.001	− 0.133	0.048	− 0.135	0.006
Attitude toward wild fish	→	Intention to purchase wild fish	0.714	0.102	0.418	< 0.001	0.86	0.101	0.532	< 0.001
Attitude toward farmed fish	→	Intention to purchase wild fish	− 0.193	0.049	− 0.227	< 0.001	− 0.271	0.057	− 0.246	< 0.001
Objective knowledge	→	Intention to purchase wild fish	0.022	0.036	0.031	0.540	− 0.031	0.036	− 0.037	0.385
Subjective knowledge	→	Intention to purchase wild fish	0.238	0.045	0.227	< 0.001	0.147	0.042	0.136	< 0.001
Attitude toward wild fish	→	Intention to purchase farmed fish	− 0.213	0.084	− 0.098	0.011	− 0.016	0.079	− 0.009	0.837
Attitude toward farmed fish	→	Intention to purchase farmed fish	0.842	0.053	0.782	< 0.001	1.049	0.070	0.828	< 0.001
Objective knowledge	→	Intention to purchase farmed fish	0.027	0.036	0.029	0.447	− 0.001	0.038	− 0.001	0.977
Subjective knowledge	→	Intention to purchase farmed fish	0.019	0.044	0.014	0.668	0.001	0.043	0.001	0.974
Intention to purchase wild fish	→	Purchasing frequency of fish	0.101	0.030	0.185	< 0.001	0.125	0.030	0.228	< 0.001
Intention to purchase wild fish	→	Purchasing frequency of salmon	0.017	0.047	0.019	0.715	0.006	0.045	0.007	0.895
Intention to purchase wild fish	→	Purchasing frequency of seabass	0.094	0.046	0.110	0.042	0.146	0.048	0.167	0.002
Intention to purchase wild fish	→	Purchasing frequency of seabream	0.023	0.045	0.028	0.605	0.124	0.047	0.144	0.008
Intention to purchase farmed fish	→	Purchasing frequency of fish	0.054	0.023	0.126	0.020	0.063	0.026	0.133	0.016
Intention to purchase farmed fish	→	Purchasing frequency of salmon	0.233	0.037	0.330	< 0.001	0.107	0.039	0.152	0.007
Intention to purchase farmed fish	→	Purchasing frequency of seabass	0.122	0.036	0.183	< 0.001	0.177	0.042	0.234	< 0.001
Intention to purchase farmed fish	→	Purchasing frequency of seabream	0.155	0.035	0.235	< 0.001	0.226	0.041	0.301	< 0.001

Model fit: χ^2 (df) = 758.71 (364); CFI = 0.966; TLI = 0.957; RMSEA (90% CI) = 0.037 (0.034–0.041); SRMR = 0.065. SEM model used to predict the consumers' attitude toward farmed and wild fish, their intention to purchase farmed or wild fish, and the purchasing frequency of fish products, in the control (n = 389) and information treatment (n = 387) groups. The R^2 values are displayed in Fig. 1

($\beta = 0.24$, $p < 0.001$), seabass ($\beta = 0.18$, $p < 0.001$), and, albeit to a lesser extent, fish in general ($\beta = 0.13$, $p = 0.020$).

Regarding wild fish, the model explained 39% of the variance in purchase intention. The consumers' attitude toward wild fish was the main predictor of intention ($\beta = 0.42$, $p < 0.001$), followed by subjective knowledge ($\beta = 0.23$, $p < 0.001$). Conversely, the consumers' attitude toward farmed fish had a significant and negative effect on their intention to purchase wild fish ($\beta = -0.23$, $p < 0.001$). Subjective knowledge showed a positive effect on the consumers' attitude toward wild fish ($\beta = 0.15$, $p = 0.004$), whereas objective knowledge had a negative and significant effect on their attitudes ($\beta = -0.29$, $p < 0.001$). The direct effect of objective knowledge on the consumers' intention to purchase was once again not significant, thus indicating a mediating effect of the attitude on consumers' willingness to purchase wild fish. The intention to purchase wild fish significantly affected the purchasing of fish ($\beta = 0.19$, $p < 0.001$), and marginally affected the purchasing frequency of seabass ($\beta = 0.11$, $p = 0.042$), whereas it did not affect the purchasing frequency of salmon or seabream.

Treatment group

Table 3 and Fig. 1b shows the model explained 69% of the variance in the intention to purchase farmed fish. The consumers' attitude toward farmed fish was the main predictor for the intention ($\beta = 0.83$, $p < 0.001$), whereas their attitude toward wild fish had no effect on their intention to purchase farmed fish ($\beta = -0.01$, $p = 0.837$). Subjective knowledge had a negative effect on their attitude toward farmed fish ($\beta = -0.14$, $p = 0.006$). The effect of objective knowledge on affecting their intention to purchase farmed fish was mediated by the consumers' attitude toward farmed fish; indeed, we found a positive and significant effect of objective knowledge on the consumers' attitude toward farmed fish ($\beta = 0.44$, $p < 0.001$), whereas its direct effect on the intention was not significant. The intention to purchase farmed fish had a positive effect on the frequency of purchasing salmon, seabass, and seabream fish. The intention to consume farmed fish significantly affected the consumers' purchasing frequency of seabream ($\beta = 0.30$, $p < 0.001$), seabass ($\beta = 0.23$, $p < 0.001$), and fish in general ($\beta = 0.13$, $p = 0.016$), whereas its effect on salmon was less significant than that of the control group ($\beta = 0.15$, $p = 0.007$).

Regarding wild fish, the model explained 55% of the variance in consumers' purchase intention. The consumers' attitude toward wild fish was the main predictor of intention ($\beta = 0.53$, $p < 0.001$), followed by subjective knowledge ($\beta = 0.14$, $p < 0.001$). Conversely, the consumers' attitude toward farmed fish had a significant and negative effect on their intention to purchase wild fish ($\beta = -0.25$, $p < 0.001$). Subjective knowledge showed a positive effect on the consumers' attitude toward wild fish ($\beta = 0.22$, $p < 0.001$), whereas objective knowledge had a negative and significant effect on their attitude (treatment: $\beta = -0.26$, $p < 0.001$). The direct effect of objective knowledge on the consumers' intention to purchase was not significant, thus indicating a mediating effect of attitude on affecting the consumers' willingness to purchase wild fish. The effect of intention on the purchase frequency was more significant for fish in general ($\beta = 0.23$, $p < 0.001$), seabass ($\beta = 0.17$, $p = 0.002$), and seabream ($\beta = 0.14$, $p = 0.008$); however, the purchasing frequency of salmon was not affected by the consumers' intention to purchase wild fish.

Discussion

Today, with the increasing demand of consumers for more sustainable food (Galati et al. 2021; Bimbo et al. 2022; Pucci et al. 2022) and the increasing concerns about animal welfare in animal husbandry (Pulcini et al. 2020), it is crucial to investigate how the public perceives the fish sector. Several studies have investigated the perception (opinion) of individuals toward fish using belief statements about safety, quality, and healthiness (Claret et al. 2014, 2016; Ferfolja et al. 2022; Krešić et al. 2022). However, less research has focused on the perception toward sustainability and ethical concerns in the fish sector (e.g., healthy animal diet, marine pollution, etc.) and their impact on consumers' decision-making (Verbeke et al. 2007b).

Consistently with H1, our results showed a different impact of consumers' beliefs on their attitudes toward farmed and wild fish. In line with a previous study (Claret et al. 2014), healthiness and quality were key beliefs for consumers who had not received information provision. Moreover, availability, affordability (price), guarantee, safety, and control were other relevant aspects related to farmed fish. In the group that received information regarding the production method, besides availability and affordability, marine pollution, a healthy animal diet, and quality were critical beliefs that affected the respondents' attitudes toward farmed fish. On the other hand, in the same group, a healthy animal diet and marine pollution were relevant beliefs related to wild fish instead of healthiness and quality. This difference could be explained by the role of information about the production method influencing the consumers' concerns on animal welfare and environmental issues more than only on previous beliefs (i.e., quality and healthiness of wild fish). Therefore, the obtained results confirmed that the formation of beliefs is a dynamic process that can affect consumers' attitudes toward certain products (Fishbein and Ajzen 1975; Hall and Amberg 2013; Claret et al. 2014) and that information affects the way beliefs influence consumers' attitudes toward farmed and wild fish, as postulated by H2. This result is in line with the results of another study conducted in three European countries, which showed that positive and negative information about salmon farming had modified the way consumers' beliefs had formed their attitudes toward the behaviour and intention of eating Norwegian salmon (Menozzi et al. 2023). Hence, it is important to establish precise information about the production method and quality of farmed fish, which could impact consumers' intention to buy fish, and this information (e.g., about marine pollution, a healthy animal diet, safety, etc.) should be properly communicated to the public.

Moreover, our results suggested that both objective and subjective knowledge affected the consumers' attitudes toward wild and farmed fish; therefore, H3 and H5 were supported. Objective knowledge positively influenced their attitudes toward farmed fish but negatively affected their attitude toward wild fish. On the contrary, subjective knowledge had a positive impact on attitudes toward wild fish and the opposite effect on farmed fish. Participants with high objective knowledge of fish had more positive attitudes toward farmed fish, whereas participants who had high subjective knowledge about fish had a more positive attitude toward wild fish.

Providing information could also reduce consumers' concerns and skepticism about aquaculture products, which have grown in importance due to recurrent 'food scares' about farming practices, such as pollutants in marine aquaculture or antibiotics in

salmon aquaculture (Kaiser and Stead 2002; Verbeke et al. 2005; Olsen and Osmundsen 2017; Govaerts 2021). Several studies showed how adverse messages regarding food health issues can influence consumers' perceptions and choices (Verbeke et al. 2005). Thus, the increasing attention by the media, with generally negative news about aquaculture products (Olsen and Osmundsen 2017), has led to changes in consumers' preferences toward wild fish (Kaiser and Stead 2002; Govaerts 2021).

Although objective knowledge showed effects on consumers' attitudes toward both wild and farmed fish, it had no direct effect on their intention to purchase wild or farmed fish; hence, H6 was rejected. This indicates that people's actual knowledge could influence their opinion about the fish production method, but not their intention to purchase this food. On the other hand, H4 was partially supported, as subjective knowledge impacted both the consumers' attitude toward and intention to purchase wild fish; however, it only affected their attitude toward—but not their intention to purchase—farmed fish. This result is slightly different from that of Hoque & Alam (2020), who investigated the effects of both objective and subjective knowledge on consumers' intention to purchase farmed fish and found that only subjective knowledge significantly affected the purchasing intention for farmed fish. However, both results indicate that subjective knowledge influences purchasing intention more than objective knowledge. Therefore, it is not only what people actually know that is important since they need to internalize this knowledge and turn it into subjective knowledge before they can use it to make a decision.

In line with the Theory of Planned Behavior (Ajzen 1991) and previous literature (Olsen 2004; Mitterer-Daltoé et al. 2013; Yi 2019), our results supported H7, as the consumers' attitude played a more important role as an antecedent of intention to purchase fish than knowledge did.

The obtained results supported H8 and H9, thereby showing that consumers' intention to purchase farmed and wild fish affects the purchasing frequency of fish in general and of specific fish species (i.e., salmon, seabass, and seabream). The consumers' intention to purchase farmed fish significantly affected their purchasing frequency of fish in general, but also of specific species, whereas their intention to purchase wild fish affected seabass and seabream, but not salmon. This might be related to fish availability since Italian consumers can easily find wild and farmed seabass and seabream, and it is harder to find wild salmon on the Italian market. In this case, the lack of availability of the product itself may be a barrier to consumers' perceived control over their behavior, thereby reducing the frequency of purchasing and consuming wild species (Ajzen 1991). The limited availability and the consumers' appreciation of these products lead to a vast difference between the price of farmed and wild products, with the latter usually commanding higher prices—on occasion reaching up to EUR 40/kg (EUMOFA 2017)—depending on the size, country of origin, and sales channel of the fish. These criteria create a complex segmentation of the market. Indeed, Italian consumers also differentiate their willingness to pay for farmed seabass and seabream in relation to the country of origin (Stefani et al. 2012; Mauracher et al. 2013). Considering the Directorate-General for Maritime Affairs and Fisheries (2021), a higher percentage (55%) of Italians indicated that origin is one of the most important factors they take into consideration, whereas EU consumers averagely indicated a lower percentage (49%). Italians prefer fish coming

from their own country (43% vs. 37% of the EU average) and preferably from their region (35% vs. 29% of the EU average) (European Commission 2017).

We noticed that the consumers' intention to purchase explained only a small portion of their purchasing frequency. Hence, purchasing behaviors are not the same as intention. There might be other factors that affect consumers' fish purchasing frequency, for instance, past behavior and habits (Honkanen et al. 2005; Demartini et al. 2019), the perceived health benefits and risks of the product (Verbeke et al. 2005), the perceived sustainability of the production method (Verbeke et al. 2007b), the product quality (Verbeke et al. 2007c; Saidi et al. 2022), its origin (Verbeke and Roosen 2009; Saidi et al. 2022), convenience (Olsen et al. 2007; Saidi et al. 2022), the price and value of the product (Kole et al. 2009; Saidi et al. 2022), and the preparation forms of fish (Gaviglio et al. 2014; Saidi et al. 2022). Moreover, another reason for the low explained variance of behavior may be related to the different measurement scales applied to assess intention (i.e., 7-point Likert scale) and behavior (i.e., 0–6 and 1–6 fish consumption frequency scales), which therefore lack compatibility (Fishbein & Ajzen 2010, p. 44).

Finally, the direct effect of information provision was unclear. Information affected consumers' attitudes but did not have a direct effect on their purchasing intention. It has been suggested that attitudes are more malleable and directly influenced by external interventions than intentions; the effectiveness of treatment framing in modifying intentions is more context- and individual-specific (Dolgopolova et al. 2022). Furthermore, the information did not have any moderating effect between objective knowledge and intention, perhaps due to the type of information provision.

Some limitations of the study should be acknowledged to achieve further improvements. The sample comprised a high proportion of higher-educated individuals, which might be because of the way the survey was provided to participants (online). Hence, the results should be interpreted with care, and further research should be conducted to gather a more balanced and representative sample of the Italian population. Another limitation is that the measurement of the purchasing frequency was not perfectly aligned with the purchasing intention since we used different scales. Future research should also consider this issue. Finally, the information was provided in the context of a specific study, and its perception could be different in a communication campaign.

Conclusions

The results of this study indicate that subjective knowledge is a key factor in influencing attitudes and intentions to purchase farmed and wild fish. The approach underlying this study is fully in line with the 2021–2027 priority themes of the Italian Ministry of Agriculture's National Strategic Aquaculture Plan (PNSA) and, specifically, with one of its macro-objectives, "improving the social acceptability of aquaculture and contributing to the enhancement of aquaculture products and to the provision of correct consumer information". The implication for policy makers and producer associations/industries is that scientific knowledge should be transferred through more accessible and understandable messages to educate consumers and increase their acceptance of farmed fish products (Petereit et al. 2022). Information and promotion campaigns could focus on promoting farmed fish in general so that people become knowledgeable about the product. Using credible and trustworthy sources to educate consumers about the fish

production method could result in an improvement in trust /transparency of the aquaculture sector (Krešić et al. 2022), which in turn could improve consumers' knowledge and understanding.

This study also showed that encouraging the customers' knowledge about aquaculture production could augment the perceived value and quality of aquaculture products, foster trust, and increase purchasing intention. This could be achieved by using an accredited and reliable standard, such as the Aquaculture Stewardship Council (ASC) label, as a communication tool at the point of purchase. However, together with the label (e.g., QR code), more information should be provided about the adopted aquaculture methods to increase consumers' knowledge. In this way, additional information about this added-value scheme would be transferred to consumers. This strategy could help differentiate farmed fish from wild fish so that consumers could make more conscious and informed food decisions.

Appendix

See Tables 4 and 5.

Table 4 Survey measures and response scales

Measures	Item wording, and origin	Response scale
Purchasing frequency		
Fish/Salmon/Seabass/Seabream	Please indicate how often you purchase the following fish and fish species (fresh, frozen, canned, smoked, ready to eat, etc.; this includes at home): (before the Covid-19 emergency)	7-point scale, ranging from "Never" (0) to "Almost every day" (6)
Beliefs concerning wild fish	(Adapted from Claret et al. 2014 and Hall & Amberg 2013)	
	To what extent do you disagree/agree with the following statements?	7-point scale, ranging from "Totally disagree" (1) to "Totally agree" (7)
Safety		
Safety	Wild fish are safer than farmed fish	
Marine pollution	Wild fish are affected more by marine pollution than farmed fish (R)	
Antibiotics	Wild fish contain more antibiotics than farmed fish (R)	
Heavy metals	Wild fish contain more heavy metals than farmed fish (R)	
Parasites	Wild fish are affected more by parasites than farmed fish	
Healthy animal diet	Wild fish have a healthier diet than farmed fish	
Healthiness	Wild fish are healthier than farmed fish	

Table 4 (continued)

Measures	Item wording, and origin	Response scale
Quality		
Quality	Wild fish are of better quality than farmed fish	
Freshness	Wild fish are fresher than farmed fish	
Nutritional values	Wild fish are more nutritious than farmed fish	
Fat	Wild fish are more fatty than farmed fish	
Flavor	Wild fish taste better than farmed fish	
Firmness	Wild fish are firmer than farmed fish	
Control		
Control	Wild fish are more controlled than farmed fish	
Handling	Wild fish are handled more than farmed fish (R)	
Artificiality	Wild fish are more artificial than farmed fish (R)	
Guarantee	Wild fish provide more guarantees than farmed fish	
Moment of purchase		
Availability of wild fish	Wild fish are easier to find than farmed fish	
Price	Wild fish are cheaper than farmed fish	
Affordability of farmed fish	Fish farming provides a consistent, affordable product (R)	
Availability of farmed fish	Farm raised fish provide a healthy food for people who cannot afford wild fish	
Subjective knowledge	(Claret et al. 2014; Perez Cueto Eulert et al. 2011; Verbeke et al. 2007a, b, c)	
	To what extent do you disagree/agree with the following statements?	7-point scale, ranging from "Totally disagree" (1) to "Totally agree" (7)
	I feel I know more about fish in general than the average person	
	I feel I know more about fish in general than my friends	
	I have a great deal of knowledge about how to purchase fish	
	I have a great deal of knowledge about how to evaluate the quality of wild and farmed fish	
Objective knowledge		
	Please answer the following statements to the best of your ability	5-point scale, ranging from "False" (1) to "True" (5)

Table 4 (continued)

Measures	Item wording, and origin	Response scale
Healthiness and quality	The Omega-3 content is higher in wild fish (F)	
	Wild fish tend to accumulate more fat than farmed fish (T)	
	Wild fish have a more constant nutritional composition than farmed fish (F)	
Safety and quality	The risk of the presence of micro-plastics is lower in farmed fish than in wild fish (T)	
	Farmed fish grow faster thanks to the use of antibiotics and hormones (F)	
	Wild fish are always safer than farmed fish because they do not contain any harmful substances for human health (F)	
Animal welfare	Farmed fish are treated in an unethical way in the near-death phases of their lives, and they suffer more than wild fish (F)	
	Farms are unhealthy places for fish because most of them become sick (F)	
	The living conditions of farmed fish have been improved thanks to the use of technological innovations (T)	
Attitudes toward eating fish	(Adapted from Perez Cueto Eulert et al. 2011; Verbeke et al. 2007a, b, c)	
	"Eating wild fish is…" / "Eating farmed fish is…"	7-point semantic differential scale
	Unhealthy-Healthy	
	Not nutritious-Nutritious	
	Unfavorable-Favorable	
	Unethical-Ethical	
	Unsafe-Safe	
	Expensive-Cheap	
Purchase intentions	(Adapted from Banovic et al. 2019; Boase et al. 2019)	
	Please indicate your intention to purchase farmed/wild fish	7-point scale, ranging from "Totally disagree" (1) to "Totally agree" (7)
	I am planning to purchase farmed fish in the near future	
	I am expecting to purchase farmed fish in the near future	
	I will try to purchase farmed fish in the near future	

(R) indicates items reversed in the questionnaire (T) indicates the statement is true; (F) indicates the statement is false

Table 5 Socio-demographic and other characteristics of the sample

Item		Total	Control	Treatment	*p* value
	n	776	389	387	
	%	100	50.1	49.9	
Gender	Median	Male	Female	Male	0.108
	Male	50.6	49.4	51.9	
	Female	48.5	50.4	46.5	
	Other	0.9	0.3	1.6	
Age	Mean (SD)	49.9 (15.1)	49.72 (15.1)	50.03 (15.2)	0.778
Near coastline	Median	No	No	No	0.088
	Yes	35.3	32.4	38.2	
	No	64.7	67.6	61.8	
Region of residence	Median	Central	Central	South	0.679
	North-West Italy	15.1	15.9	14.2	
	North-East Italy	7.9	7.9	7.9	
	Central Italy	27.3	27.8	26.9	
	Southern Italy	23.2	20.6	25.9	
	The Islands (i.e., Sicily, Sardinia)	14.3	15.1	13.5	
	Other	12.2	12.7	11.6	
Life environment	Median	Urban area	Urban area	Urban area	0.726
	Rural area ($N < 5000$)	11.2	12.1	10.3	
	Suburban area ($5000 < N < 50{,}000$)	38.5	37.8	39.3	
	Urban area ($N \geq 50{,}000$)	50.3	50.1	50.4	
Education	Median	University degree	University degree	University degree	0.619
	Middle school	3.1	3.3	2.8	
	High school	34.9	35.5	34.4	
	University degree	62.0	61.2	62.8	
Employment status	Median	Full-time	Full-time	Full-time	0.549
	Full-time	58.1	56.8	59.4	
	Part-time/Other	7.6	7.5	7.8	
	Unemployed	3.6	4.1	3.1	
	Retired	17.0	15.9	18.1	
	Student	6.8	8.2	5.4	
	Other	6.8	7.5	6.2	
Study area	Median	Food technology and others	Food technology	Others	0.920
	Veterinary or similar	5.8	6.4	5.2	
	Agricultural or similar	7.5	7.7	7.2	
	Gastronomic science or similar	3.4	3.9	2.8	
	Nutrition, dietetic or similar	8.0	7.7	8.3	
	Food technology or similar	25.4	24.7	26.1	
	Others	50.0	49.6	50.4	
Household income per month	Median	2500–3499	2500–3499	2500–3499	0.783
	1: < 900 euros	1.7	1.5	1.8	
	2: 900–1499 euros	9.8	9.3	10.3	

Table 5 (continued)

Item		Total	Control	Treatment	*p* value
	3: 1500–2499 euros	28.1	28.0	28.2	
	4: 2500–3499 euros	20.6	20.8	20.4	
	5: 3500–4499 euros	10.3	10.3	10.3	
	6: ≥ 4500 euros	9.8	11.6	8.0	
	Do not know/do not want to answer	19.7	18.5	20.9	
Food regime	Median	Normal	Normal	Normal	0.047**
	Normal	79.0	81.5	76.5	
	Flexitarian[a]	20.0	17.0	23.0	
	Others	1.0	1.5	0.5	
Fish purchasing frequency	Median	> once a week	> once a week	> once a week	0.839
	Less than once a week	32.0	31.6	32.3	
	More than once a week	68.0	68.4	67.7	
Salmon purchasing frequency	Median	< once a week	< once a week	< once a week	0.313
	Never	11.2	11.8	10.6	
	Less than once a week	73.5	70.4	76.5	
	More than once a week	15.3	17.7	12.9	
Seabass purchasing frequency	Median	< once a week	< once a week	< once a week	0.737
	Never	24.6	24.2	25.1	
	Less than once a week	67.1	68.9	65.4	
	More than once a week	8.2	6.9	9.6	
Seabream purchasing frequency	Median	< once a week	< once a week	< once a week	0.356
	Never	12.8	12.3	13.2	
	Less than once a week	74.4	76.9	71.8	
	More than once a week	12.9	10.8	15.0	
Point of purchase[b]	Fish shops/Fishmongers	47.7	47.8	47.5	0.940
	Supermarket	77.3	77.4	77.3	0.969
	Discount shop	6.1	5.9	6.2	0.866
	Online channel	1.9	2.1	1.8	0.802
	Direct from fishermen	5.2	3.3	7.0	0.022**
	Others	1.8	2.1	1.6	0.596

SD Standard deviation

[a] Flexitarian is a plant-based diet with the occasional inclusion of animal products

[b] The participants could choose multiple purchasing points. Student t-test: age. Pearson chi-square: gender, employment status, near coastline, and point of purchase. Mann–Whitney U Test: education, household monthly income, and fish purchasing frequency

**Indicates significant at $p < 0.05$

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Author contributions
GS, FG, GP and CM contributed to conceptualization; DM, RW and GS contributed to methodology; DM analyzed and interpreted the data regarding structural equation model; RW contributed to data curation and data analysis; DM, RW, GS, FG and GP contributed to writing—original draft preparation; DM, RW, GS, FG, GP and CM contributed to writing—review and editing; GS and CM supervised the study. All authors have read and approved the final article.

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Availability of data and materials
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Declarations

Competing interests
The authors declare that they have no competing interests.

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