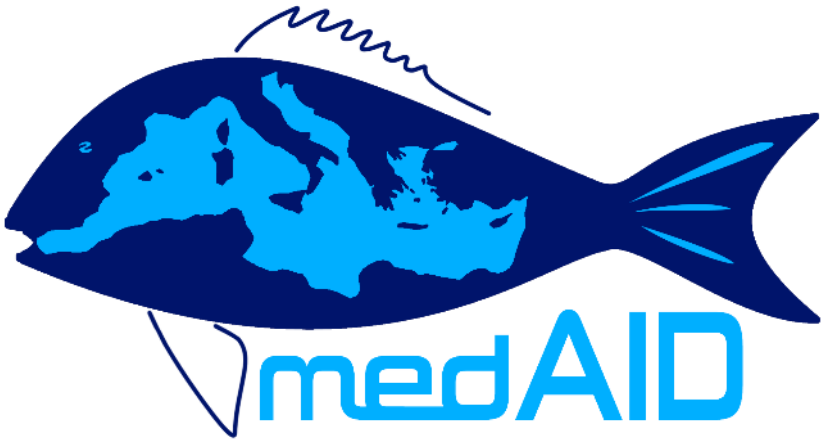

Mediterranean Aquaculture Integrated Development

Deliverable No. 5.5

Market validation, technical and socioeconomic analysis of fish products

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Dissemination level: **PU= Public, fully open, e.g. web; **CO** = Confidential, restricted under conditions set out in Model Grant Agreement; **CI** = Classified, information as referred to in Commission Decision 2001/844/EC

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Executive summary

Innovation and development of new products for existing and new markets is clearly needed for a long-term competitive supply-demand equilibrium of Mediterranean marine aquaculture. As in the rest of the food industry, the improvement of the competitiveness and sustainability of the sector is governed by current consumer trends, which translates into the need to transform aquaculture species to offer consumers the safe, healthy, quality and convenience products they demand.

Considering the current consumer demand and the lack of aquaculture seafood products on the market, the development of new fish aquaculture products can be an opportunity to generate differentiation in the product range and increase the commercial value and profitability of the Mediterranean aquaculture value chain.

Moreover, the changes that the European consumer is experiencing in terms of new lifestyles, trends and habits in food purchasing and consumption, and others such as increasing food environmental awareness, are influencing the development of innovations in the food market regarding new product concepts but also affecting production and market strategies and marketing channels.

In this sense, understanding consumer behaviour towards innovative aquaculture products can help us to provide EU consumers and fish/food supply actors with high added-value, market-oriented fish products that deliver the value that contemporary EU fish/food consumers expect.

Deliverable 5.5 "Market validation, technical and socioeconomic analysis of fish products", covers the results from several studies involving consumer activities performed in Task 5.4 "Market validation"; the profiling of key EU consumer segments for new product adoption (through large-scale quantitative and qualitative surveys), the identification of the optimal product configuration (through choice experiments), the identification of the optimal combination of packaging attributes (validated through neuroscience), the assessment of sustainability dimensions (choice experiment) and finally the validation tests (Home Use Tests and online questionnaires) of the new products in three European countries (Spain, France and Germany).

It also includes the results of Task 5.5 "Technical and economic feasibility analysis of products" performing case studies for producing the four new food products (grilled seabass with lemon, sea and mountain burger, seabream breaded bites and organic seabream with couscous) developed in the framework of MedAID. The information provided could facilitate the implementation of these developments by industry.

Finally, as main findings and conclusions resulting from the studies developed, the following key points can be highlighted:

- **Enhance aquaculture knowledge** focusing the promotion of new aquaculture fish products towards target consumer segments emphasizing the benefits of aquaculture fish, especially in terms of taste and quality, since a high percentage of EU consumers has still never consumed products from aquaculture.
- Develop strategies to be able to **change the general awareness and to break down consumer preconceptions** about Mediterranean aquaculture: feeding practices, sustainability, or products' health and safety conditions, improving consumer's confidence and trust.
- **Incorporate the voice of consumers in all stages of the new product development** process to increase the success rate when launching a new product on the market.
- Emphasize the combination in the **packaging** of visual and textual attributes that were mostly preferred by consumers.

- **Consider consumption habits and preferences of a target group** in the development of new fish products from aquaculture and follow a market-based segmentation.
- **Work on a wider range of products** to launch different concepts according to the specific demands and needs of each market niche (school canteens, food industry, food service and/or retail channels).
- **Develop healthy and convenient products** with high nutritional value, easy preparation, consumption, and handling, longer shelf life and a better organoleptic profile more suitable for new consumer lifestyles.
- Consider taste, texture, tasty appearance, healthiness, percentage of aquaculture fish in the final recipe and good nutritional value attributes during the development of new fish products to **increase new aquaculture product purchase intention**. ASC label, Nutri-Score, domestic origin, a health claim and lower price would improve purchase intention as well.

The work performed in WP5 and reported in this deliverable can provide useful information to enhance the success in the market of the new products developed and is expected to contribute to enhance the competitiveness of Mediterranean aquaculture by improving its market performance through a supply chain-wide, market-oriented design of diversified or new types of added-value fish products for EU consumers and food supply actors.

Table of contents

Introduction

The Mediterranean aquaculture industry faces new challenges in an increasingly globalized market with competitiveness as the key factor and in which innovations in the supply chain are as important as innovations in production. With an increasing fish demand, aquaculture will clearly be the most important seafood production technology in the next years to come.

More product innovation and development of new products for new markets are clearly needed for a more long-term competitive supply-demand equilibrium of Mediterranean aquaculture (European seabass, gilthead seabream and meagre). Even though producers are aware of the importance of diversifying their products, and despite the progress that has been made (production of different fish sizes, fillets, vacuum packaging or frozen fish), most seabass and seabream still compete in the markets as fresh whole products.

Moreover, the changes that the European consumer is experiencing in terms of new lifestyles, trends and habits in food purchasing and consumption, and others as increasing environmental awareness regarding food products, are influencing the development of innovations in the food market regarding new product concepts but also affecting production and market strategies and distribution channels.

In order to increase the chances for such innovations in production to be successful on the market, and identify the best market solution for each type of fish species, there is a need to understand consumer behaviour towards innovative aquaculture products and also engage aquaculture chain stakeholders in the aquaculture innovation process.

In this sense, consumer involvement (Task 5.4) in market validation research activities for the identification of the optimal product configuration in terms of extrinsic, added-value-giving attributes (choice experiments), the validation through Home Use Tests and online questionnaires of the new products developed in the three European countries (Spain, France and Germany) against their expectations and the identification of the optimal combination of packaging attributes can provide useful information to enhance the success in the market of the new products developed.

Finally, the estimation of the technical and economic viability (Task 5.5) of producing the four new food products developed in the framework of MedAID through the analysis of case studies, could facilitate the possible implementation of these developments by the food industry at industrial level.

Objective

Work Package 5 (WP5), explores and validates the technical and market feasibility of developing different product alternatives from Mediterranean aquaculture species for commercial exploitation, analysing the potential of different market opportunities, and taking into account physico-chemical and technical characteristics of farmed fish, socioeconomic aspects and consumer requirements.

The goal is to identify the best market solution for each type of fish species (seabass, gilthead seabream and meagre), transforming them into new value-added products, tailor-made to satisfy the needs of different consumer profiles and adapted to the needs of diverse food and fish market channels.

Task 5.4. "Market validation" aimed to validate the new added-value product alternatives developed against the expectations and requirements of consumers in three European countries (Spain, France, and Germany). By **product pilot testing (Home Use Test and online questionnaires)**, sensory acceptability, preferences, food packaging and purchase intention are evaluated. Moreover, a **product-market matching** study aimed to identify the optimal product configuration in terms of extrinsic, added-value-giving attributes in order to satisfy consumers' relevant product requirements. Finally, a study was carried out on optimization of the **packaging attributes of products** and the validation of the results obtained through **neuroscience** and **a**

choice experiment to assess the relevance of different **dimensions of sustainability** (environmental, social, and animal welfare) for the consumer.

The work performed in **Task 5.5. "Technical and economic feasibility analysis of products"** focused on the development of new aquaculture fish products' technical and economic specification documents needed to evaluate their industrial feasibility for the fish processing food industry. This task estimated the technical and economic feasability of producing four new food products (grilled seabass with lemon, sea and mountain burger, seabream breaded bites and organic seabream with couscous) developed in the framework of MedAID at pilot scale and selected for the validation studies with consumers in Spain, France and Germany.

Deliverable 5.5 "Market validation, technical and socioeconomic analysis of fish products" compiled the results obtained in both market validation and technical and economic studies developed and their main conclusions and findings.

Market validation:

- New aquaculture fish product tasting in Spain
- Innovative aquaculture products in France and Germany
- Product-market matching
- Packaging and sustainability dimensions validated through neuroscience

Technical and economic analysis:

- Technical and economic feasibility analysis of new aquaculture seafood products

New aquaculture fish product tasting in Spain

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Table of contents

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1. Introduction

WP5 (Product development, market and consumer assessment) explored and validated the technical and market feasibility of different product alternatives from specific Mediterranean aquaculture fish species for commercial exploitation, analysing the potential of different market opportunities, and taking into account socioeconomic aspects and consumer requirements.

For this purpose, Mediterranean aquaculture seafood products were developed in AZTI's facilities taking into account the consumers´ needs and ideas generated in Task 5 (see Task 5.1, Task 5.2 and Task 5.3).

According to the objective specified in Task 5.3 "Technical development of the new fish products", eight (8) new food products from Mediterranean aquaculture species were designed, formulated and developed at pilot-scale in AZTI's facilities. Considering consumers' needs and expectations, a selection of four products were included in the pilot testing with consumers. Due to the coronavirus outbreak, the tasting sessions were held only in Spain.

2. Objective

In WP5, the main objective of Task 5.4 "Market validation" was to determine the consumers´ acceptability of the products developed in Task 5.3.

3. Material and methods

3.1. Products selected for consumer tasting

Four out of eight new food products made from Mediterranean aquaculture species were designed, formulated, and developed at pilot-scale in AZTI's facilities and selected for consumers' sensory evaluation (Figure 1):

1) Grilled seabass with lemon
2) Sea and mountain burger
3) Seabream breaded bites
4) Organic seabream with couscous

Figure 1: Products selected for consumers´ sensorial evaluation.

3.2. Taste procedure

3.2.1. Delivery of the samples

The selected consumers picked up the tasting samples from AZTI facilities (Derio, Bilbao) or CIHEAM facilities (Zaragoza). When they picked up the products, the consumers were given a brief explanation about how they had to preserve the products, how they had to prepare the products at home before tasting and how they had to fill in the online tasting questionnaire. In addition to the samples, they were given a dossier with all the information needed to carry out the tasting at home (Figure 2).

The consumers did the product sensorial evaluation at home, reproducing a real experience with the products.

Figure 2: Left: How the products were delivered (AZTI facilities); right: Explanation of the tasting procedure (CIHEAM facilities).

3.2.2. Questionnaire

The consumers filled in an online questionnaire. The questionnaire included queries regarding the sensorial evaluation of each product, purchase intention and motivation, improvements that consumers would make to each product, product innovation, products suitable for children and finally, sociodemographic questions.

The sensory attributes evaluated by consumers were:

1) **Visual phase:** appearance, colour*
2) **Olfactory phase:** aroma
3) **Taste phase:** general taste, fish taste, salt level, juiciness
4) **Texture:** general texture and crunchiness*
5) **Overall liking**

*Attributes evaluated only for the seabream breaded bites sample.

To evaluate the selected sensory attributes, structured nine-point scales were used (1 "dislike extremely" and 9 "like extremely"), in accordance with the UNE ISO 4121 2006 and UNE ISO 6658 2019 standards.

The samples to be evaluated were presented to consumers in a random order according to a different and balanced design.

3.2.3. Statistical analysis

The data have been evaluated with the XLSTAT software.

3.3. Consumer selection and profile

The consumers were selected considering the following requirements:

1) Men and woman from 18 to 75 years old.
2) Fish consumption frequency almost twice a month.
3) No food allergies.
4) No problems for chewing and/or swallowing.
5) Knowledge of how to use computers, tablets or smart phones.

80 consumers were selected to participate in this study. However, only 75 questionnaires were correctly completed, 43 from Bilbao (North of Spain) and 32 from Zaragoza (North East of Spain, Figure 3).

The participants had the following characteristics:

1) **Age:** from 18 to 67 years old (mean age: 43.64 ± 1.49).
2) **Gender:** 60 % female (mean age: 43.02 ± 1.91) and 40 % men (mean age: 44.57 ± 2.40).

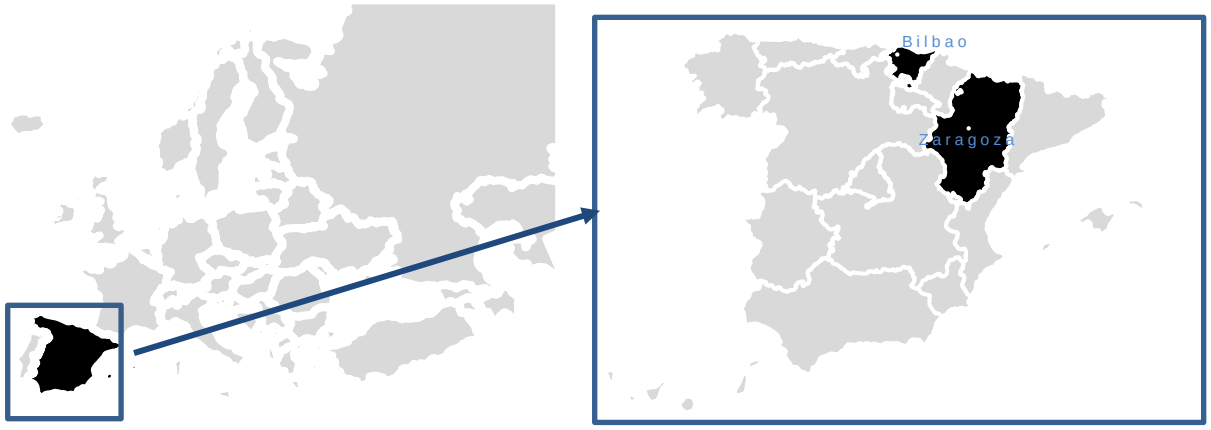

Figure 3: Areas where the Spanish consumers were selected.

4. Results

4.1. Grilled seabass with lemon

4.1.1. Sensorial evaluation

In general, all the sensorial attributes were evaluated positively, general taste and juiciness being the sensorial attributes better scored by consumers (more than 7 out of 9 points), contrary to the appearance which was the feature worst scored (5.86 out of 9 points). Consumers over 55 years old liked all the sensorial attributes more than the rest of the consumer groups (Figure 4).

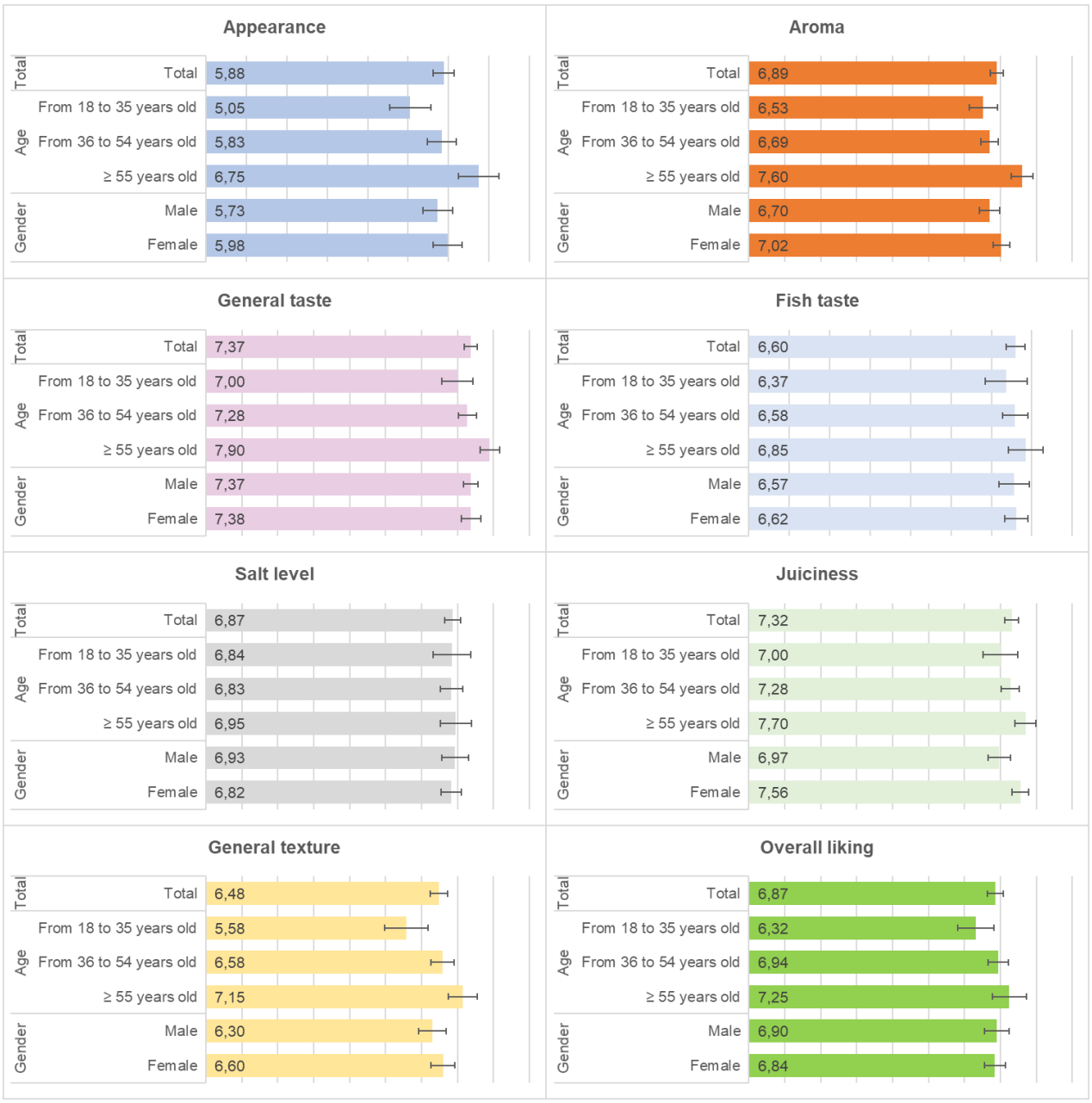

Figure 4: Consumers' liking of the sensorial attributes of grilled seabass with lemon sample. Evaluated from 1 "dislike extremely " to 9 "like extremely" (mean ± SD). Data shown by age and gender (N=75).

4.1.2. Purchase intention

The consumers showed a positive purchase intention, since 68 % stated that they would buy this product (sum of I would definitely and I would probably buy). The higher purchase intention was shown by the older consumers (80 % would buy the product), contrary to the younger ones, since 53 % would buy this product (Figure 5).

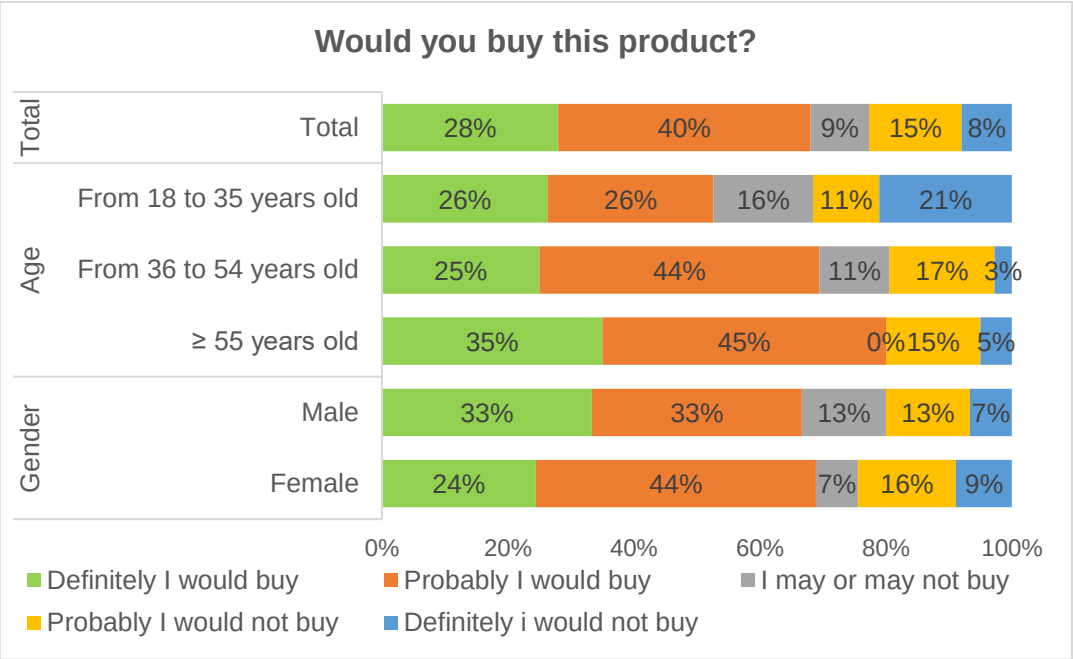

Figure 5: Percentage of the consumers' purchase intention. Data shown by age and gender (N=75).

The main reasons why 32 % of the consumers would not buy this product were because they did not like its texture (58 %), appearance (38 %) or taste (25 %; Figure 6).

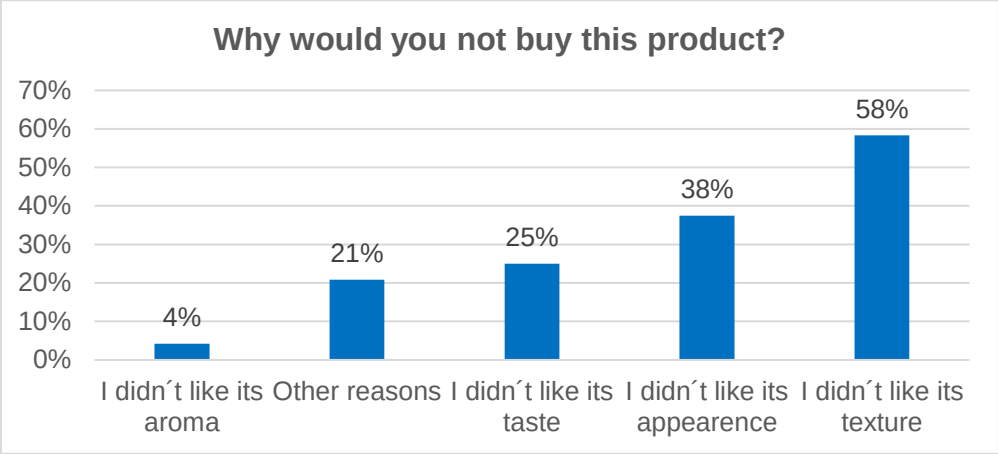

Figure 6: Reasons why the consumers would not buy the grilled seabass with lemon sample (sum of I may or may not buy, probably and definitely would not buy). Data shows the percentage of each option selected. Note that it could be higher than 100 % since more than one option could be chosen (N=24).

The information shown in Figure 7 was shown to consumers, and then they were asked again if they would buy the sea and mountain burger.

GRILLED SEABASS WITH LEMON

This product is a sliced seabass. This product has neither skin nor bones. It contains 66 % aquaculture seabass.

This product has a slight fish flavour with a hint of lemon and can be used in many recipes.

Thanks to its good nutritional profile it is suitable for all ages.

Figure 7: Grilled seabass with lemon description given to consumers.

Although the positive purchase intention grew until 70 % after knowing the information (sum of I would definitely buy and I would probably buy), no clear effect was observed in all the cases (Figure 8).

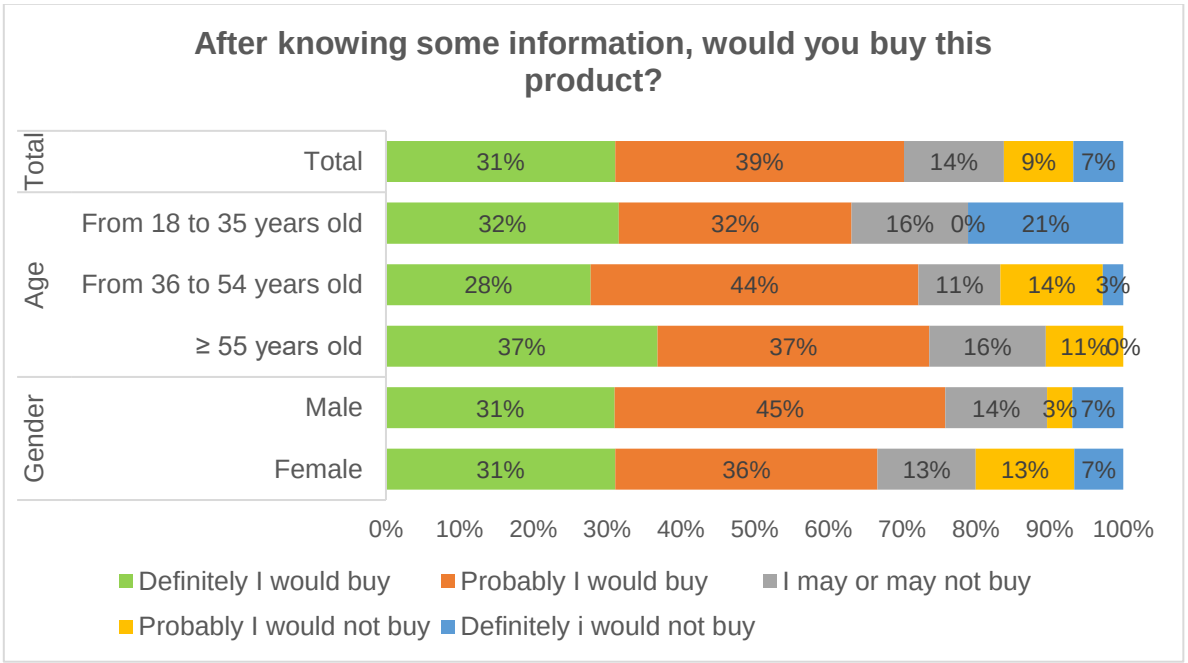

Figure 8: Percentage of the consumers' purchase intention after knowing some information about the grilled seabass with lemon. Data shown by age and gender (N=75).

4.1.3. Improvement

The consumers were asked if they would improve anything about this product, and 69.3 % would. They would change packaging, texture and some features related to the way it had to be cooked, since most of the consumers would improve the texture to make it easier to cook (Figure 9).

Figure 9: Word cloud generated with the consumers' improvements of the grilled seabass with lemon sample. The size of the letters is proportional to the frequency of each improvement suggested by consumers (N=52).

4.1.4. Packaging

In general, the consumers liked the packaging, they scored it with 5.80 points out of 9 (Figure 10). However, 22.7 % of the consumers did not like the packaging. They scored the packaging with less than 4 out of 9 points, by contrast, 49.3 % of consumers scored the packaging with more than 6 out of 9 points.

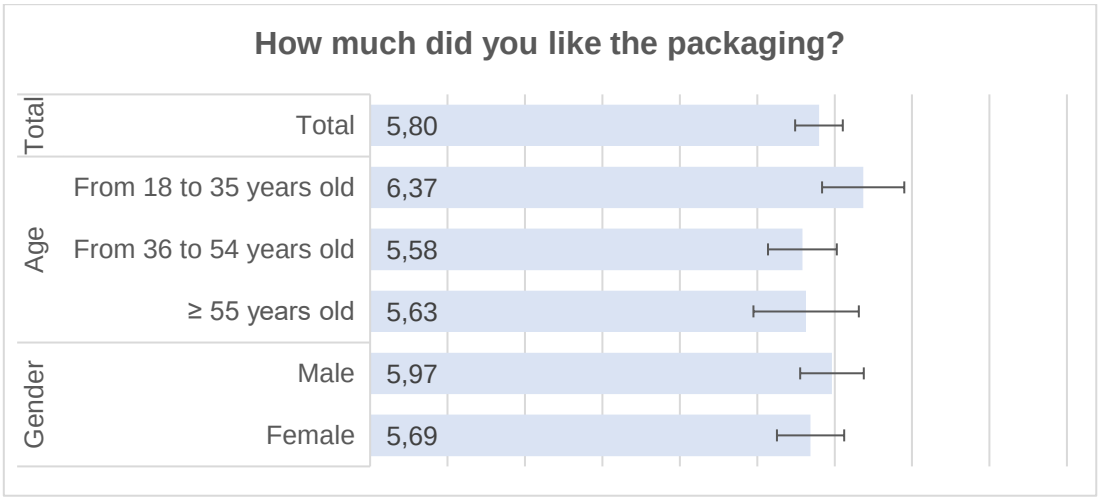

Figure 10: Consumers' evaluation of how much they liked the packaging of grilled seabass with lemon sample. Evaluated from 1 "dislike extremely" to 9 "like extremely" (mean ± SD). Data shown by age and gender (N=75).

4.1.5. Product preparation

The consumers thought that the grilled seabass with lemon was very easy to prepare (2.53 points out of 9). The older consumers found this product more difficult to prepare (Figure 11).

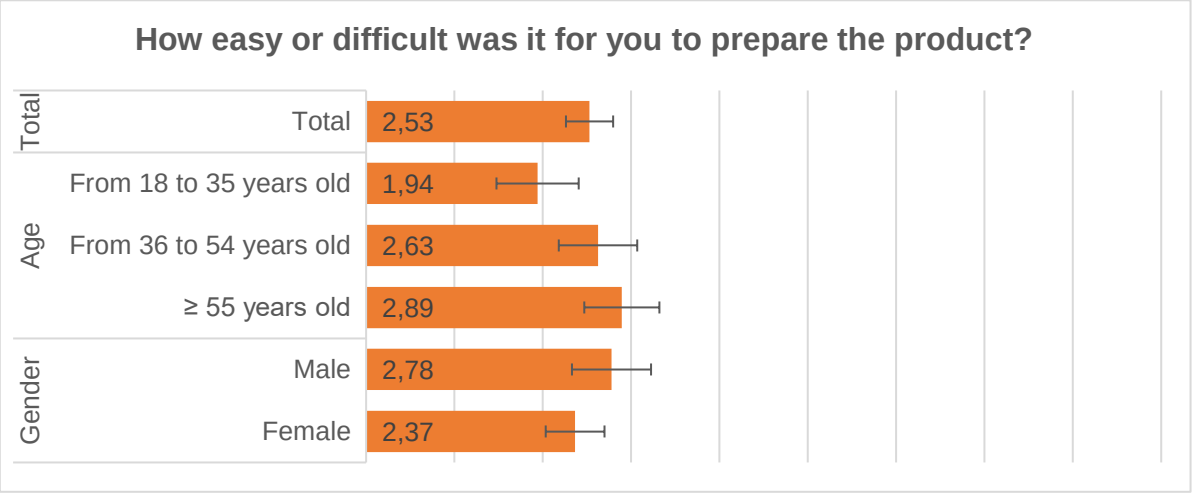

Figure 11: Consumers' evaluation of how easy or difficult it was to prepare the grilled seabass with lemon sample. Evaluated from 1 "very easy" to 9 "very difficult" (mean ± SD). Data shown by age and gender (N=69).

4.1.6. Innovation

Seabass with lemon is considered by 95 % of the consumers as an innovative product (Figure 12).

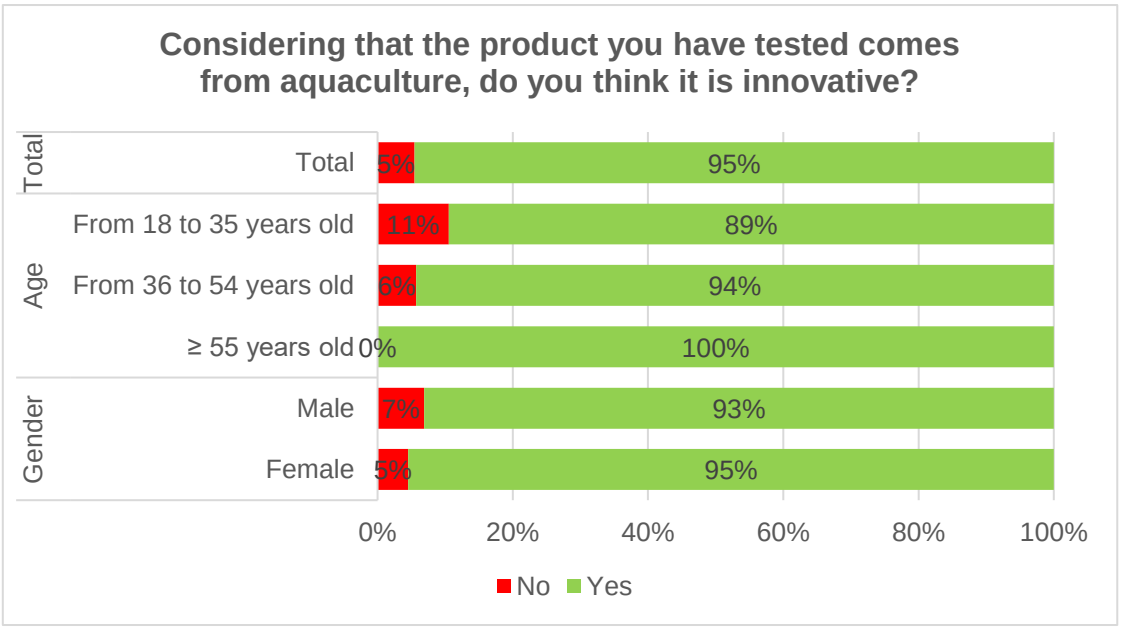

Figure 12: Percentage of consumers who considered that the grilled seabass with lemon sample is innovative. Data showed by age and gender (N=75).

4.1.7. Fish intake improvement

Consumers considered that this product would increase the daily intake of fish consumption, since 60 % of them have a positive consideration (sum of definitely and probably it would increase; Figure 13).

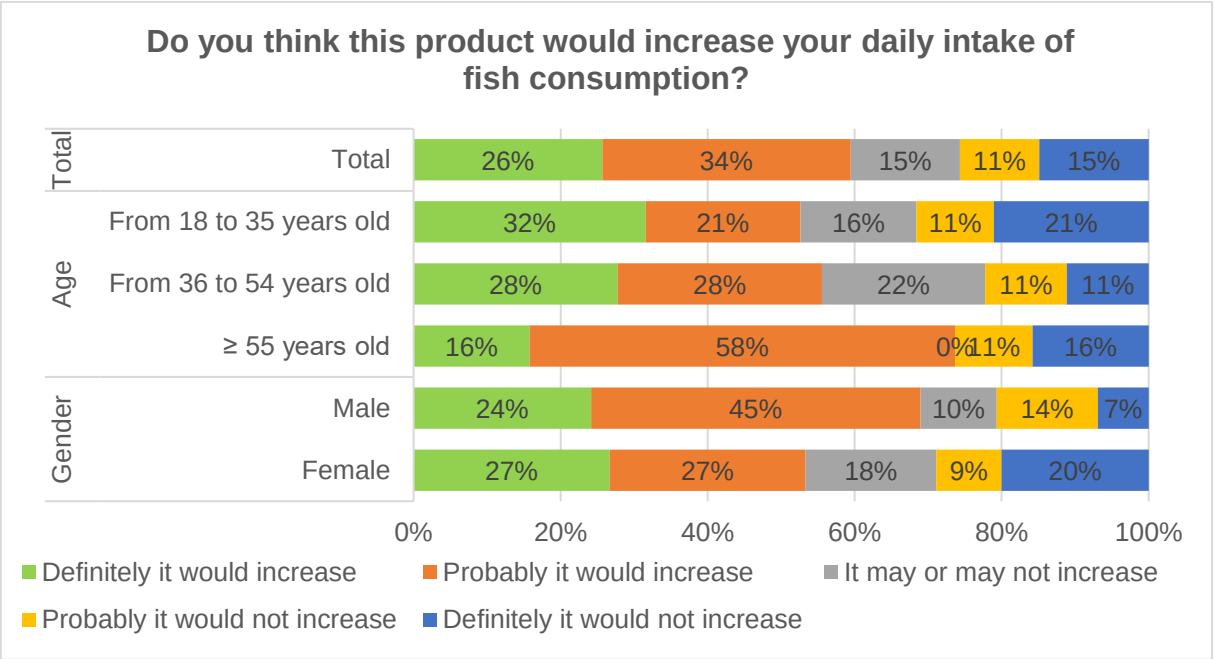

Figure 13: Percentage of consumers who considered that the grilled seabass with lemon sample would increase the daily intake of fish consumption. Data shown by age and gender (N=75).

4.1.8. Product suitable for consumption by children

85 % of consumers considered that the grilled seabass with lemon would be suitable for children under 16 years old (Figure 14).

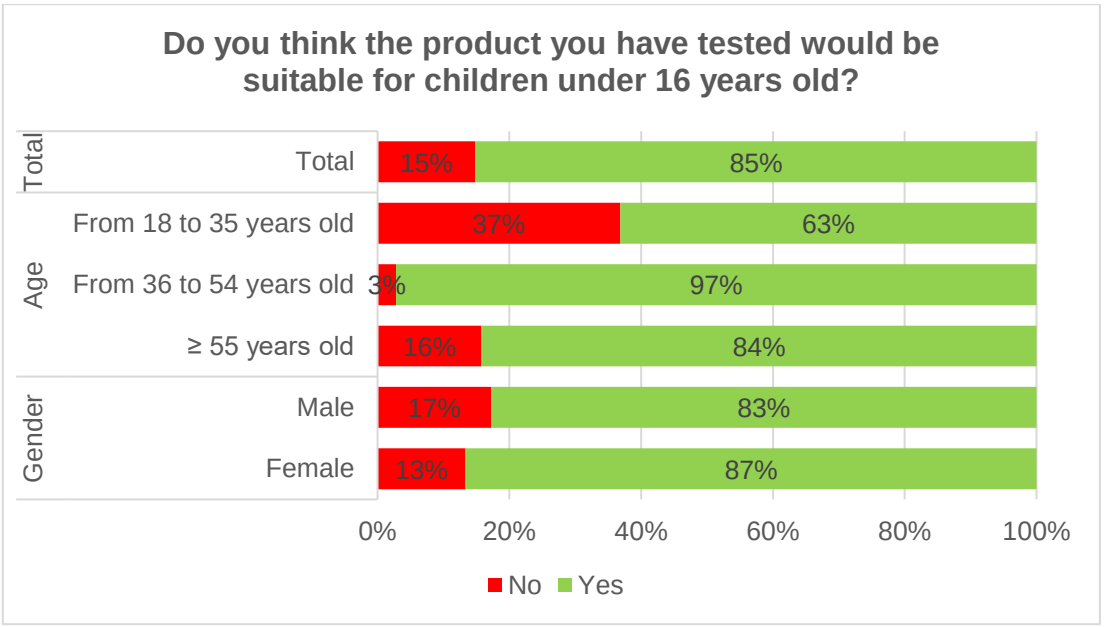

Figure 14: Percentage of consumers who considered that the grilled seabass with lemon sample would be suitable for children under 16 years old. Data shown by age and gender (N=75).

4.2. Sea and mountain burger

4.2.1. Sensorial evaluation

In general, all the sensorial attributes were evaluated positively. The juiciness was the sensorial attribute best scored by consumers, by contrast the salt level scored the worst (7.03 and 5.69 out of 9 points respectively). Consumers between 36 to 54 years old least liked all the sensorial attributes (Figure 15).

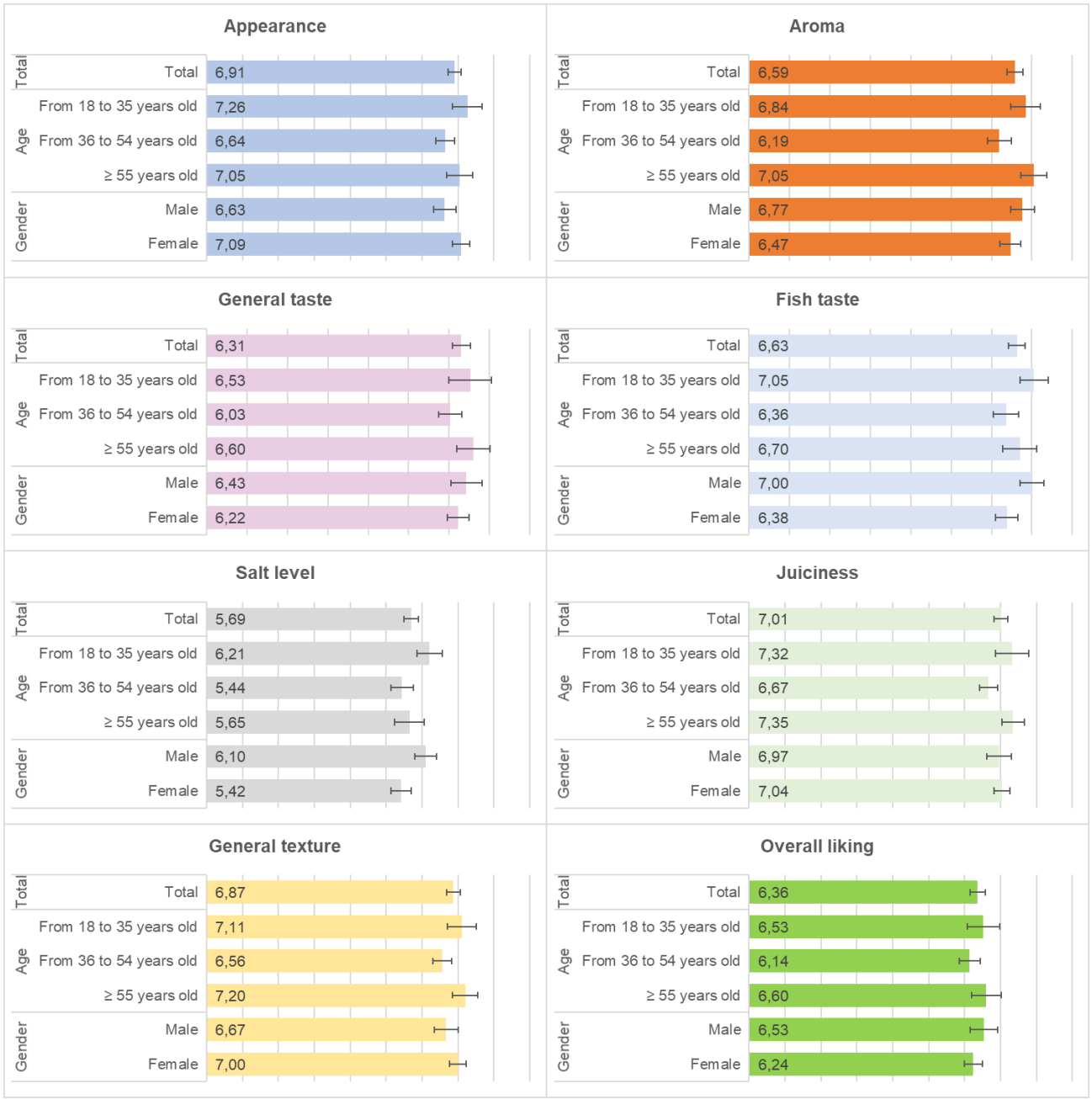

Figure 15: Consumers' liking of the sensorial attributes of the sea and mountain burger. Evaluated from 1 "dislike extremely " to 9 "like extremely" (mean ± SD). Data shown by age and gender (N=75).

4.2.2. Purchase intention

The consumers showed a positive purchase intention, since 50 % stated that they would buy this product (sum of I would definitely buy and I would probably buy). The higher purchase intention was shown by the older consumers (65 % would buy the product), contrary to those from 36 to 54 years old, 42 % of whom would buy this product (sum of I would definitely buy and I would probably buy; Figure 16). It is noteworthy that the consumers between 36 and 54 years old wee the most hesitant about this product since 31 % chose the option I may or may not buy this product (Figure 16).

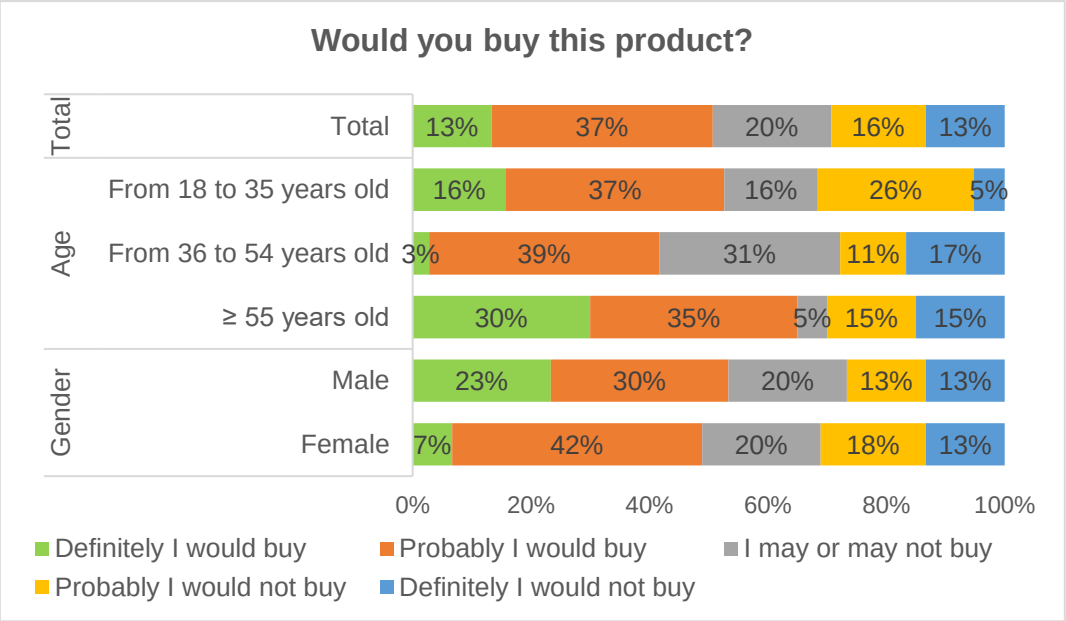

Figure 16: Percentage of the consumers' purchase intention. Data shown by age and gender (N=75).

The main reasons why 49 % of the consumers would not buy this product were because they did not like its taste (51 %), texture (27 %) or other reasons such as salt content and size (24 %; Figure 17).

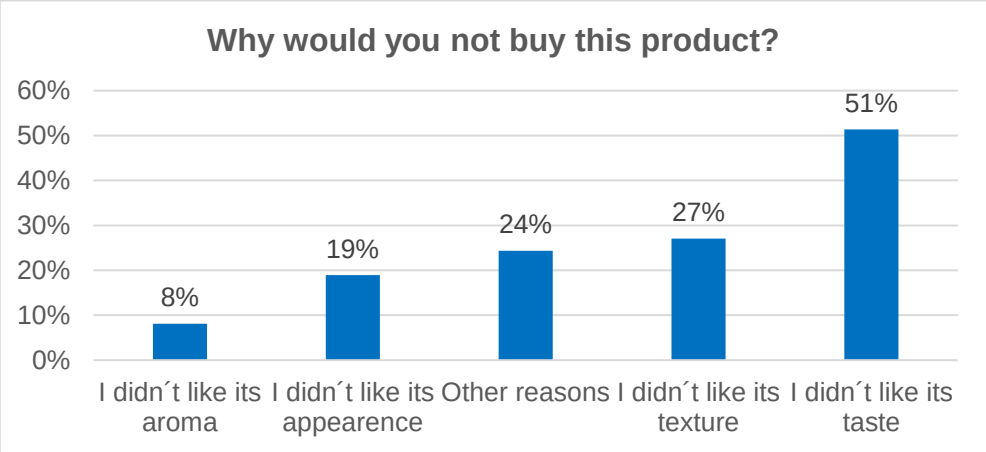

Figure 17: Reasons why the consumers would not buy the sea and mountain burger (sum of I may or may not buy, I would probably and definitely not buy). Data showed the percentage of each option selected. Note that it could be higher than 100 % since more than one option could be chosen (N=37).

A brief description of the sea and mountain burger was shown to consumers (Figure 18). Then consumers were asked again if they would buy the sea and mountain burger.

SEA AND MOUNTAIN BURGER

Frozen seabass burger with mushrooms and no added salt. The product has no bones and is made with natural ingredients. It contains 95 % fish from aquaculture (seabass).

Thanks to its good nutritional profile it is suitable for all ages. Gourmet recipe.

Figure 18: Sea and mountain burger description given to consumers.

After reading the product description, the consumers' positive purchase intention grew up to 77 % (sum of I would definitely buy and I would probably buy), due to the percentage reduction of "may or may not buy" (Figure 19).

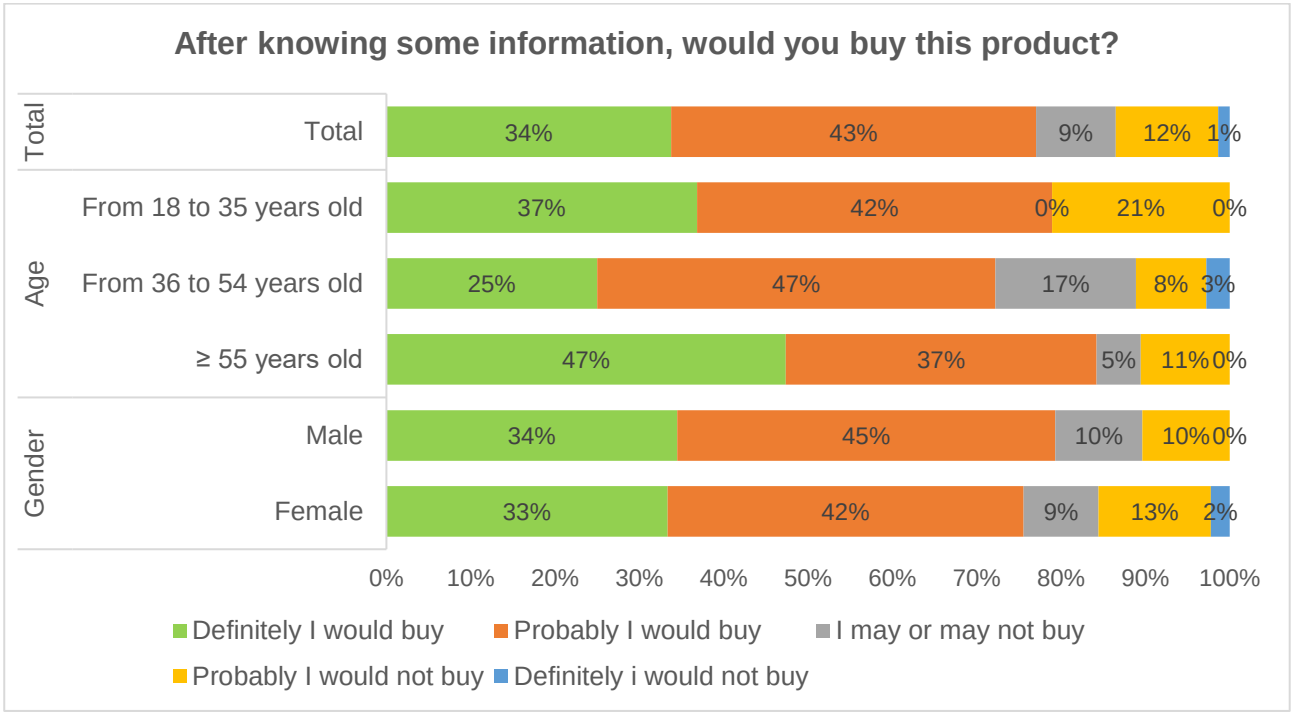

Figure 19: Percentage of the consumers' purchase intention after knowing some information about the sea and mountain burger. Data shown by age and gender (N=75).

4.2.3. Improvement

63.5 % of the participants would change something about the product. They would change the salt content and the burger size, as they thought that the burger was bland and small (Figure 20).

Figure 20: Word cloud generated with the consumers' improvements of the sea and mountain burger. The size of the letters is proportional to the frequency of each improvement suggested by consumers (N=49).

4.2.4. Packaging

In general, the consumers liked the packaging, they scored it with 6.45 point out of 9. The younger consumers liked the packaging the most compared with the rest of the age groups (Figure 21).

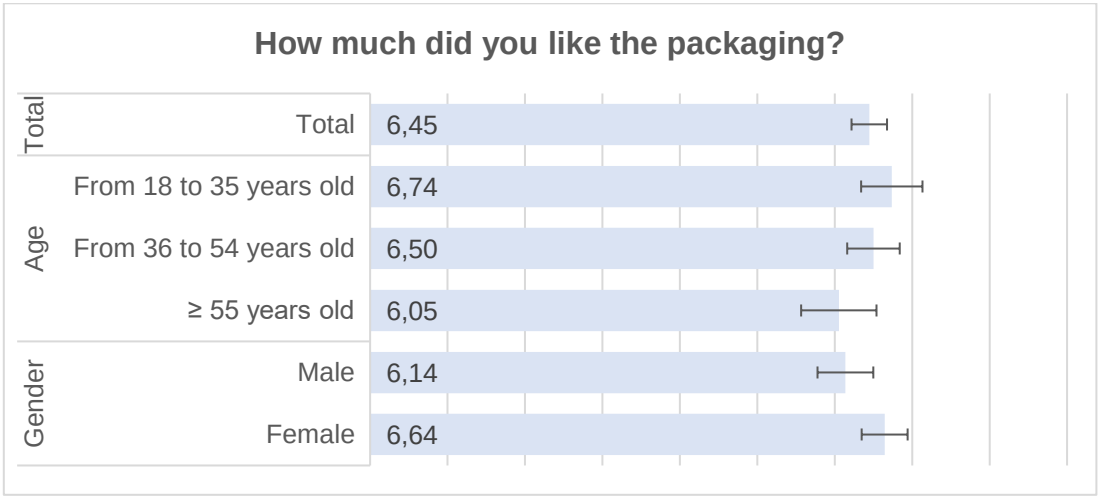

Figure 21: Consumers' evaluation of how much they liked the packaging. Evaluated from 1 "dislike extremely" to 9 "like extremely" (mean ± SD). Data shown by age and gender (N=75).

4.2.5. Product preparation

The consumers thought that the sea and mountain burger was very easy to prepare (1.46 points out of 9), the older consumers found this product more difficult to prepare (Figure 22).

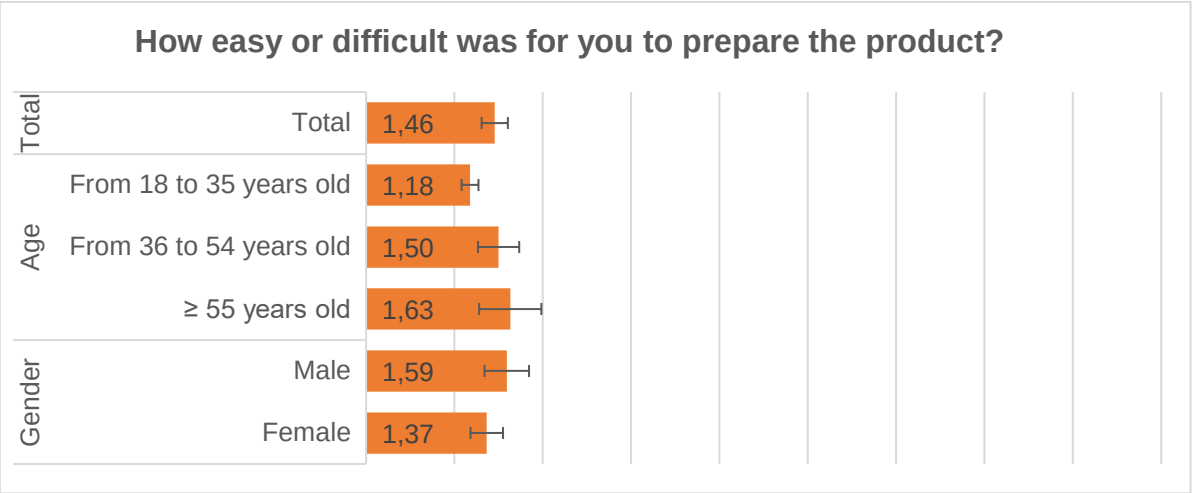

Figure 22: Consumers' evaluation of how easy or difficult the sea and mountain burger was to prepare. Evaluated from 1 "very easy" to 9 "very difficult" (mean ± SD). Data shown by age and gender (N=69).

4.2.6. Innovation

80 % of the consumers considered the sea and mountain burger as an innovative product (Figure 23).

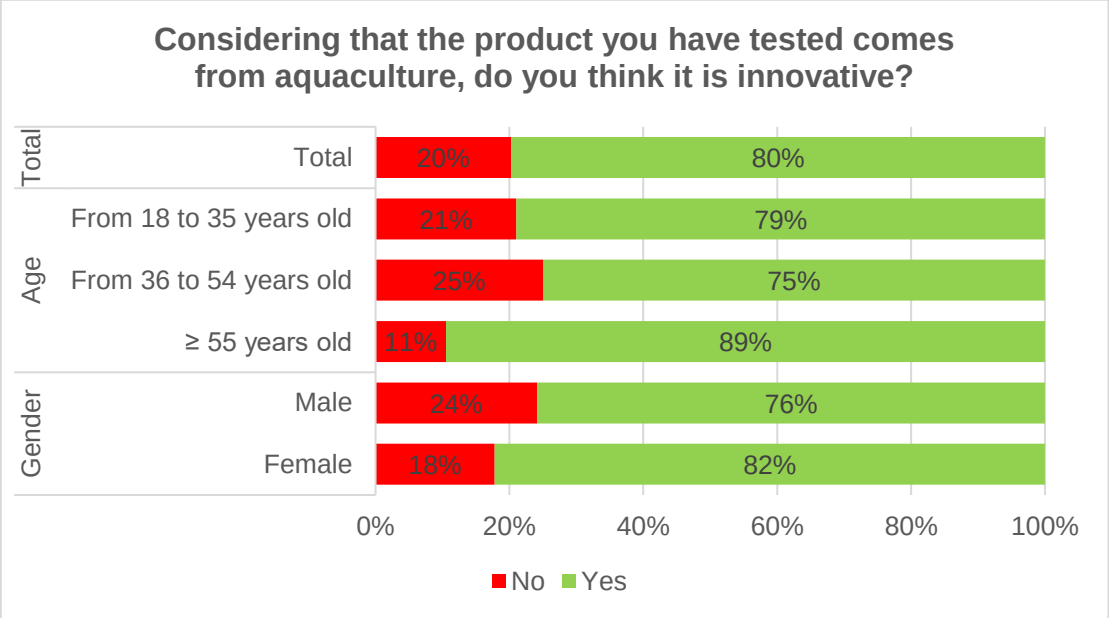

Figure 23: Percentage of consumers who considered that the sea and mountain burger was innovative. Data shown by age and gender (N=75).

4.2.7. Fish intake improvement

Consumers considered that this product would increase the daily intake of fish consumption, since 54 % had a positive consideration (sum of it would definitely increase and it would probably increase). However, just 47 % of the younger consumers considered that this product would increase their daily intake of fish consumption (Figure 24).

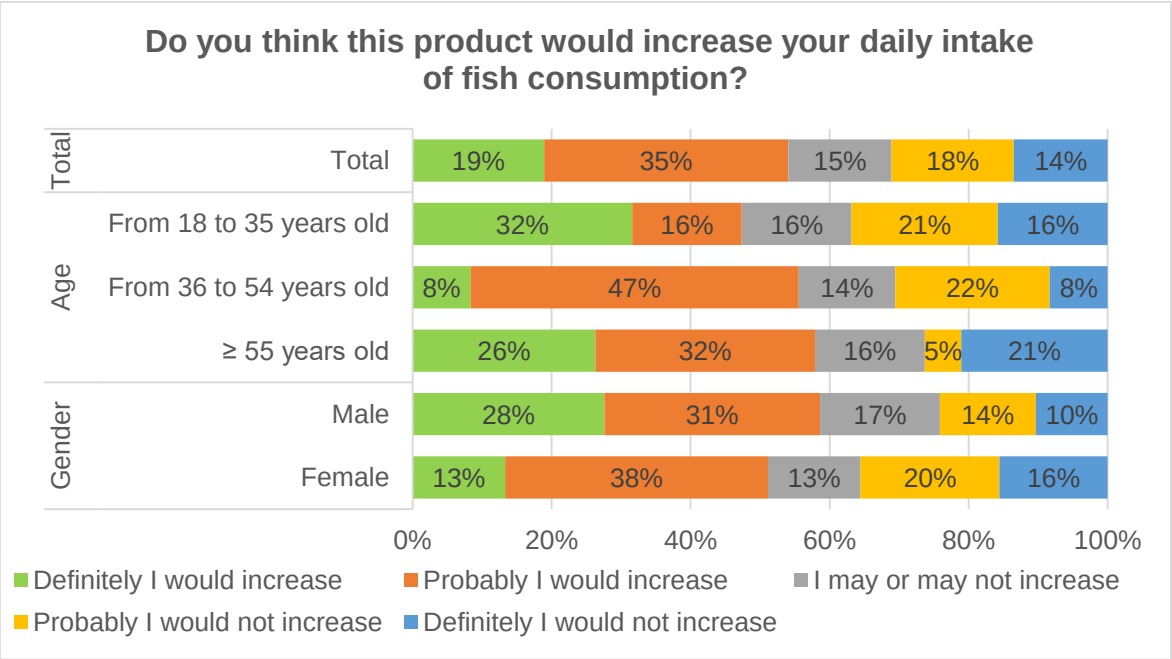

Figure 24: Percentage of consumers who considered that the sea and mountain burger would increase the daily intake of fish consumption. Data shown by age and gender (N=75).

4.2.8. Product suitable for consumption by children

92 % of the consumers considered that the sea and mountain burger would be suitable for children under 16 years old (Figure 25).

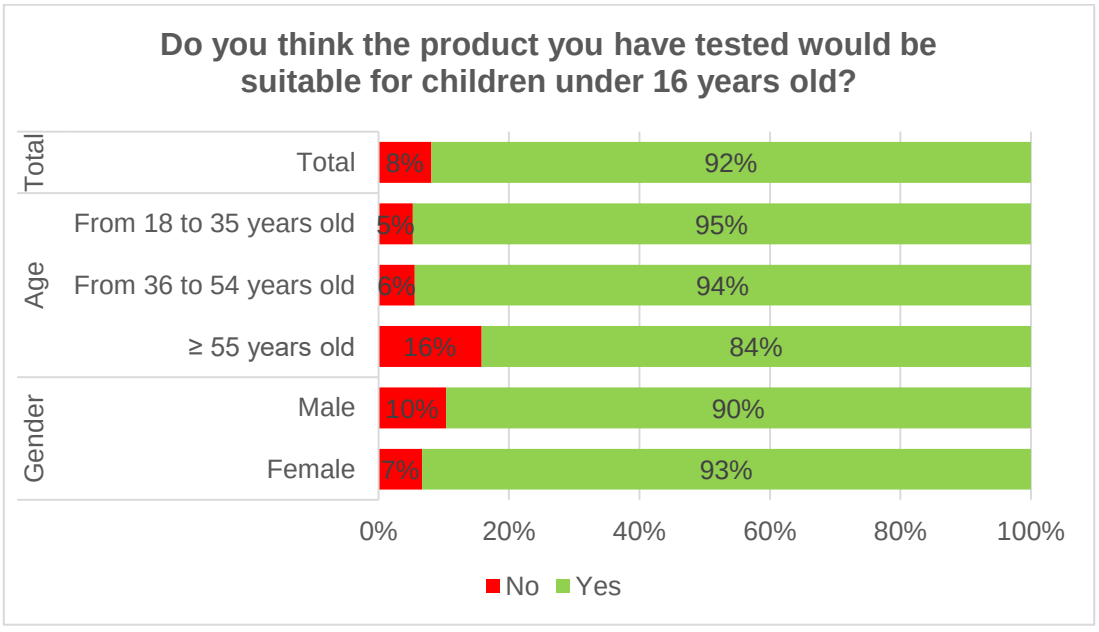

Figure 25: Percentage of consumers who considered that the sea and mountain burger would be suitable for children under 16 years old. Data shown by age and gender (N=75).

4.3. Seabream breaded bites

4.3.1. Sensorial evaluation

In general, all the sensorial attributes were evaluated positively, crunchiness, colour, appearance and general texture being the sensorial attributes better scored by consumers (higher than 7 out of 9 points), By contrast, salt level was the attribute worst scored (5.59 points out of 9). The consumers between 36 and 54 years old least liked all the sensorial attributes of this product (Figure 26).

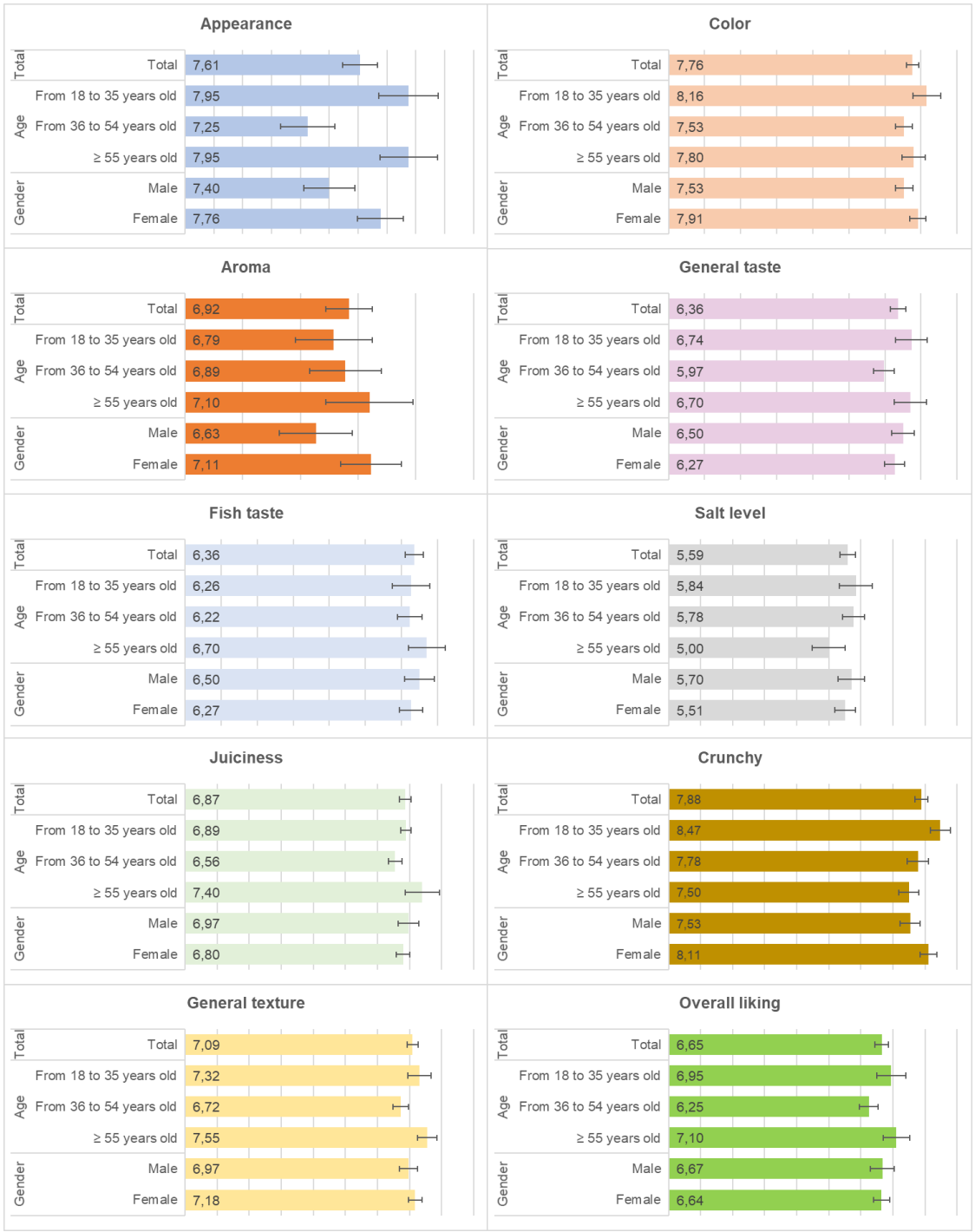

Figure 26: Consumers' liking of the sensorial attributes of seabream breaded bites. Evaluated from 1 "dislike extremely " to 9 "like extremely" (mean ± SD). Data shown by age and gender (N=75).

4.3.2. Purchase intention

The consumers showed a positive purchase intention, since 47 % affirmed that they would buy this product (sum of I would definitely buy and I would probably buy). The higher purchase intention was shown by the older consumers (55 % would buy the product), contrary to those 36 to 54 years old, 42 % of whom would buy this product (sum of I would definitely buy and I would probably buy; Figure 27). Considering gender, men showed a higher positive purchase intention than women (60 % *vs.* 38 % respectively, Figure 27).

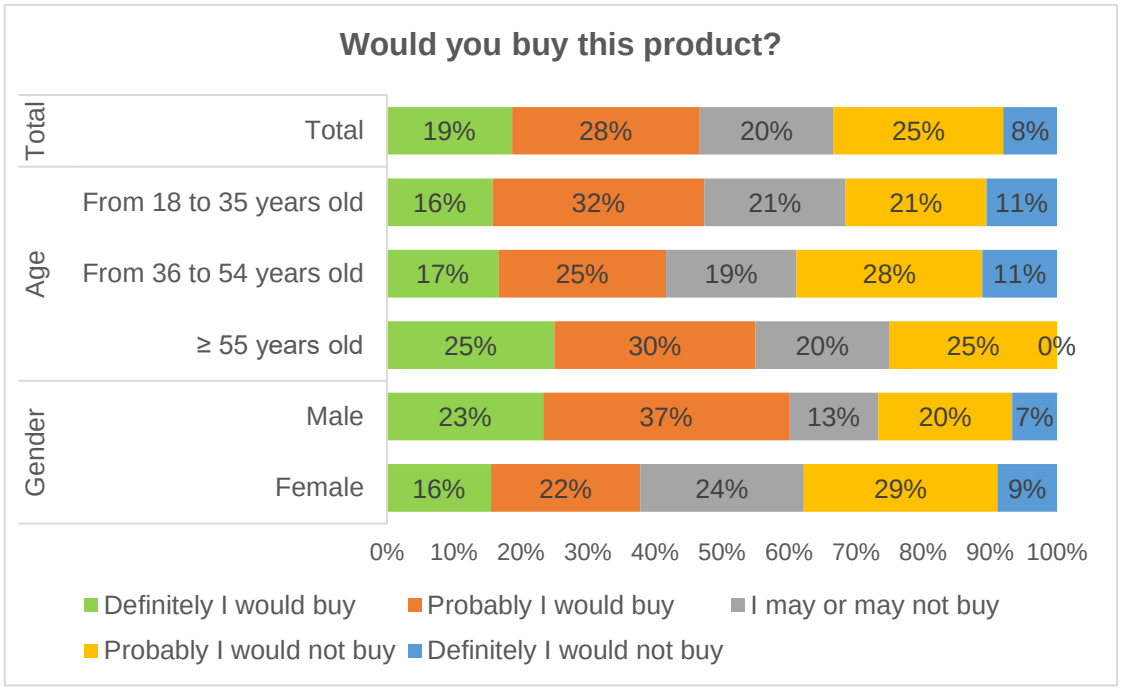

Figure 27: Percentage of the consumers' purchase intention. Data shown by age and gender (N=75).

The main reasons why 53 % of consumers would not buy this product (sum of I may or may not buy, I would probably not buy and I would definitely not buy) were because they did not like its taste (40 %), texture (18 %) or other reasons (63 %) since most consumers considered that the product was bland and the breading was too thick (Figure 28).

Figure 28: Reasons why the consumers would not buy seabream breaded bites (sum of I may or may not buy, I would probably not buy and I would definitely not buy). Data shows the percentage of each option selected. Note that it could be higher than 100 % since more than one option could be chosen (N=40).

The information shown in Figure 29 was shown to consumers, and then they were asked again if they would buy the sea and mountain burger.

NUTRI-SCORE

A B C D E

SEA BREAM BREADED BITES

This product is boneless and contains 73% aquaculture fish (sea bream) and a crispy pea coverage.

This product has a mild fish flavour and crispy texture.

Thanks to its good nutritional profile it is suitable for all ages.

Figure 29: Seabream breaded bites description given to consumers.

After knowing the product characteristics, the consumers' positive purchase intention grew up to 73 % (sum of I would definitely buy and I would probably buy), due to the percentage reduction of "I would probably not buy" in all the cases studied (total, age and gender, Figure 30).

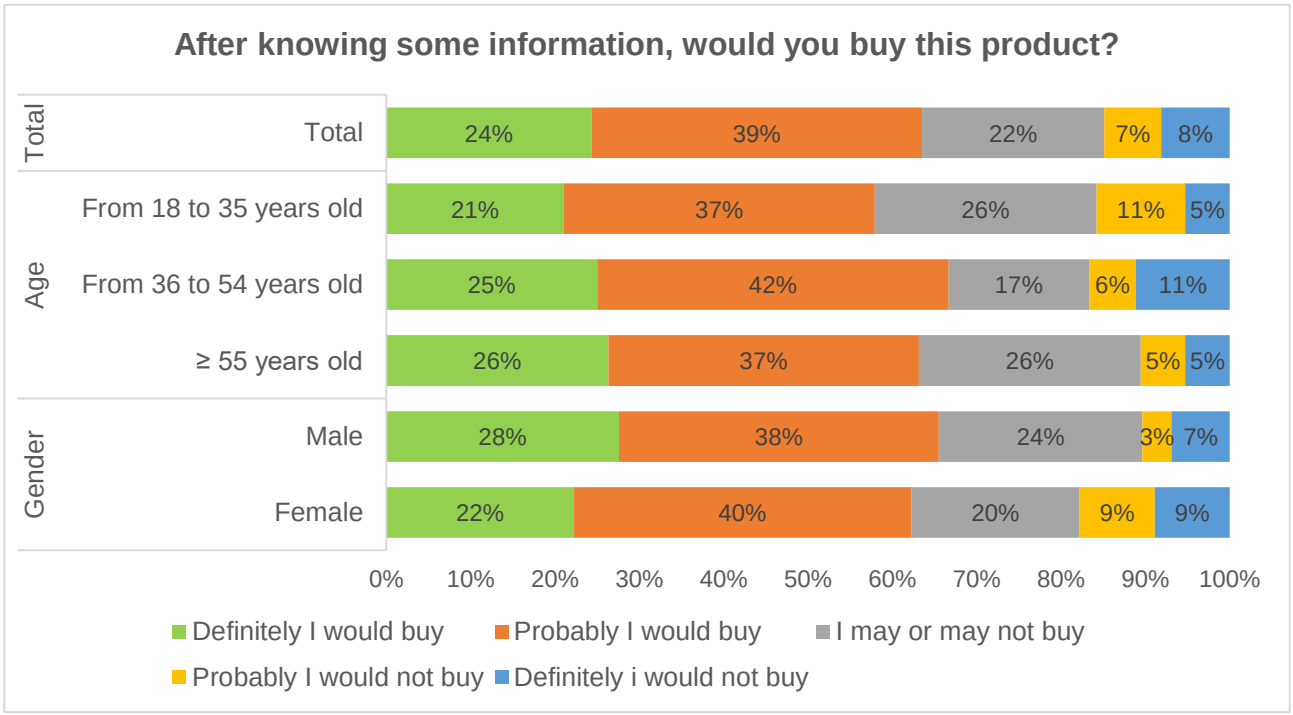

Figure 30: Percentage of the consumers' purchase intention after knowing some information about the seabream breaded bites. Data shown by age and gender (N=75).

4.3.3. Improvement

73.3 % of the consumers would change something about the product. They would increase salt content, change the taste and reduce the thickness of the breading, since they thought that the product was bland and the breading was too thick (Figure 31).

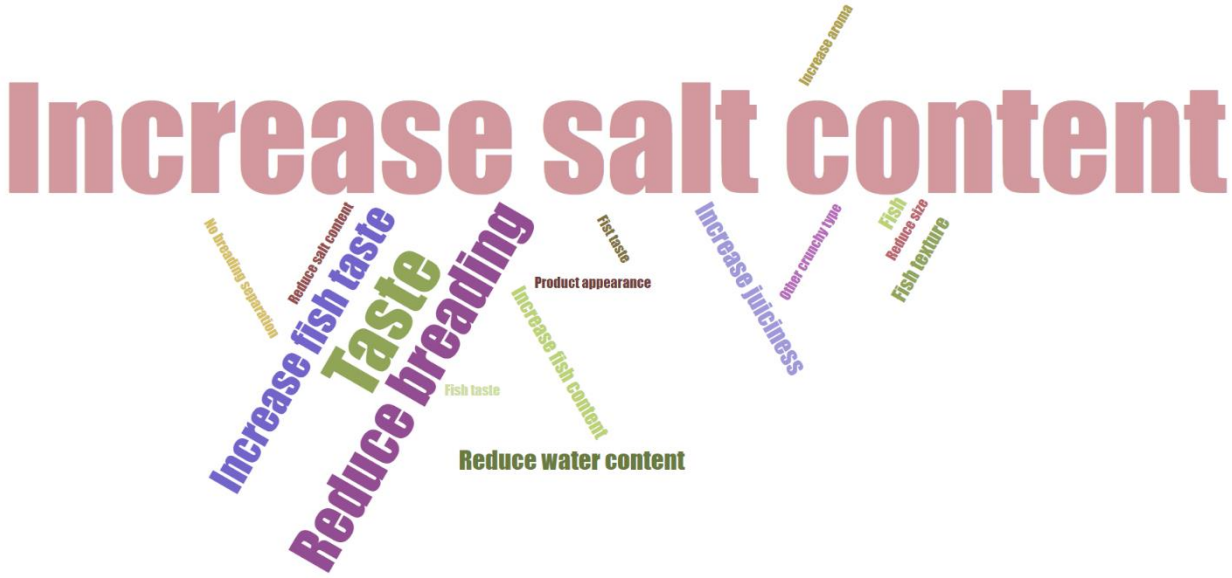

Figure 31: Word cloud generated with the consumers' improvements of seabream breaded bites. The size of the letters is proportional to the frequency of each improvement suggested by consumers (N=55).

4.3.4. Packaging

In general, the consumers liked the packaging, they scored it with 6.59 points out of 9. Consumers between 36 and 54 years old liked the packaging slightly more than the rest of the age groups (Figure 32).

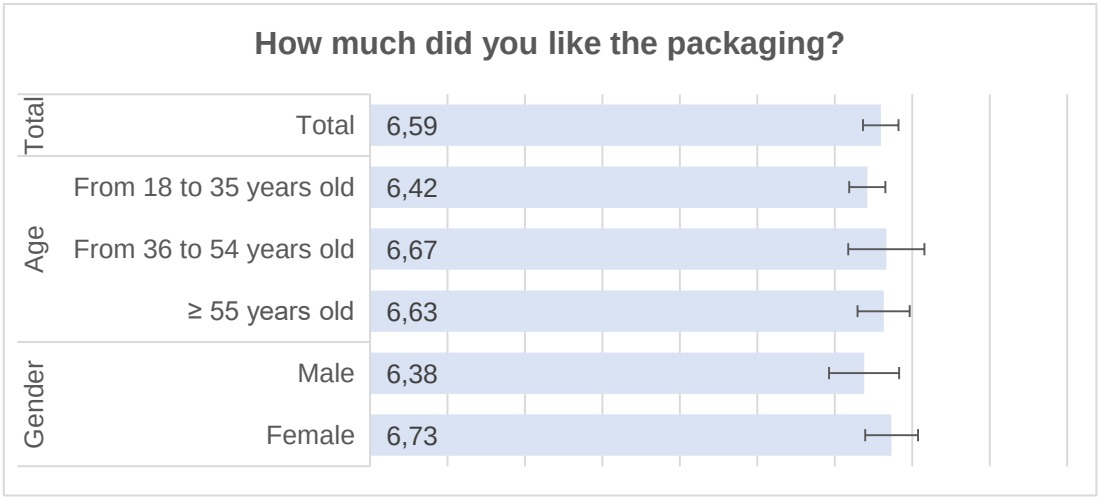

Figure 32: Consumers' evaluation of how much they liked the packaging. Evaluated from 1 "dislike extremely" to 9 "like extremely" (mean ± SD). Data shown by age and gender (N=75).

4.3.5. Product preparation

The consumers thought that seabream breaded bites were very easy to prepare (2.25 points out of 9). The older consumers found this product more difficult to prepare (Figure 33).

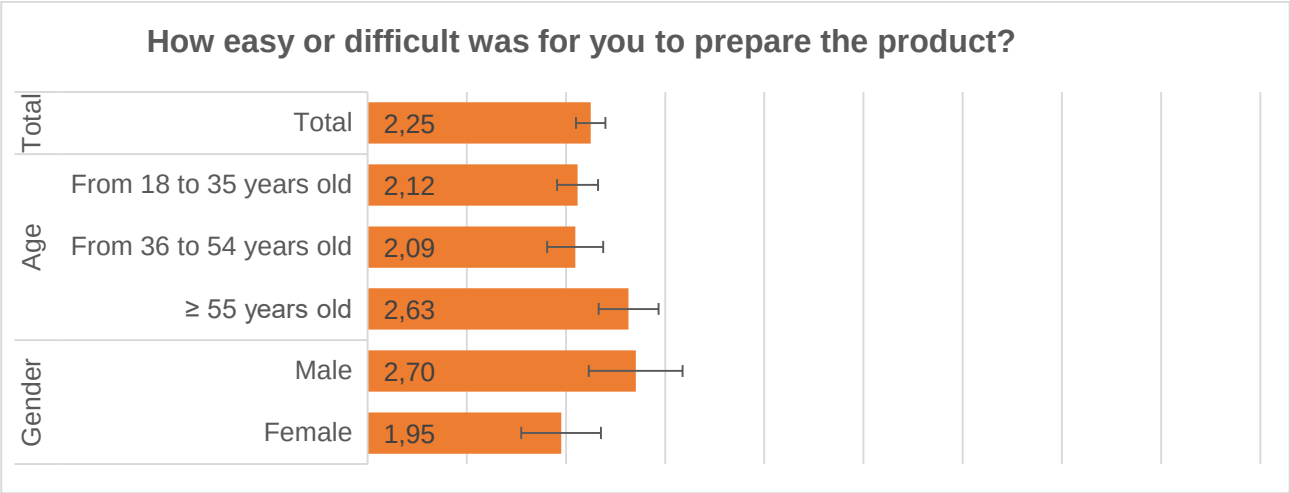

Figure 33: Consumers' evaluation of how easy or difficult it was to prepare seabream breaded bites. Evaluated from 1 "very easy" to 9 "very difficult" (mean ± SD). Data shown by age and gender (N=69).

4.3.6. Innovation

Only 38 % of the consumers considered seabream breaded bites as an innovative product (Figure 34).

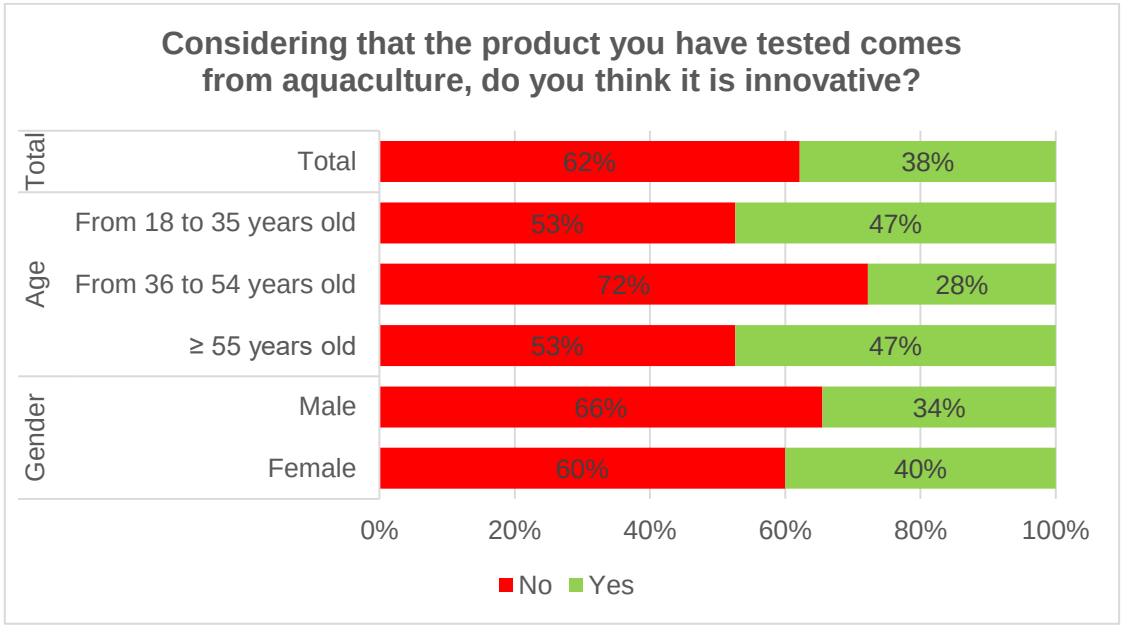

Figure 34: Percentage of consumers who considered that the seabream breaded bites wee innovative. Data shown by age and gender (N=75).

4.3.7. Fish intake improvement

32 % of consumers considered that this product would not increase their daily intake of fish consumption (sum of definitely and probably it would not increase). In all cases, the percentage of consumers who thought that the seabream breaded bites would not increase their daily intake of fish consumption was higher than the percentage of consumers who thought that it would increase it (sum of definitely and probably it would increase). However, the percentage of consumers who chose the option may or may not increase consumption ranged between 17 % and 42 % from consumers from 36 to 54 years old and from 18 to 35 years old respectively (Figure 35).

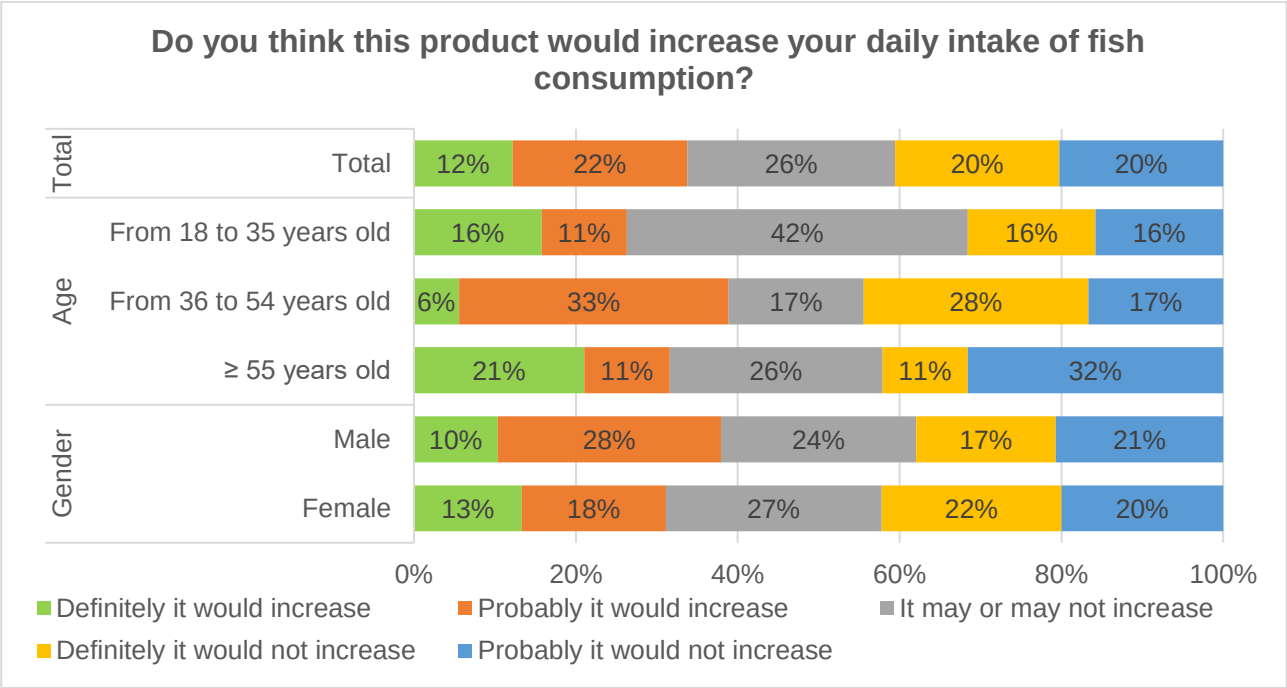

Figure 35: Percentage of consumers who considered that seabream breaded bites would increase the daily intake of fish consumption. Data shown by age and gender (N=75).

4.3.8. Product suitable for children consumption

95 % of the consumers considered that seabream breaded bites would be suitable for children under 16 years old (Figure 36).

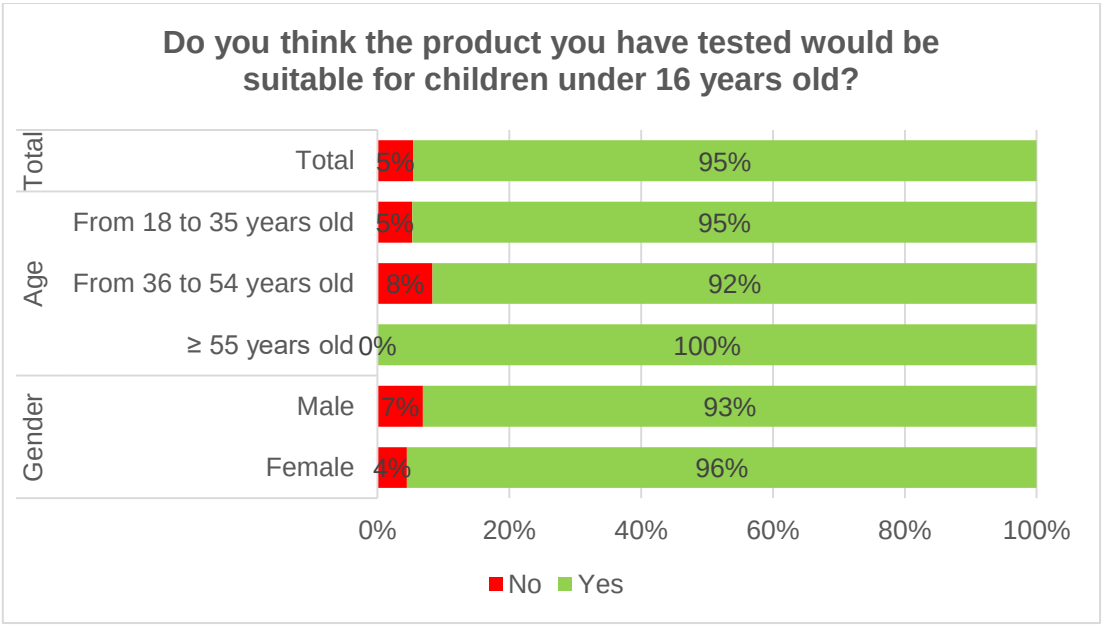

Figure 36: Percentage of consumers who considered that seabream breaded bites would be suitable for children under 16 years old. Data shown by age and gender (N=75).

4.4. Organic seabream with couscous

4.4.1. Sensorial evaluation

In general, all the sensorial attributes were evaluated positively, appearance and fish taste being the sensorial attributes better scored by consumers (6.67 and 6.43 out of 9 points respectively). By contrast, salt level and juiciness were the attributes with the worst scores (5.35 and 5.56 out of 9 points respectively). The older consumers most liked all the sensorial attributes of this product (Figure 37).

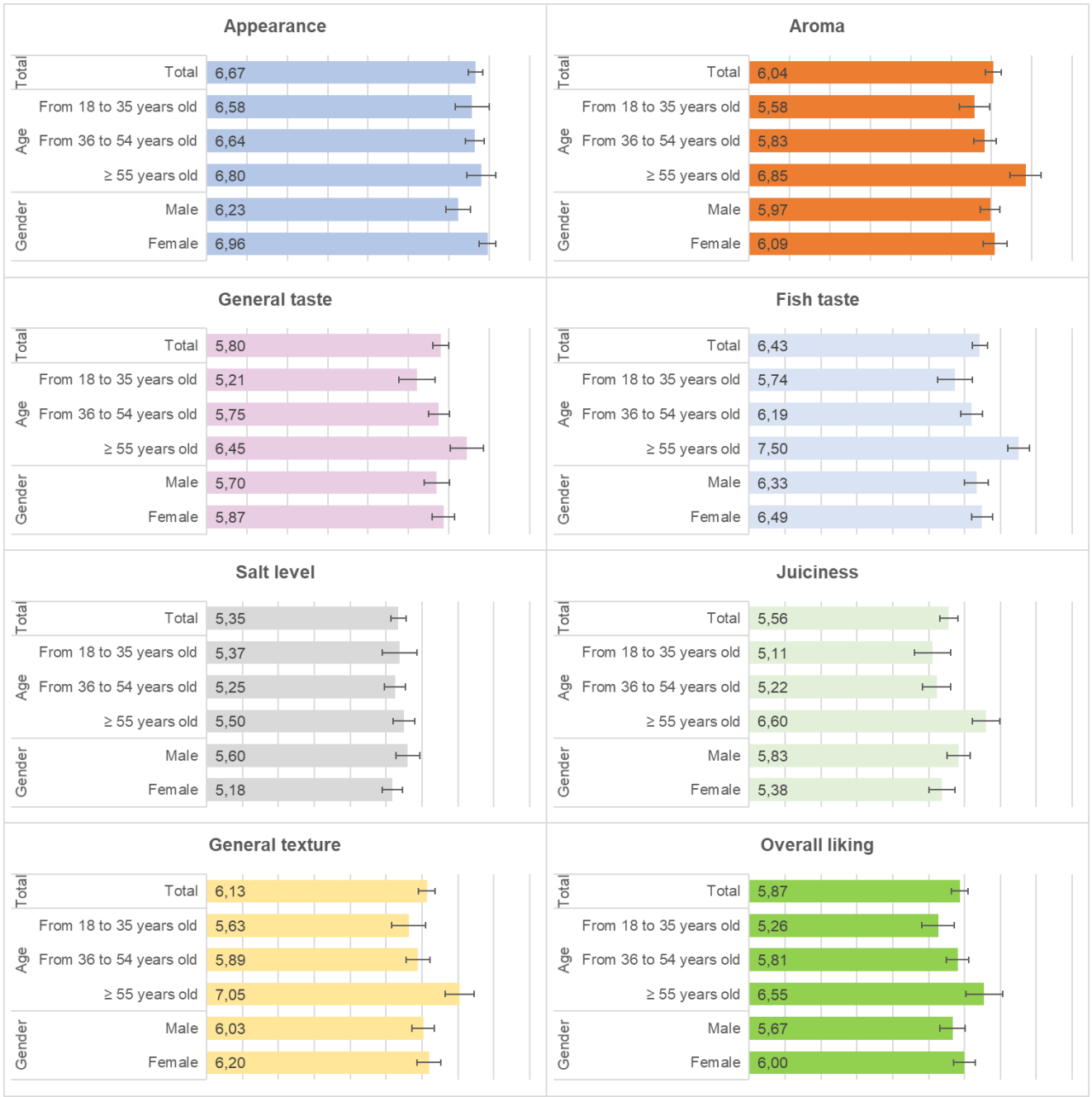

Figure 37: Consumers' liking of the sensorial attributes of organic seabream with couscous. Evaluated from 1 "dislike extremely " to 9 "like extremely" (mean ± SD). Data shown by age and gender (N=75).

4.4.2. Purchase intention

For this product, the positive purchase intention (sum of I would definitely and I would probably buy) is lower than the negative purchase intention (sum of probably and definitely I would not buy), since 32 % of the consumers showed a positive purchase intention *versus* 47 % of consumers who would not buy this product.

The higher purchase intention was shown by the older consumers (45 % would buy the product), contrary to the youngest ones, since just 10 % would buy this product (sum of I would definitely and I would probably buy; Figure 38).

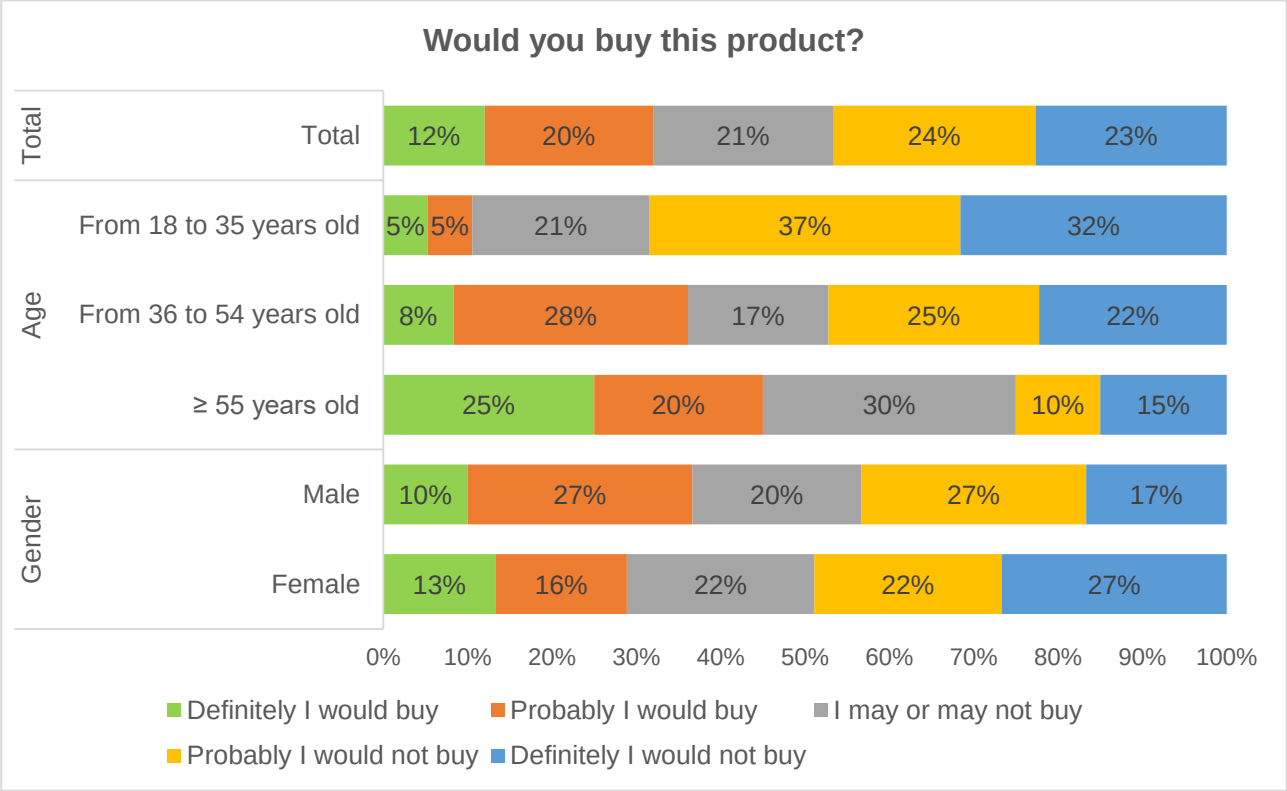

Figure 38: Percentage of the consumers' purchase intention. Data shown by age and gender (N=75).

The main reasons why 68 % of the consumers would not buy this product (sum of I may or may not buy, I would definitely and I would probably not buy) were because they did not like its taste (59 %), texture (45 %) or other reasons (59 %) since most of the consumers considered that the fish was dry (Figure 39).

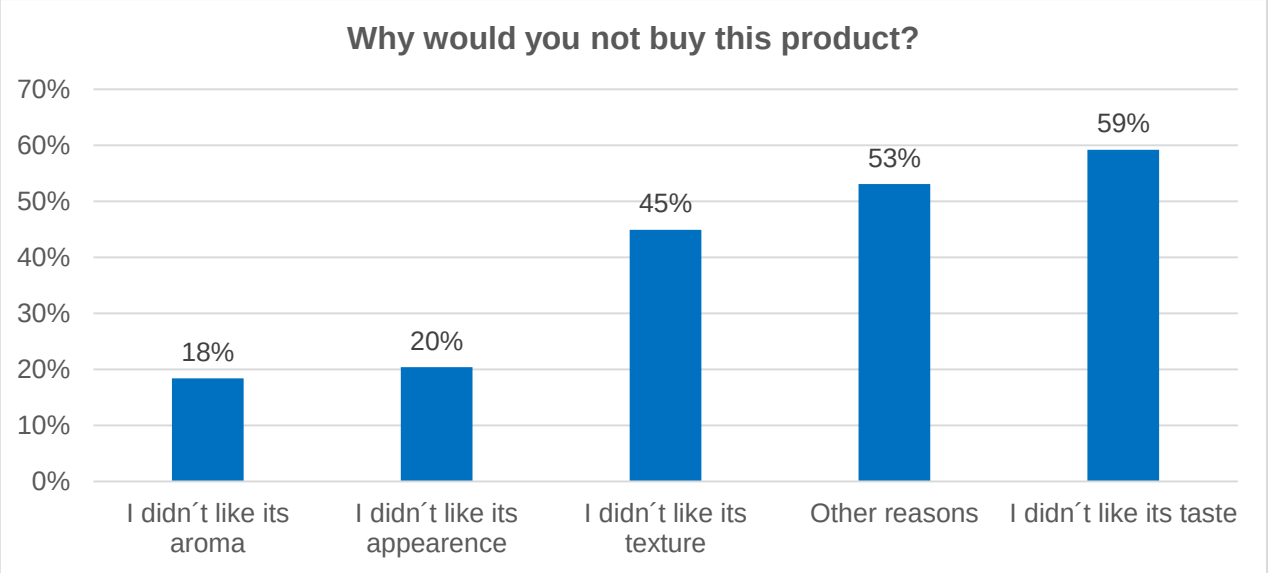

Figure 39: Reasons why the consumers would not buy organic seabream with couscous (sum of I may or may not buy, I would probably and I would definitely not buy). Data shows the percentage of each option selected. Note that it could be higher than 100 % since more than one option could be chosen (N=51).

A brief description of the product was given to consumers (Figure 40). Then, consumers were asked again if they would buy the organic seabream with couscous.

BAKING ORGANIC SEA BREAM WITH COUSCOUS

Boneless sea bream fillet with low-salt couscous garnish, ready to eat. The fish comes from aquaculture.

Ready-to-eat product prepared in the oven or microwave in its own packaging.

Microwaveable, bakeable and 100% recycled packaging.

Thanks to its good nutritional profile it is suitable for all ages. Ethnic recipe.

Figure 40: Organic seabream with couscous description given to consumers.

After knowing the product characteristics, the consumers' positive purchase intention grew up to 50 % (sum of I would definitely and I would probably buy), the positive purchase intention being higher than the negative one (sum of definitely and probably I would not buy). Due to the percentage reduction of definitely and probably would not buy the product in all the cases studied (total, age and gender, Figure 41).

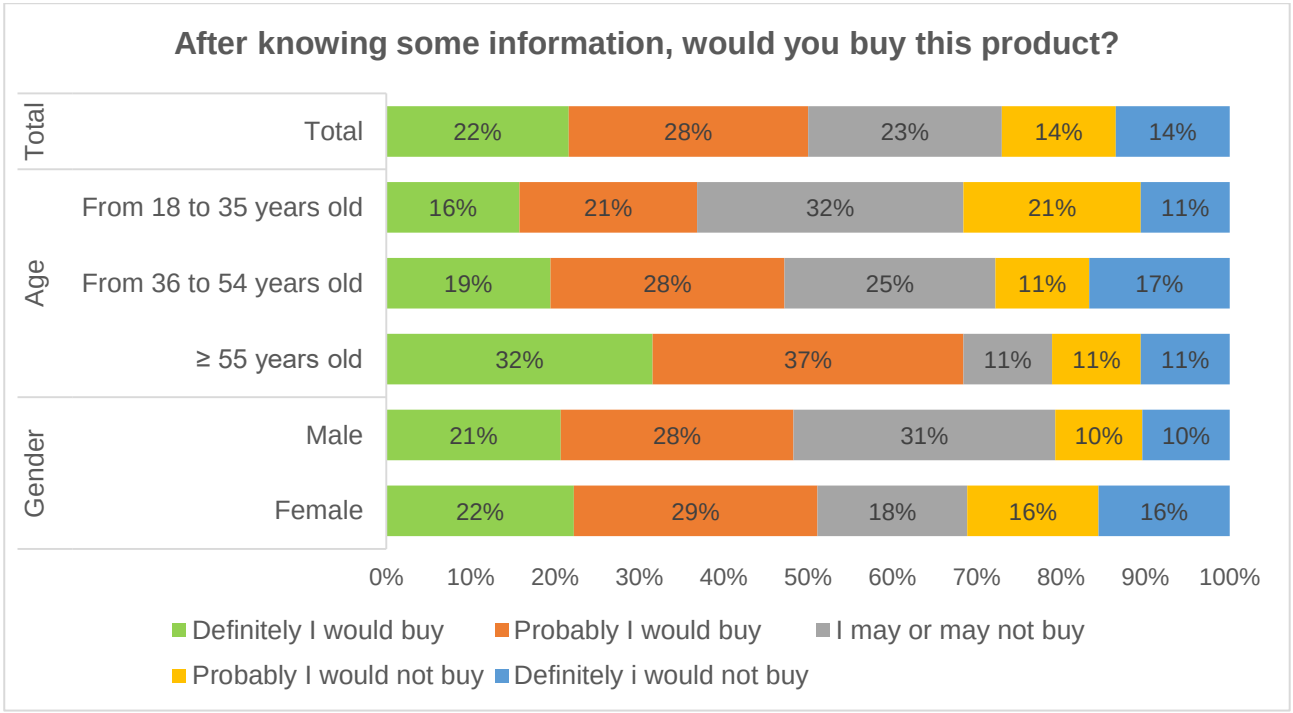

Figure 41: Percentage of the consumers' purchase intention after knowing some information about organic seabream with couscous. Data shown by age and gender (N=75).

4.4.3. Improvement

77.3 % of the consumers would change something about the product. Most of them would change the fish texture, through increasing juiciness and reducing fish dryness) or they would change the side dish (couscous) and increase salt content (Figure 42).

Figure 42: Word cloud generated with the consumers' improvements of organic seabream with couscous. The size of the letters is proportional to the frequency of each improvement suggested by consumers (N=58).

4.4.4. Couscous

The consumers liked the couscous (5.41 out of 9 points). However, the consumers between 18 to 35 years old did not like it (Figure 43).

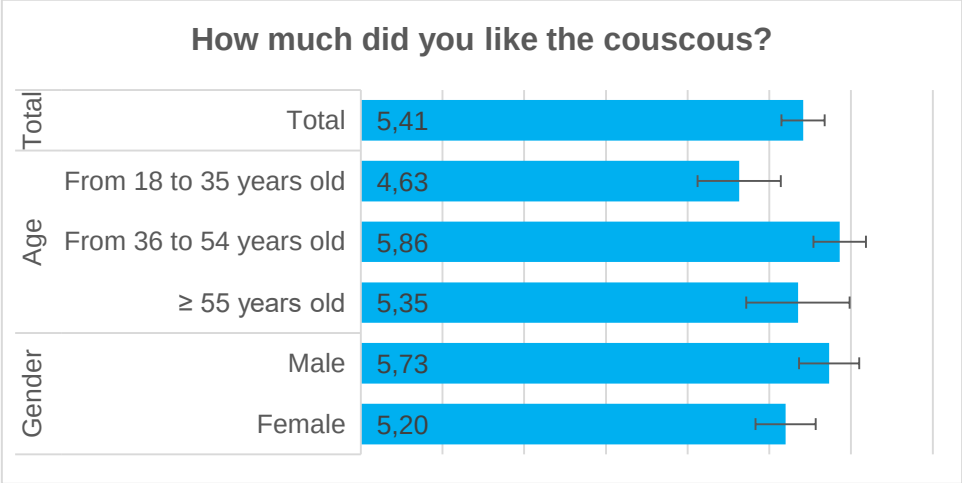

Figure 43: Consumers' liking of couscous. Evaluated from 1 "dislike extremely " to 9 "like extremely" (mean ± SD). Data showed by age and gender (N=75).

The consumers were asked if they thought the couscous was a good accompaniment for this dish and 62.7 % answered positively. They were asked if they could suggest an alternative side dish for the seabream and they proposed an alternative for couscous. The alternatives most suggested were vegetables, grilled vegetables and potatoes (Figure 44).

Figure 44: Word cloud generated with the consumers' alternative of couscous as a side dish for the organic seabream. The size of the letters is proportional to the frequency of each idea suggested by consumers (N=42).

4.4.5. Packaging

In general, the consumers liked the packaging, they scored it with 6.89 points out of 9. The older consumers preferred the packaging compared with the rest of the age groups (Figure 45).

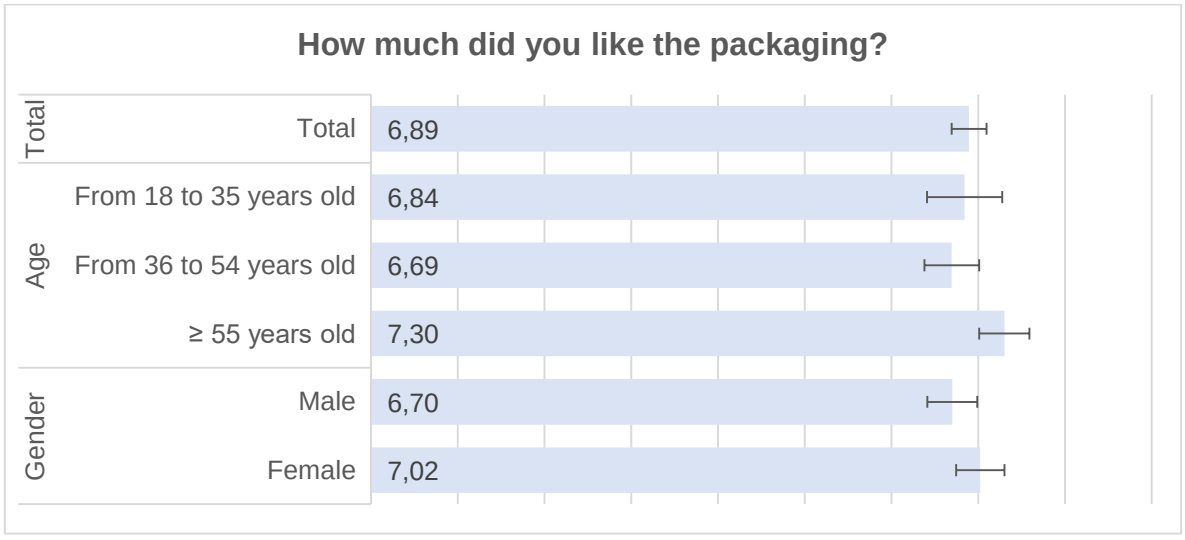

Figure 45: Consumers' evaluation of how much they liked the packaging. Evaluated from 1 "dislike extremely" to 9 "like extremely" (mean ± SD). Data shown by age and gender (N=75).

4.4.6. Product preparation

The consumers thought that organic seabream with couscous was very easy to prepare (1.32 points out of 9). The older consumers found this product slightly more difficult to prepare compared with the rest of the age group studied (Figure 46).

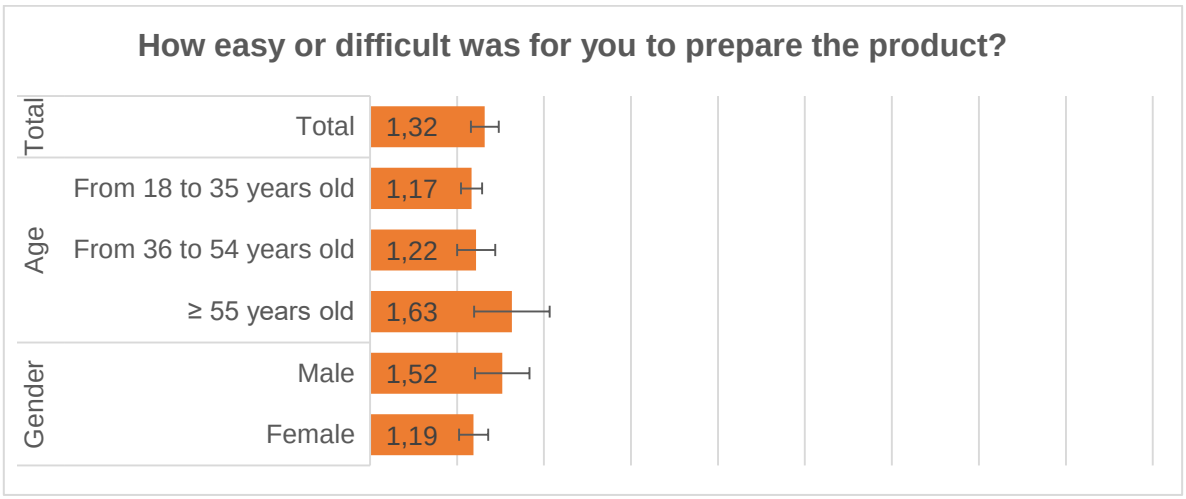

Figure 46: Consumers' evaluation of how easy or difficult it was to prepare organic seabream with couscous. Evaluated from 1 "very easy" to 9 "very difficult" (mean ± SD). Data shown by age and gender (N=69).

4.4.7. Innovation

Only 43 % of the consumers considered organic seabream with couscous as an innovative product (Figure 47).

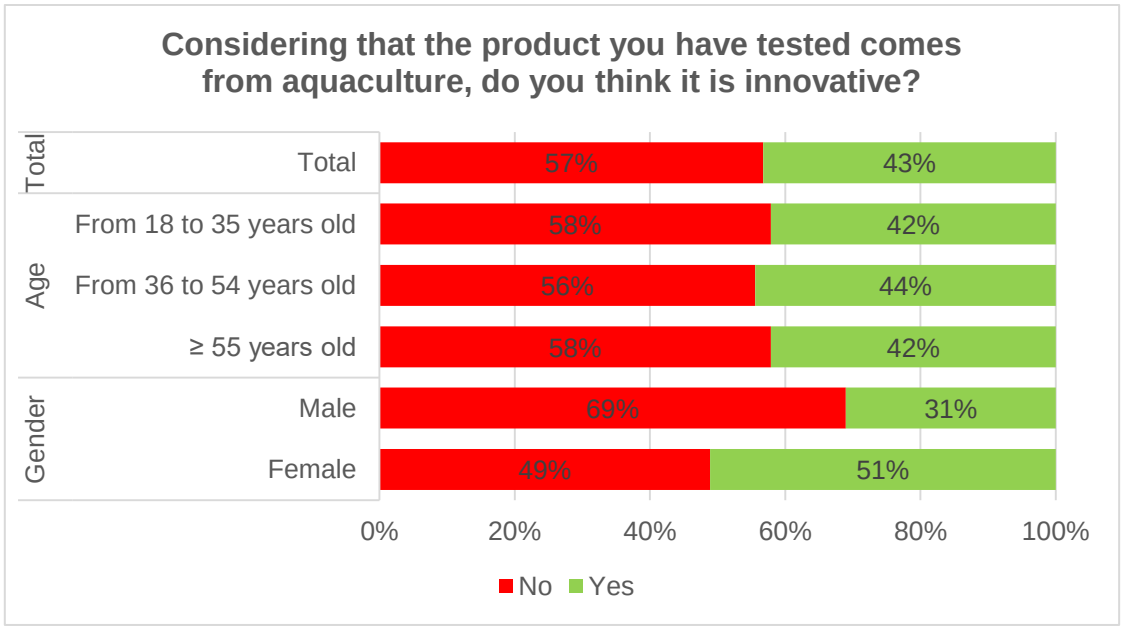

Figure 47: Percentage of consumers who considered that organic seabream with couscous was innovative. Data shownd by age and gender (N=75).

4.4.8. Fish intake improvement

The consumers were divided since 38 % of consumers considered that this product would not increase the daily intake of fish consumption (sum of it would definitely and it would probably not increase) *versus* 41 % that considered that it would not increase the fish intake (sum of it would definitely and it would probably increase) based mainly on the opinions of the younger consumers, since 47 % thought that this product would definitely not increase their fish intake (53 %; Figure 48).

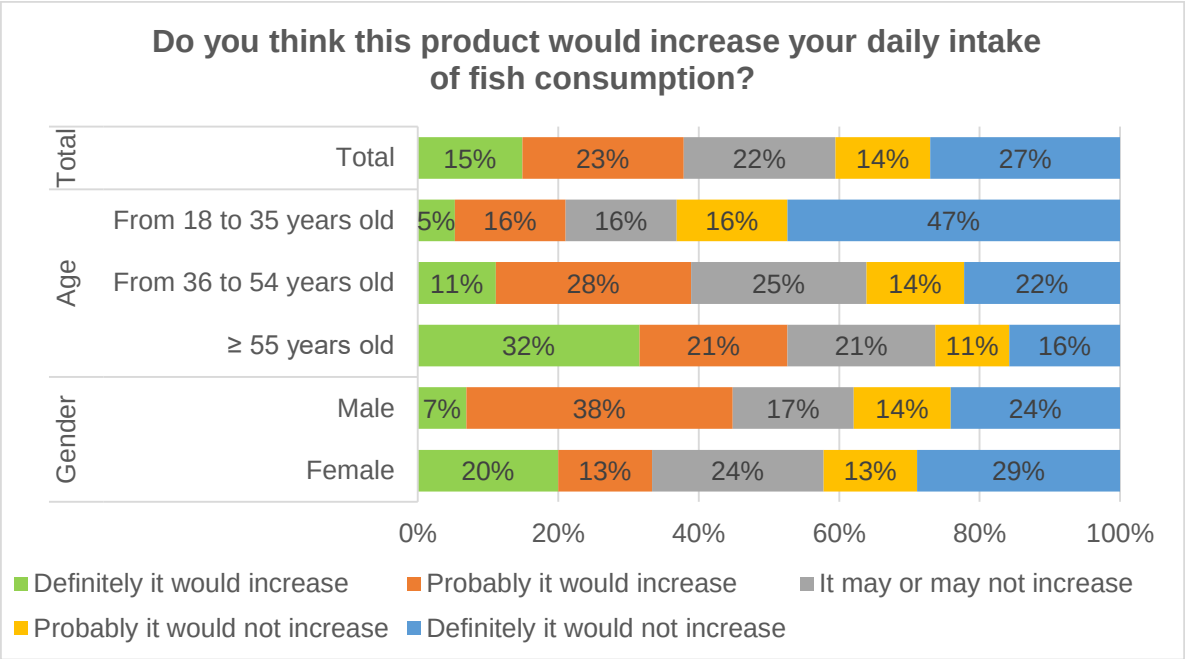

Figure 48: Percentage of consumers who considered that organic seabream with couscous would increase the daily intake of fish consumption. Data shown by age and gender (N=75).

4.4.9. Product suitable for children consumption

59 % of the consumers considered that organic seabream with couscous would be suitable for children under 16 years old (Figure 49).

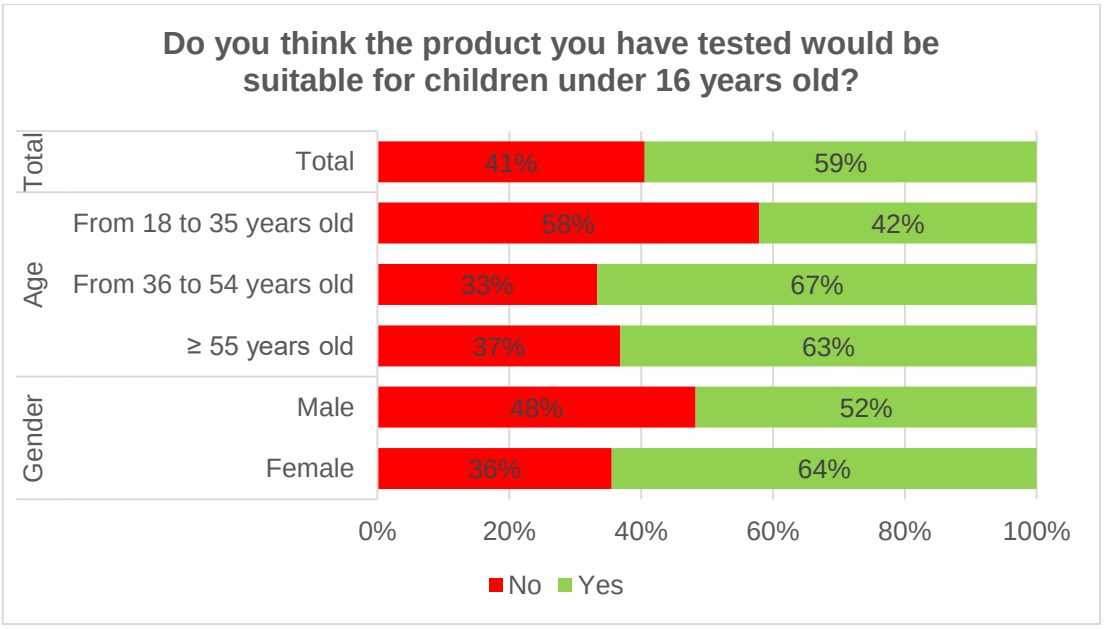

Figure 49: Percentage of consumers who considered that organic seabream with couscous would be suitable for children under 16 years old. Data shown by age and gender (N=75).

4.5. Preference order

Consumers were asked to order the four tasted products from the most to the least preferred. The grilled seabass with lemon was the most preferred in all the cases studied (total, age and gender). The least preferred was the organic seabream with couscous (Figure 50).

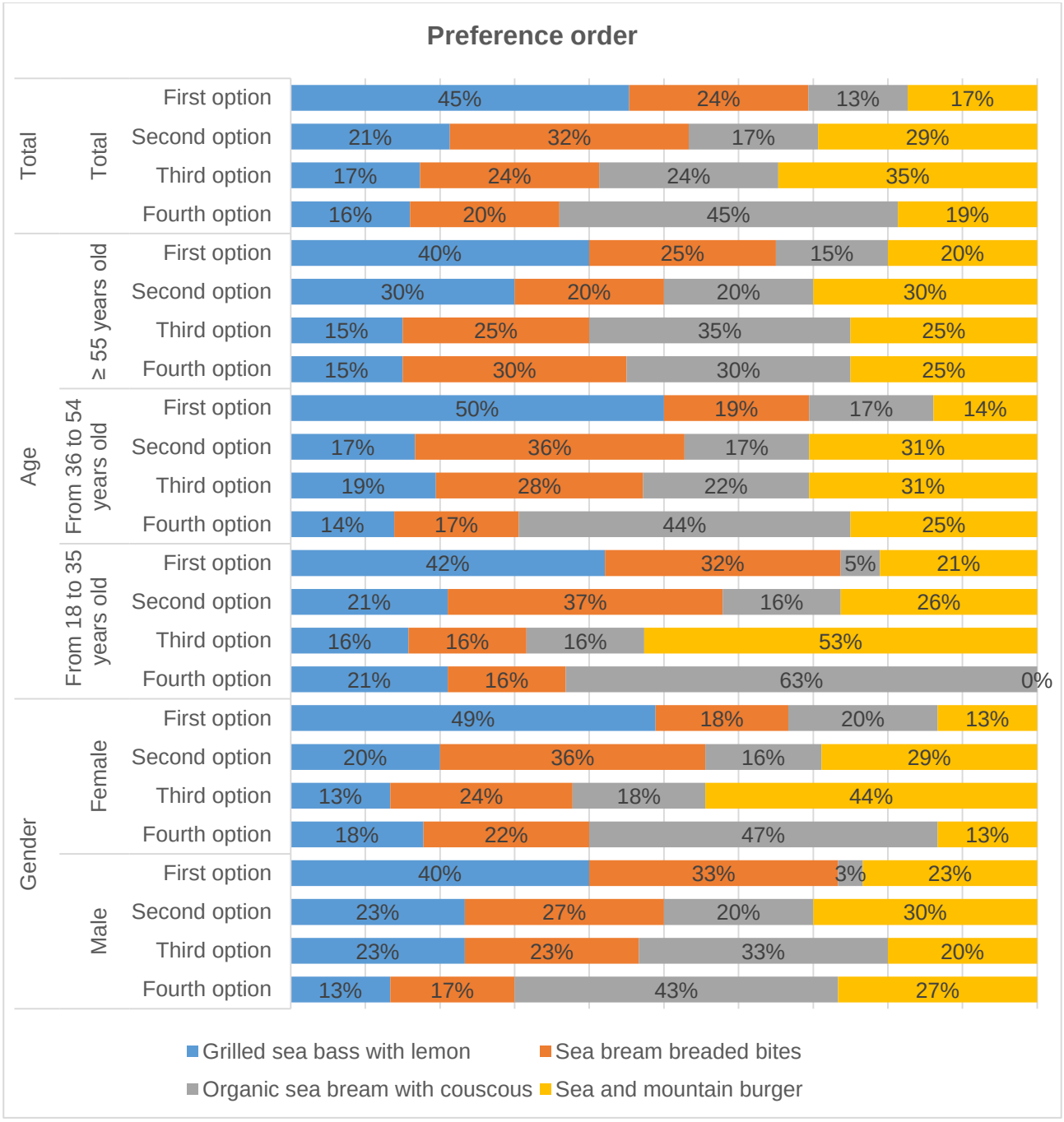

Figure 50: Percentage of consumers who chose each product as first, second, third and fourth option (from the most to the least preferred). Data shown by age and gender (N=75).

4.6. Taste at home experience

Consumers were asked about their experience of developing the taste at home and they liked this experience very much (7.86 out of 9 points). Slight differences were found between age and gender. The consumers from 36 to 54 years old and the female consumers most liked the experience (Figure 51). Moreso, when the consumers were asked if they would repeat the experience all of them would repeat it.

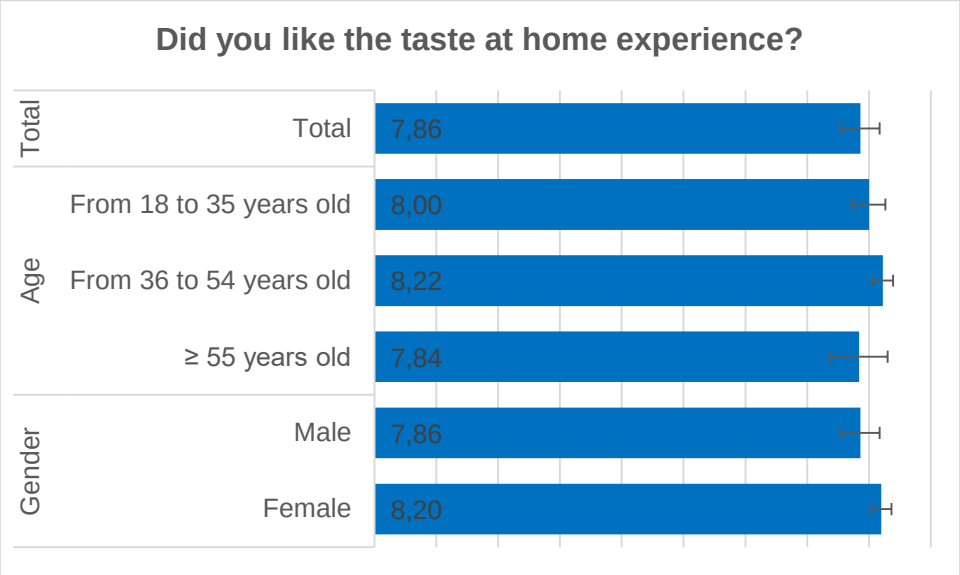

Figure 51: Consumers' liking of the taste at home experience. Evaluated from 1 "dislike extremely " to 9 "like extremely" (mean ± SD). Data shown by age and gender (N=75).

Most of the consumers thought that the taste at home experience was fun and convenient (Figure 52).

Figure 52: Word cloud generated with the consumers' comments about the taste at home experience. The size of the letters is proportional to the frequency of consumers' opinion (N=31).

5. Conclusions

- In general, **all the products have been well accepted by consumers**. Slight differences have been found between the acceptability of the sensorial attributes by the groups studied (gender and age groups). In general, the older consumers best scored all the sensorial attributes.
- The **consumers** have a positive **purchase intention** (sum of I would definitely and I would probably buy) higher than negative purchase intention (sum of definitely and probably would not buy) for all the products, except for the organic seabass with couscous. The positive purchase intention ranked from 68 % for grilled seabass with lemon to 32 % for organic seabream with couscous, and the negative purchase intention ranked from 23 % from grilled seabass with lemon to 47 % for organic seabass with couscous. Slight differences have been found between the studied groups (gender and age groups). In general, the older consumers showed the highest purchase intention for all the products studied. The highest purchase intention was shown for the grilled seabass with lemon and the lowest for the organic seabass with couscous (68 % and 32 % respectively). The reasons why the consumers did not have a positive purchase intention is linked to its sensorial characteristics. It is noteworthy that when a brief product description information is given to consumers, its purchase intention is higher for all the products, being in all the cases higher than 50 %.
- **More than 63 % of consumers would like to change something about the tasted products**. They would like to improve the texture, packaging and consistency of grilled seabass with lemon; increase the salt content and size of the sea and mountain burger; increase salt content, change the taste and reduce the thickness of the seabass breaded bites and finally, increase juiciness and reduce fish dryness, and change the side dish and increase salt content of the seabass with couscous. The alternatives suggested by consumers for the couscous were vegetables, grilled vegetables and potatoes.
- In general, **the packaging of the products was well accepted**. The most attractive packaging for consumer was the organic seabass with lemon and the least attractive the grilled seabass with lemon (6.89 and 5.80 out of 9 points respectively).
- **All the products were considered as easy to prepare,** the organic sea bass with couscous being the easiest to prepare, contrary to the grilled seabass with lemon, since some consumers found it quite difficult to slice the pieces and cook them without breaking them.
- The consumers considered the **grilled seabass with lemon and the sea and mountain burger** as **the most innovative products** (95 % and 80 % of the consumers thought that they were innovative products, respectively). By contrast, **the organic seabass with couscous and the seabass breaded bites** were considered **the least innovative products**, since just 43 % and 38 % of the consumers, respectively, thought that they were innovative products.
- The products considered more suitable for children were the seabass breaded bites, sea and mountain burger and grilled seabass with lemon (95 %, 92 % and 85 % respectively), contrary to the organic seabass with couscous that was considered suitable for children by 59 % of the participants.
- 60 % of the consumers thought that the grilled seabass with lemon would increase their **daily intake of fish consumption**, following by the sea and mountain burger (54 %), organic seabass with lemon (38 %) and in the last position, the seabass breaded bites (32 %).
- The **grilled seabass with lemon was the product most preferred by consumers**. By contrast, **the least** preferred product was the **organic seabream with couscous**.
- **The consumers liked very much the taste at home experience.**

Innovative aquaculture product validation in France and Germany

Author/s: García Muñoz, S., Llorente, R., Peral, I. (AZTI).

Table of contents

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1. Introduction

WP5 (Product development, market and consumer assessment) explored and validated the technical and market feasibility of different product alternatives from specific Mediterranean aquaculture fish species for commercial exploitation, analysing the potential of different market opportunities, and taking into account socioeconomic aspects and consumer requirements.

For this purpose, Mediterranean aquaculture seafood products were developed in AZTI facilities (Spain) considering the consumers´ needs and ideas generated in Task 5 (see Task 5.1, Task 5.2 and Task 5.3).

According to the objective specified in Task 5.3 "Technical development of the new fish products", eight (8) new food products from Mediterranean aquaculture species were designed, formulated and developed at pilot-scale in AZTI's facilities (Spain). Considering the consumers' needs and expectations, a selection of four products were included in the pilot testing with consumers.

2. Objective

In WP5, the main objective of Task 5.4 "Market validation" was to know the consumers´ acceptability of the products developed in Task 5.3. This document will be focused on the results of French and German consumers´ acceptability.

3. Material and methods

3.1. Consumer segmentation and framework definition

Consumer perception studies were finally made in two countries (France and Germany), enrolling 500 participants per country, 1000 consumers in total (Figure 1). During the project proposal, 3 countries were considered to develop the tasting sessions i.e., Spain, France and Germany. However, due to the Covid-19 outbreak, the tasting sessions were developed only in Spain. The working team looked for alternatives for the tasting sessions initially planned in France and Germany and considering the situation, the best alternative was to develop online surveys regarding product acceptability in France and Germany.

Consumers were selected considering the following requirements:

1) Men and woman from 18 to 75 years old
2) Men and women responsible for home shopping (food products) or cooking or at least co-responsible for home shopping or cooking
3) Fish consumption frequency at least once a month

Figure 1: Countries where the consumers were selected.

Segmentation variables were age, gender (to assure 50 % women), level of education, kind of work, place of residence (town, countryside), family configuration, household size, attitude to these products' consumption and family income.

The number of participants in each area per each country is shown in Table 1 (France) and Table 2 (Germany).

Table 1: Number of participants for each geographical area of France (Total 500 participants)

France	Number of participants
Paris Basin	85
Centre-East	60
East	45
Mediterranean	60
North - Pas-De-Calais	30
West	70
South-West	55
Île De France	95
Total	**500**

Table 2: Number of participants for each geographical area of Germany (Total 500 participants).

Germany	Number of participants
Baden-Württemberg	65
Bavaria	75
Berlin	20
Brandenburg	15
Hessen - Thuringia	50
Mecklenburg-Vorpommern	10
Lower Saxony - Bremen	55
North Rhine-Westphalia	110
Rheinland-Pfalz-Saarland	30
Saxony - Saxony-Anhalt	40
Schleswig-Holstein - Hamburg	30
Total	**500**

The sampling error for each country was ± 4.4 % for global data and for a 95 % confidence level in the most unfavourable case of p=q=0.5.

3.2. Products selected for consumers´ acceptability

Four out of eight new food products from Mediterranean aquaculture species designed, formulated, and developed at pilot-scale in AZTI's facilities (Spain) were selected for consumers' acceptability (Figure 2), these products were the same as those tasted in Spain:

1) Grilled seabass with lemon.
2) Sea and mountain burger.
3) Gilthead seabream breaded bites (hereafter seabream breaded bites).
4) Organic gilthead seabream with couscous (hereafter organic seabream with couscous).

Figure 2: Products selected for consumers´ sensory evaluation.

3.3. Questionnaire design and data collection

3.3.1. Questionnaire

Considering the objective of the task, a questionnaire was designed by AZTI. This consisted of 35 questions grouped in the following sections: screening criteria, habits and preferences, behaviour, consumption drivers/motives of purchase, product acceptability, segmentation constructs and socio-demographic data. As foreseen in the proposal, online programming, consumer databases and hosting of the questionnaire was subcontracted by AZTI. Following H2020 rules, the contract was awarded on a "best value for money basis". Four offers were collected, selecting the proposal from “We are Testers” as the best valued based on 4 criteria: price (41 % of the score), technical adjusting (35 %), delivery time (10 %) and method of payment (5 %).

Diversity dimensions (diversity analysis in research/innovation) and mainstreaming (equality) were both integral to the project and the partners, following EC Horizon2020 policy. Consumer recruitment followed 2 basic principles: (1) engage people broadly without discrimination at any level (gender, age, ethnic, national or social origin, religion or belief, sexual orientation, language, disability, political opinion, social or economic condition) and (2) ensure gender equality.

3.3.2. Product acceptability

The samples selected for evaluation were presented to the consumers in random order according to a different and balanced design.

Each product acceptability was evaluated online. Consumers were asked to imagine that they were in a supermarket environment buying fish/fish products. Considering that they could see a photograph of the product packaging and the product itself, they were asked about how much they agreed or disagreed with

some statements (i.e. “It is something I would like to taste”, “It is familiar to me”, “I might easily prepare this”, “I might like the taste” and “It is something I would like to purchase”). Then, some information was given to consumers regarding ingredients, percentage of aquaculture fish in the final recipe, storage conditions, servings and packaging weight, product preparation, sensory description, suitability for consumers, Nutri-Score label, recipe suggestion and photographs of the cooked products. After seeing this information, consumers were asked about how much they agreed or disagreed with some statements (i.e., “It seems a natural product”, “It is easy to prepare”, “The portion sizes are too small”, “I like the idea of a boneless product”, “It has a good image”, “It seems to take a short time to prepare”, “Many ways to prepare”, “It could be healthy for me”, “The pack fits my needs” and “It seems tasty”).

Finally, for each product, consumers were asked about their purchase intention, if the consumption of the product would improve their day-to-day options for fish consumption and if they considered that the products were interesting to increase children´s fish intake (<16 years old).

3.4. Statistical analysis

In order to evaluate whether there were significant differences between evaluation of the statements by participants related to product associations, purchase intention, beliefs about improvement of the day-to-day options for fish consumption, increasing children´s fish intake (<16 years old) and consumption habits and preferences, contingency tables and Chi-squared tests were calculated (p<0.05).

The correlations between the statements related to product associations and the purchase intention were calculated using the Spearman correlation at 0.05 significance level. The data was evaluated with the XLSTAT software.

4. Results

4.1. Fish consumption habits and preferences

4.1.1. Frequency of fish consumption

When participants were asked how often they consumed fish, 44 % stated that they consumed fish more frequently than once a week, 35 % stated that they consumed fish products (e.g., fish burgers, canned, breaded fish) once a week and 21 % of the participants stated that they consumed fish from aquaculture more frequently than once a week (Figure 3).

Comparing the results by country (France, Germany), no significant differences were found between countries regarding the frequency of consumption of **fish** (p>0.05). By contrast, significant differences were found between countries for the frequency of consumption of fish products (e.g., fish burgers, cans, breaded…) and fish from aquaculture (p<0.05). French participants consumed **fish products (e.g., fish burgers, cans, breaded…)** once a month and from 2 to 4 times a week more frequently than German participants (20 % *vs*. 15 % and 12 % *vs*. 8 %, respectively). By contrast, German participants consumed fish products from 2 to 3 times a month more frequently than French participants (32 % *vs*. 25 %; Figure 3). Concerning **fish from aquaculture**, 25 % of the French and 17 % of the German participants stated that they never consumed fish from aquaculture (p<0.05; Figure 3). By contrast, German participants consumed from 2 to 3 times a month fish from aquaculture more frequently than their French counterparts (p<0.05; 22 % *vs*. 18 %; Figure 3).

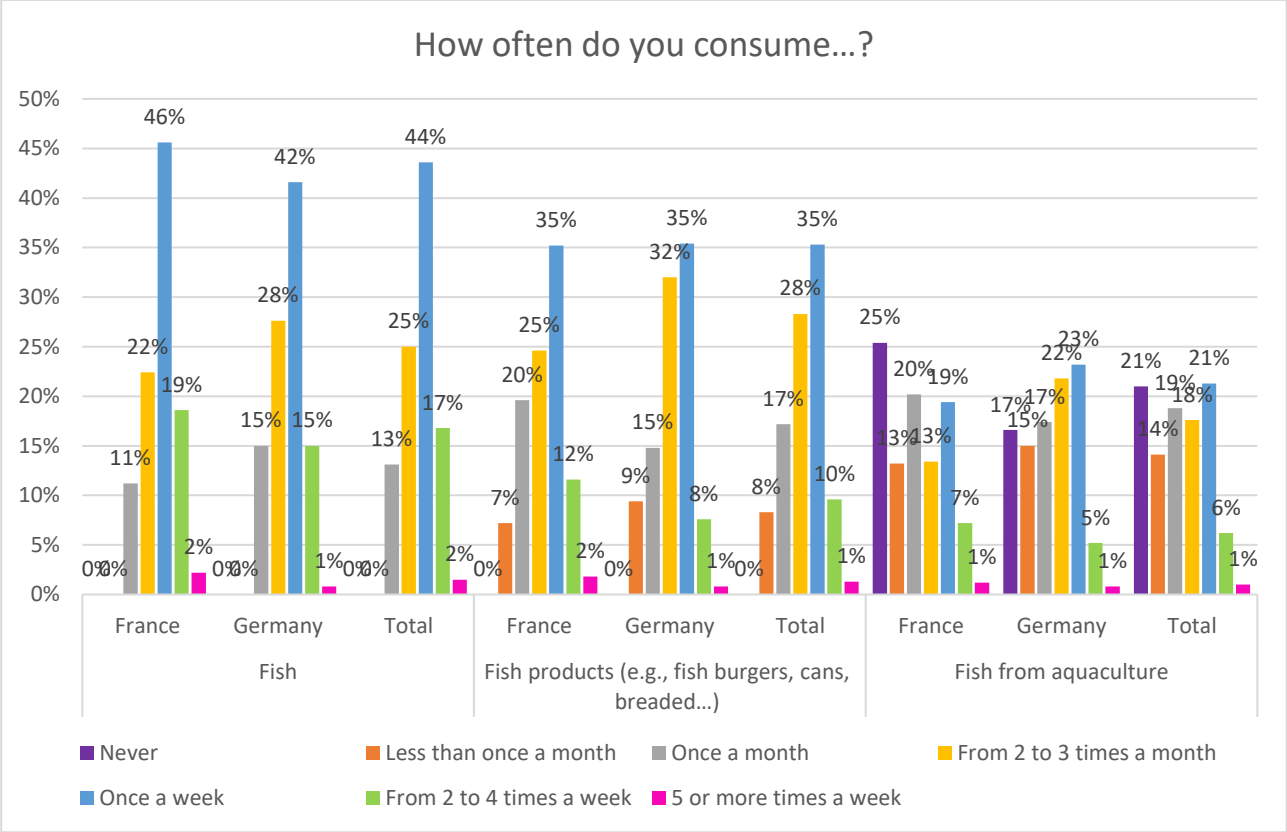

Figure 3: Percentage of selection of each statement regarding fish consumption. Data shown by country (France, Germany; N=1000, 500 per country).

4.1.2. Frequency of fish purchase

When participants were asked how often they bought fish, 39 % stated that they bought fish more frequently than once a week, 29 % bought fish products (e.g., fish burgers, cans, breaded…) once a week in the same percentage as they bought fish products from 2 to 3 times a week, and finally, 21% of the participants stated that they never bought fish from aquaculture, this percentage being similar to the percentage of participants who consumed more frequently than once a month (Figure 4).

Considering the results by country (France, Germany), significant differences were found between countries regarding the frequency of purchase of fish, fish products (e.g., fish burgers, cans, breaded…) and fish from aquaculture (p<0.05). French participants bought **fish** more frequently one a week (p<0.05; 43% *vs*. 35%). By contrast, German participants bought significantly more frequently fish from 2 to 3 times a month (p<0.05; 33% *vs*. 27% respectively; Figure 4). Regarding **fish products (e.g., fish burgers, cans, breaded…)**, French consumers bought these products once a month (27 % *vs*. 21 %) more frequently than their German counterparts. Concerning **fish from aquaculture**, 25 % of French and 17 % of German participants stated that they had never bought fish from aquaculture (p<0.05; Figure 4). In addition, German participants bought fish from aquaculture from 2 to 3 times a month more frequently than French participants (p<0.05; 22 % *vs*. 19 % respectively; Figure 4).

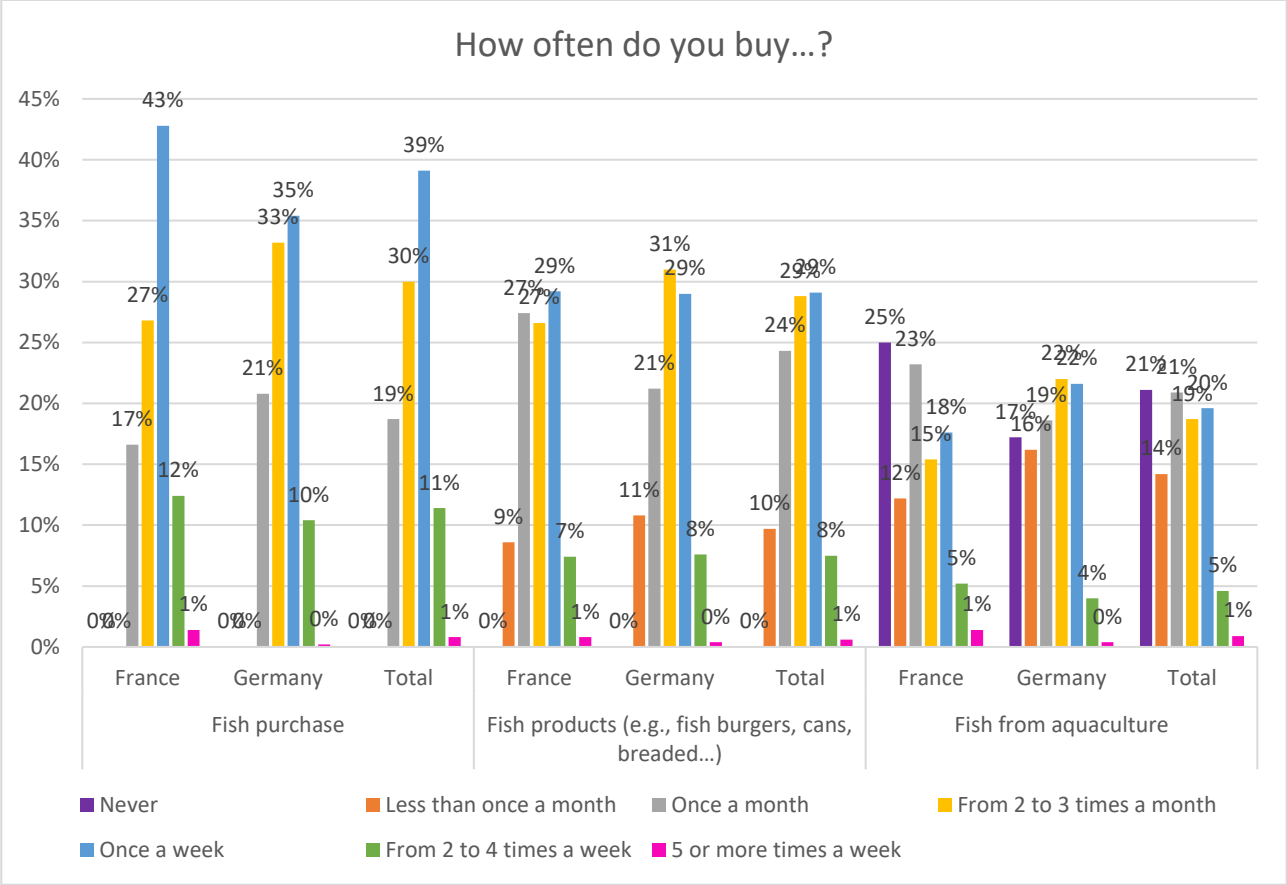

Figure 4: Percentage of selection of each statement regarding fish purchase. Data shown by country (France and Germany; N=1000, 500 per country).

4.1.3. Origin of the fish bought/consumed

In general, 45 % of the participants bought/consumed fish from both origins, wild fish and fish from aquaculture. Surprisingly, one out of four consumers did not know the origin of the fish they bought or consumed (Figure 5).

Considering the results per country, significant differences (p<0.05) were found between the origin of the fish bought/consumed. French consumers bought/consumed significantly more wild fish contrary to German ones, who bought/consumed significantly fish from both wild and aquaculture fish compared to French consumers (Figure 5).

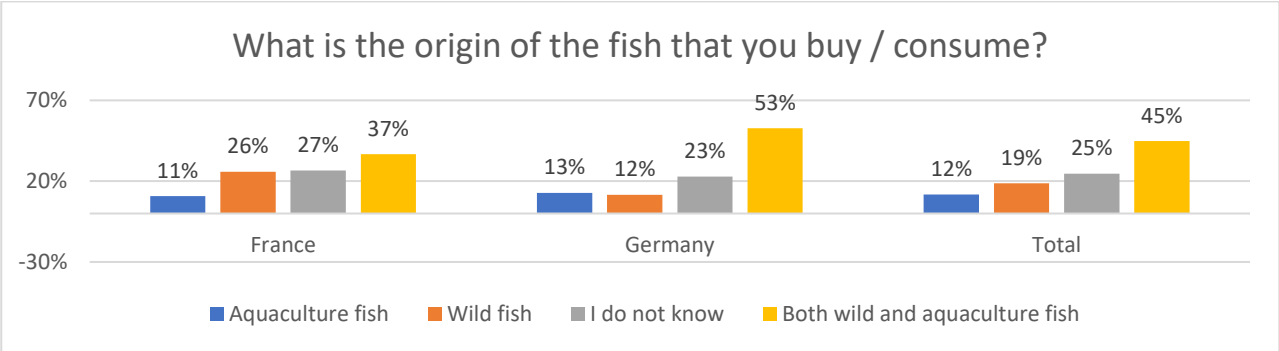

Figure 5: Percentage of consumers that bought/consumed fish considering the origin. Data shown by country (France and Germany; N=1000, 500 per country).

4.1.4. Fish species usually bought/consumed

The five fish species that consumers usually bought/consumed the most were salmon, tuna, cod, saithe (coalfish) and pollack (63 %, 62 %, 40 %, 36 % and 35 % of the consumers selected these species respectively; Figure 6).

If we split the results by country, the five fish species usually bought/consumed the most in France were salmon, tuna, hake, cod and seabream (chosen by 64 % 59 % 49 % 46 % and 32 % of the consumers respectively). Meanwhile in Germany, consumers selected in higher percentage tuna, salmon, pollack, saithe(=coalfish) and herring (selected by 65 %, 62 %, 55 %, 50 % and 48 % of the participants respectively). It should be considered that the species used for the product developed in this study (i.e., seabass, gilthead seabream and meagre) were chosen by 12 %, 32 %, and 3 % French consumers respectively, and by 12 %, 5 % and 3 % of German consumers respectively (Figure 6).

Considering the results per country, significant differences (p<0.05) were found between the fish species chosen. French consumers bought/consumed sole, sardine, seabream, hake and cod significantly more than German participants. By contrast, German consumers bought/consumed monk fish, pangasius, carp, plaice, trout/char, herring, pollack and saithe(=coalfish) significantly more than French consumers (Figure 6).

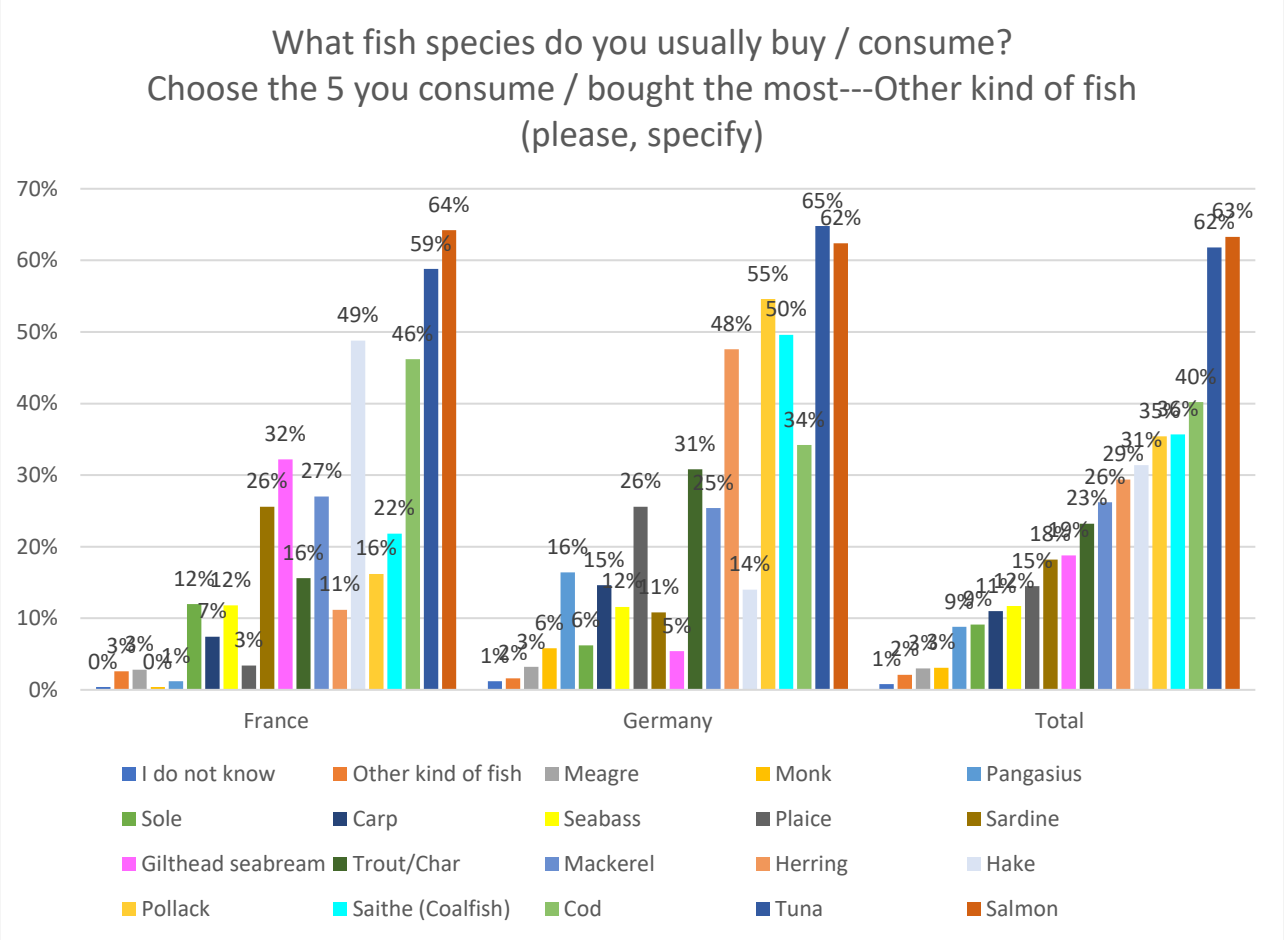

Figure 6: Percentage of consumers that chose each fish species between the 5 most usually consumed/bought). Data shown by country (France and Germany; N=1000, 500 per country).

4.1.5. Fish usually eaten at home

In general, the fish most consumed at home were fresh fish, frozen fish and fish fillets (Figure 7).

Considering the results by country, significant differences (p<0.05) were found for sushi, whole fish, canned, fish fillets, frozen fish and fresh fish usually eaten at home. The German participants consumed these types of fish more frequently, except for the fresh fish which was consumed more frequently by French consumers (Figure 7).

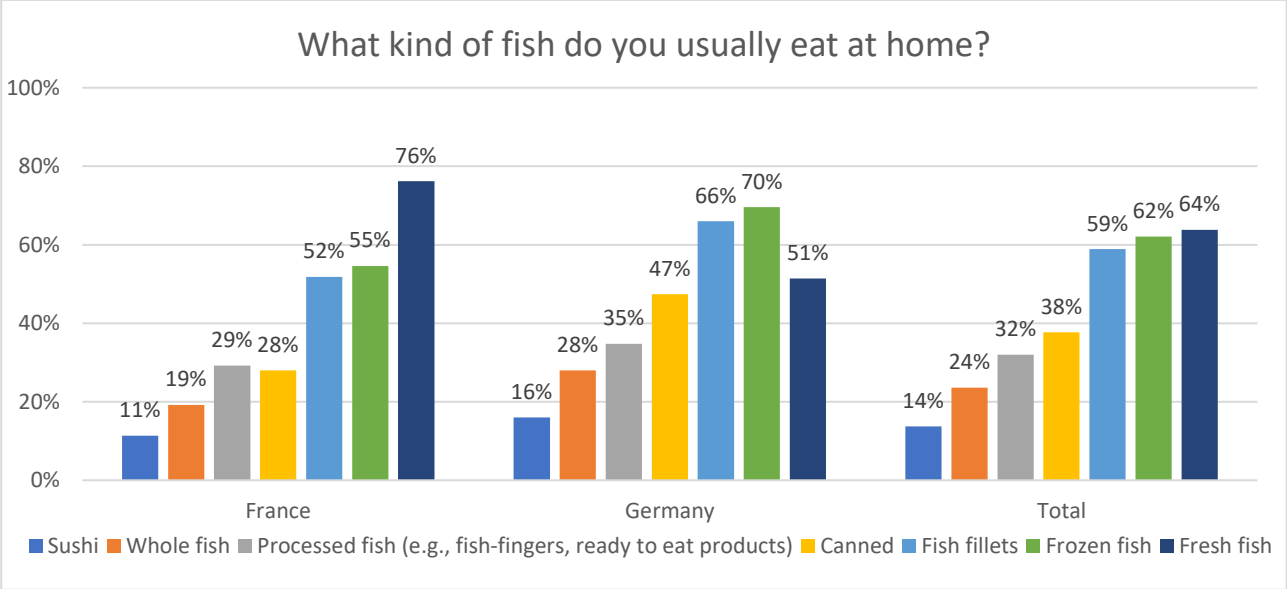

Figure 7: Percentage of consumers that chose each kind of fish among those usually eaten at home. Data shown by country (France and Germany; N=1000, 500 per country).

4.1.6. The most frequent way to prepare the fish at home

The most frequent way to prepare the fish at home were pan/fried, grilling/oven and steaming (Figure 8).

Considering the results by country, significant differences (p<0.05) were found between the two countries regarding the way of preparing the fish at home. French consumers prepared the fish at home more frequently by grilling/oven, steaming and stewed than German consumers. On the contrary, German participants prepared the fish at home more frequently in the pan/fried than French consumers (Figure 8).

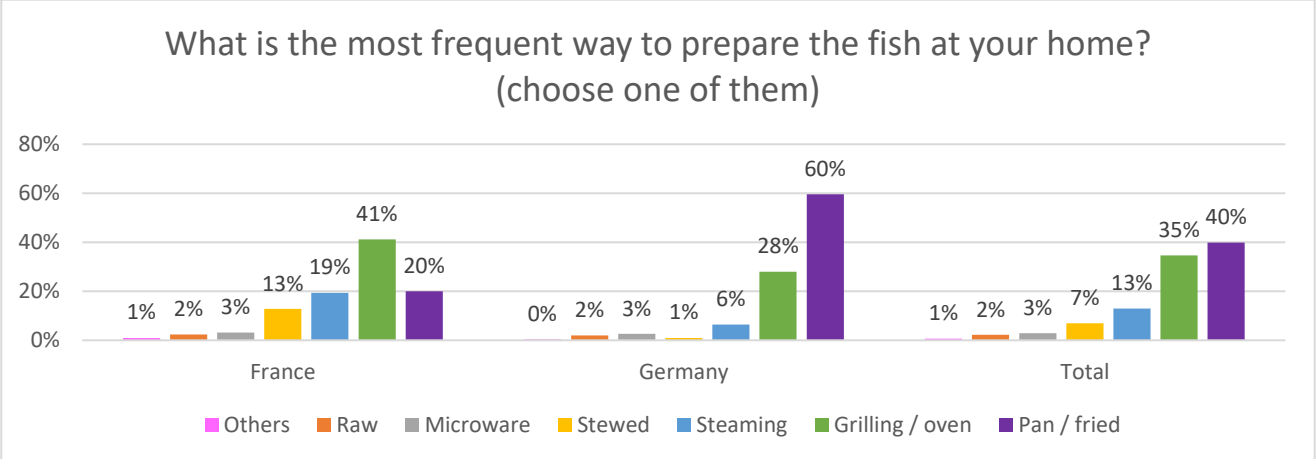

Figure 8: Percentage of consumers that chose each alternative as the most frequent way to prepare the fish at home. Data shown by country (France and Germany; N=1000, 500 per country).

4.1.7. Consumer behaviour concerning new food and new technology

Consumers were asked some questions regarding food neophobia (reluctance to eat unfamiliar foods). In general, they trusted new food. However, French consumers showed a high percentage of hesitation (48 % chose the option "Neither agree nor disagree"; Figure 9). In addition, most participants liked to try new food (Figure 9). By contrast, there were consumers who did not trust new food and did not like to try new food (16 % and 8 %, respectively; Figures 9 and 10).

Regarding food technology neophobia (reluctance to eat food produced using new technologies), most consumers considered that innovations in food technology could help us produce foods sustainably. However, French consumers showed a high percentage of hesitation (38 % chose the option "Neither agree nor disagree"; Figures 9 and 10).

Considering the aggregated results by country (Figure 10), significant differences (p<0.05) were found for the statements "I do not trust new food" and "Innovations in food technology can help us produce foods in a sustainable manner". Regarding trust in new food, German consumers trusted new food in a higher proportion than French consumers (p<0.05; 54 % *vs*. 34 %). By contrast, French consumers showed a higher percentage of both hesitation and agreement (p<0.05; Figure 10). Regarding the statement "Innovations in food technology can help us produce foods in a sustainable manner" similar results were obtained, German consumers agreeing in a significant higher percentage with this statement than their French counterparts (p<0.05; 71 % *vs*. 55 %). Contrary to French participants who showed a higher percentage of hesitation and disagreement with this statement (p<0.05; Figure 10).

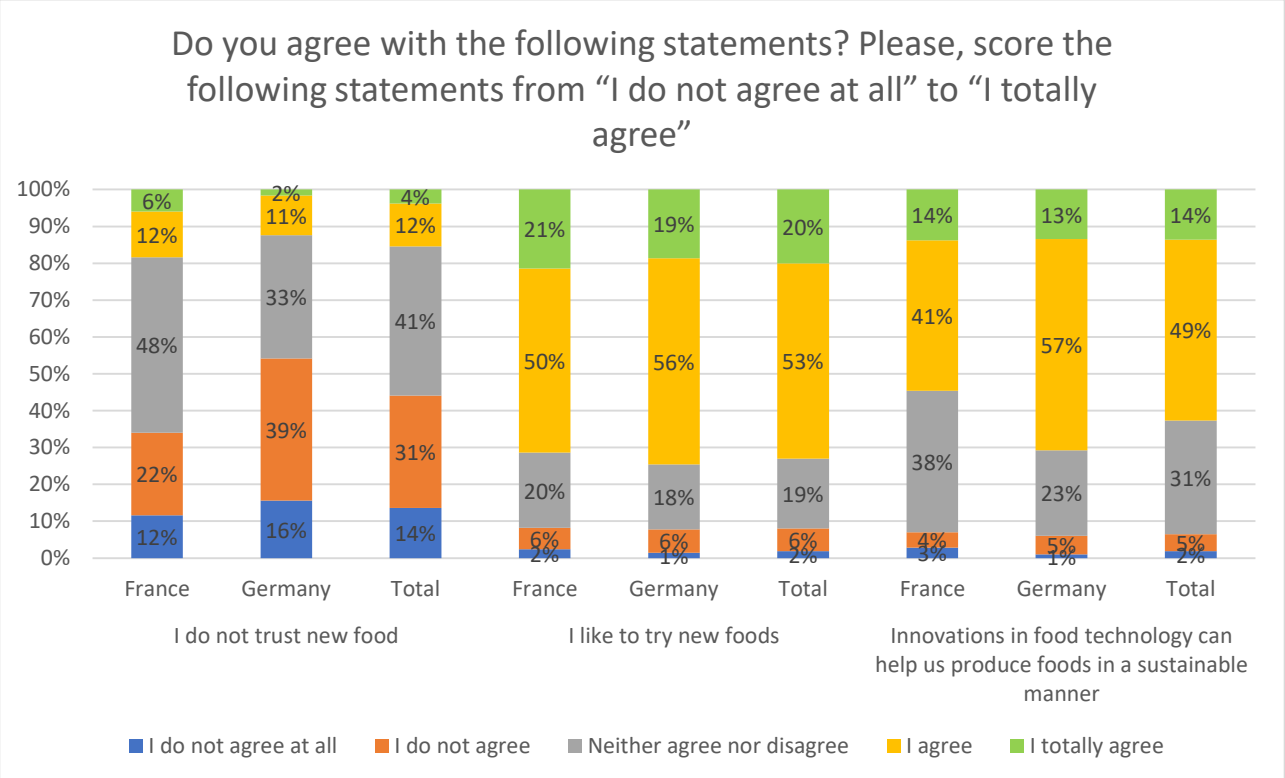

Figure 9: Percentage of selection for each statement regarding consumers' beliefs about new food and technology. Consumers scored their (dis) agreement on a 5-point scale, anchored at 1 = "I do not agree at all" to 5 = "I totally agree". Data showed by country (France and Germany; N=1000, 500 per country).

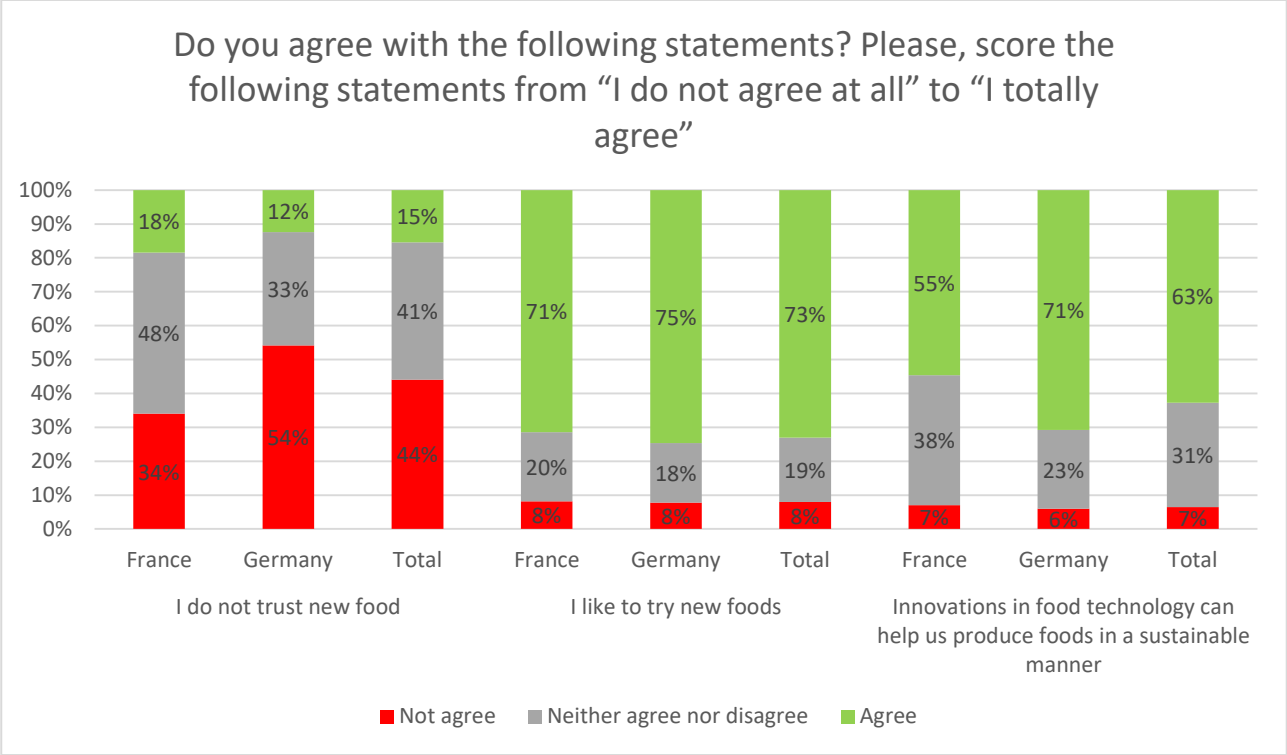

Figure 10: Percentage of selection for each statement regarding consumers' beliefs about new food and new technology. Consumers scored their (dis)agreement on a 5-point scale, anchored at 1 = "I do not agree at all" to 5 = "I totally agree". Data showed by categories ("Not agree" (sum of percentage selected for 1 and 2), "Neither agree nor disagree" (percentage of 3) and "Agree" (sum of percentage selected for 4 and 5)) and by country (France, Germany; N=1000, 500 per country).

4.1.8. Importance of several characteristics for buying fish products

Consumers were asked about the key aspect identified by European consumers for buying fish products. The French and German consumers identified taste, healthy product and percentage of fish contained as the three most important aspects for buying fish (selected with 6 and 7 on a 7-point scale by 78 %, 73 %, and 68 % of the consumers respectively). Inversely, the consumers identified as the least important characteristic for buying fish products (selected with 1 and 2 out of 7-point scale) Mediterranean origin, organic ingredients and aquaculture product (selected by 10 %, 9 % and 8 % of the consumers respectively; Figure 11).

Considering the most important characteristics selected by consumers (selected with 6 and 7 on a 7-point scale), significant differences (p<0.05) were found between the consumers from France and Germany. French consumers considered Mediterranean origin, price, and product geographic origin more important characteristics for buying fish products than German consumers. By contrast, German consumers considered boneless fish, mild fish flavour and taste more important characteristics for buying fish products than their French counterparts.

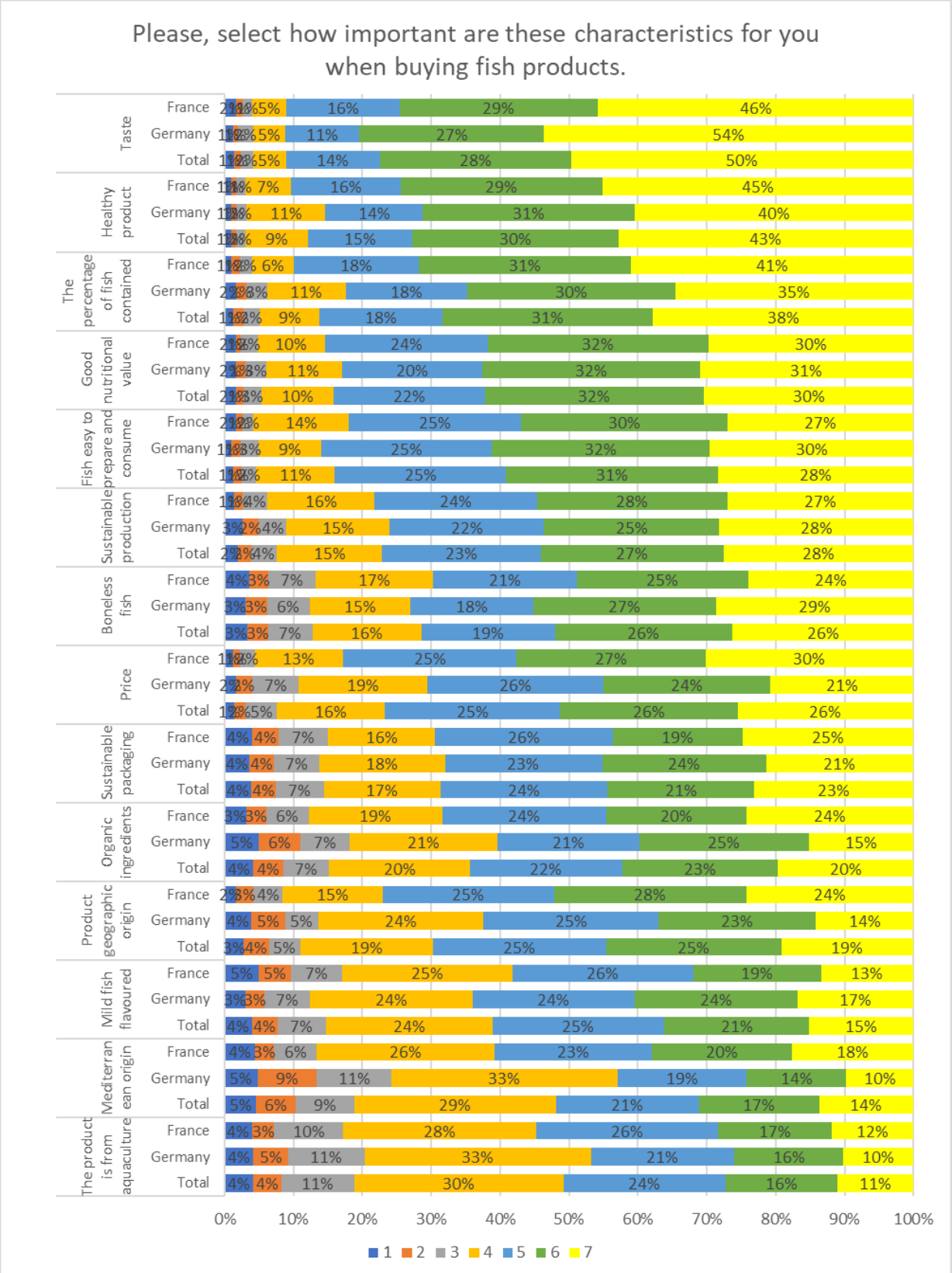

Figure 11: Percentage of selection for each characteristic regarding consumers´ key criteria for buying fish. Consumers scored the importance of each characteristic on a 7-point scale, anchored at 1 = "Not at all important" to 7 = "Extremely important". Data shown by country (France and Germany; N=1000, 500 per country).

4.2. Sea and mountain burger

4.2.1. Product associations

Some photographs of the sea and mountain burger were shown to consumers (Figure 12).

Figure 12: Photographs of sea and mountain burger shown to consumers.

In general, 50 % of the consumers would not like to taste the sea and mountain burger (sum of totally agree and agree). This product seems to be faddish for consumers since the sea and mountain burger was familiar to just 21 % of the consumers. In addition, 43 % of the consumers felt that they could prepare it easily. Moreover, 37 % of the consumers considered that they would not like the taste. However, this was not a clear answer for this statement since the results were split almost in the same percentage for each category. Finally, 49 % of the consumers would not purchase this product (Figures 13 and 14).

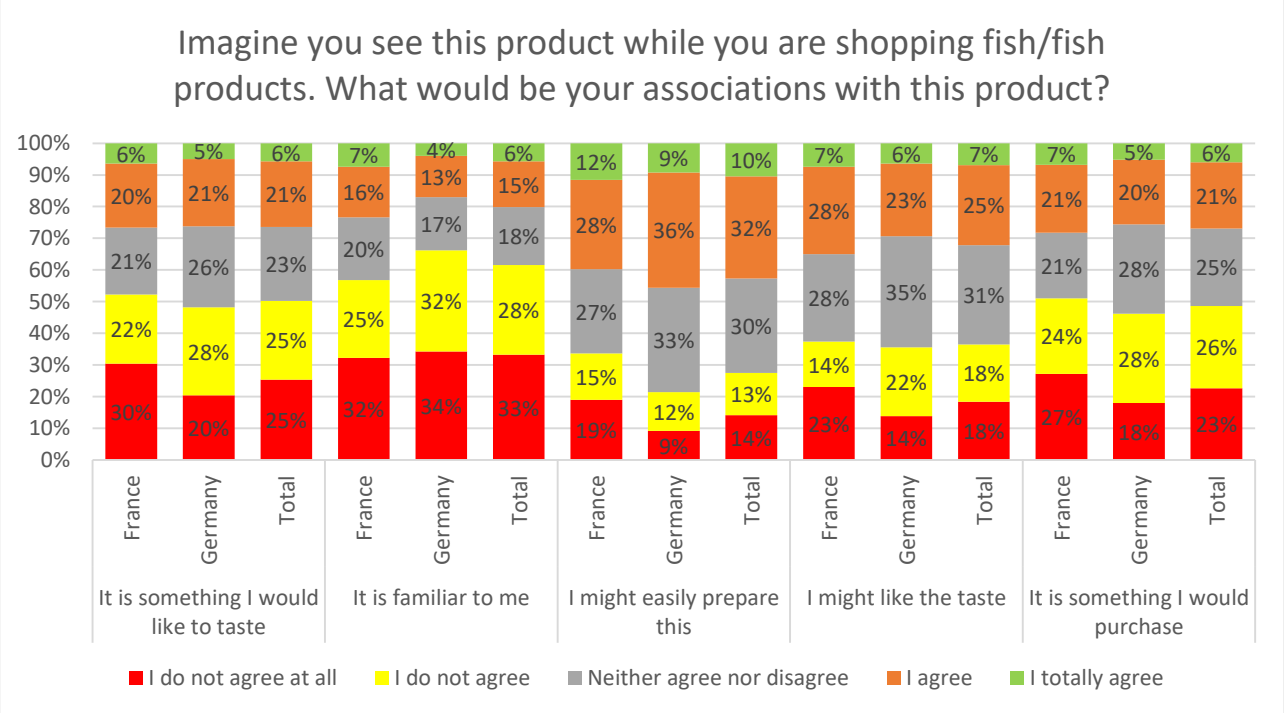

Figure 13: Percentage of selection for each statement regarding the associations consumers made while they were buying sea and mountain burger. Consumers scored their (dis) agreement on a 5-point scale, anchored at 1 = "I do not agree at all" to 5 = "I totally agree". Data shown by country (France and Germany; N=1000, 500 per country).

Figure 14: Percentage of selection for each statement regarding associations consumers made while they were buying sea and mountain burger. Consumers scored their (dis) agreement on a 5-point scale, anchored at 1 = "I do not agree at all" to 5 = "I totally agree". Data showed by categories ("Not agree" (sum of percentage selected for 1 and 2), "Neither agree nor disagree" (percentage of 3) and "Agree" (sum of percentage selected for 4 and 5)) and by country (France, Germany; N=1000, 500 per country).

If we considered the aggregated results by the percentage of agreement of each statement and by country, significant differences were found. French consumers were significantly more familiar with this product than German consumers (23 % *vs.* 17 % respectively; Figure 14).

4.2.2. Product associations after product description

A product description was given to consumers regarding ingredients, percentage of aquaculture fish in the final recipe, storage conditions, servings and packing weight, product preparation, sensory description, suitability for consumers, Nutri-Score label, recipe suggestion and photographs of the cooked products (Figure 15).

On a 5-point hedonic scale anchored at 1 = "strongly disagree" to 5 = "strongly agree", consumers were asked how much they agreed with several statements based on several attributes of fish products and packaging after knowing the product description (Figure 15). Over 50 % of participants agreed that it seemed to be a natural product (56 %). Consumers felt that sea and mountain burger was easy to prepare (72 %) and it took a short time to prepare (72 %). Most participants stated that the product could be prepared in many ways (55 %). In addition, consumers felt that the product could be healthy (55 %). Regarding the portion size, there were diverse opinions since the consumers did not have a clear idea about it. On the other hand, less than 50 % of participants felt that the product had a good image, that the pack fitted consumers' needs and that the product seemed tasty (39 %, 44 % and 45 % respectively), in all cases the positive attitude was higher than the negative attitude (Figures 16 and 17). German consumers showed the highest percentage of hesitation regarding the image of the product (46 %).

PRODUCT DESCRIPTION:

Meagre fish burger with mushrooms. The product is boneless and it is made with natural ingredients. It contains **95 % aquaculture fish** mince (meagre). No added salt.

This product should be stored frozen (-18°C). The pack contains 180 g. It contains 3 servings. Ideal for a lunch or dinner.

This is a fish burger with a mixture of flavours reminiscent of the sea and the mountains.

It can be prepared in a pan or in the oven. It is ready in less than 10 minutes.

Suitable for children, senior and general consumers due to the nutritional value and taste. Gourmet recipe.

Figure 15: Product description of sea and mountain burger provided to consumers.

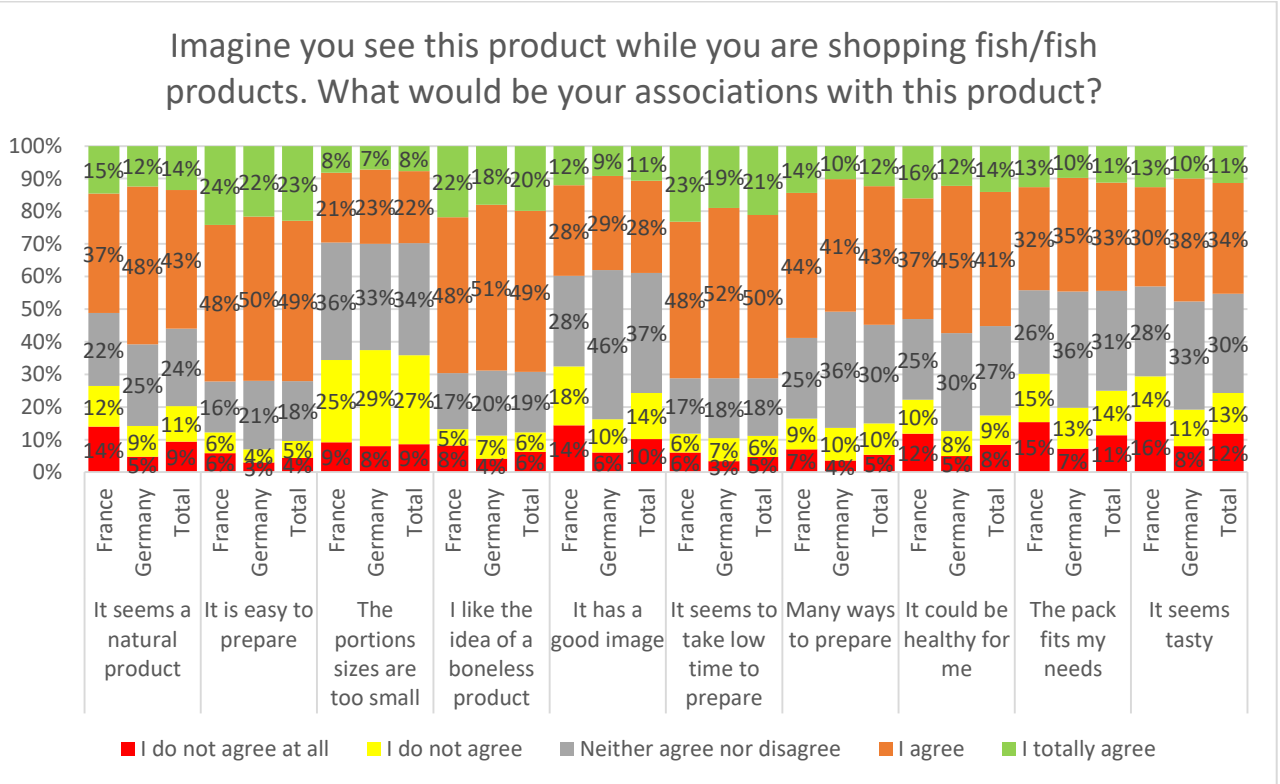

Figure 16: Percentage of selection for each statement regarding the associations consumers made while they were buying sea and mountain burger after knowing its description. Consumers scored their (dis) agreement on a 5-point scale, anchored at 1 = "I do not agree at all" to 5 = "I totally agree". Data shown by country (France and Germany; N=1000, 500 per country).

Considering the data by country, significant differences (p<0.05) were found between countries. German consumers felt that the product seemed natural in a significantly higher proportion than French consumers (61 % *vs.* 51 %). By contrast, French consumers considered that the product could be prepared in many ways in a significantly higher proportion than German consumers (59 % *vs.* 51 %; Figure 17).

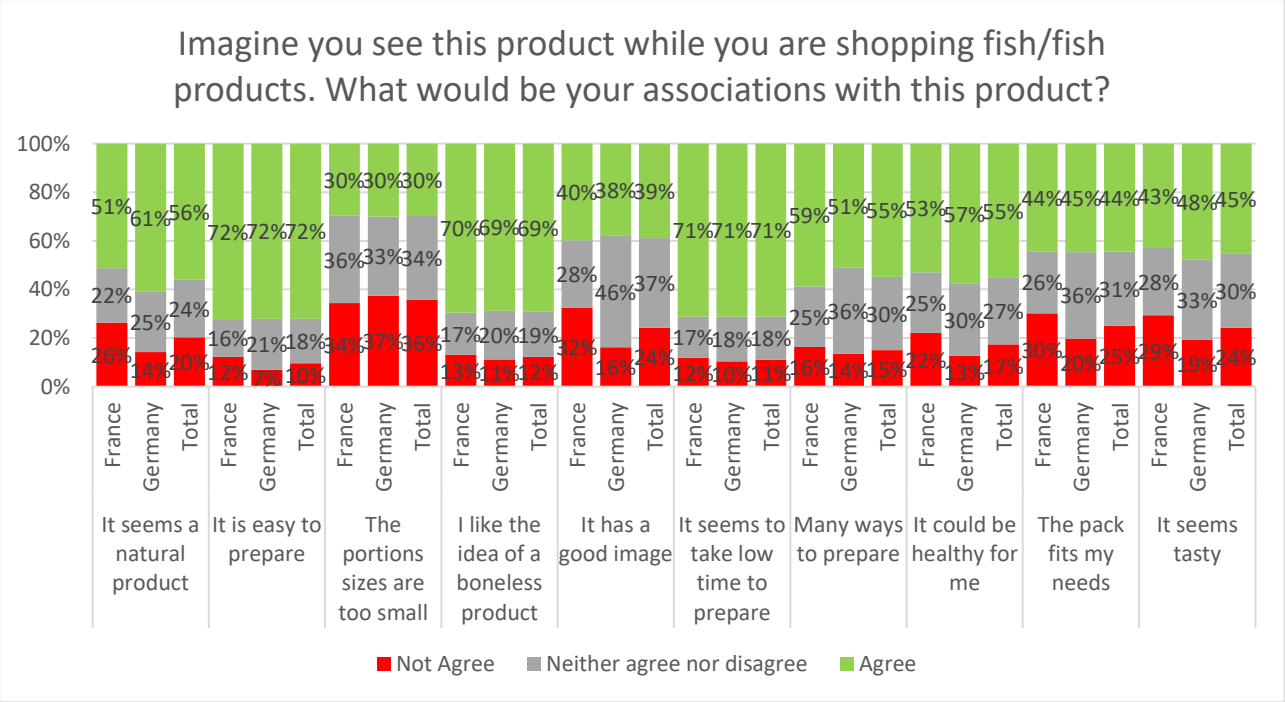

Figure 17: Percentage of selection for each statement regarding assocations consumers made while they were buying the sea and mountain burger after knowing its description. Consumers scored their (dis) agreement on a 5-point scale, anchored at 1 = "I do not agree at all" to 5 = "I totally agree". Data shown by categories ("Not agree" (sum of percentage selected for 1 and 2), "Neither agree nor disagree" (percentage of 3) and "Agree" (sum of percentage selected for 4 and 5)) and by country (France, Germany; N=1000, 500 per country).

4.2.3. Purchase intention

The results suggest that participants were almost evenly split on their purchase intention since 39 % stated that they would buy this product (sum of definitely and probably would buy), meanwhile 32 % would not buy this product (sum of definitely and probably would not buy).

Considering the data by country, significant differences were obtained (p<0.05). French consumers would not buy the product in a higher percentage than German consumers (35 % *vs*. 27 % respectively; sum of definitely and probably would not buy it). These differences were based on the percentage of choice of the option "I would definitely not buy it" (Figure 18). In addition, the percentage of hesitation was significantly higher for German consumers (p<0.05; Figure 18).

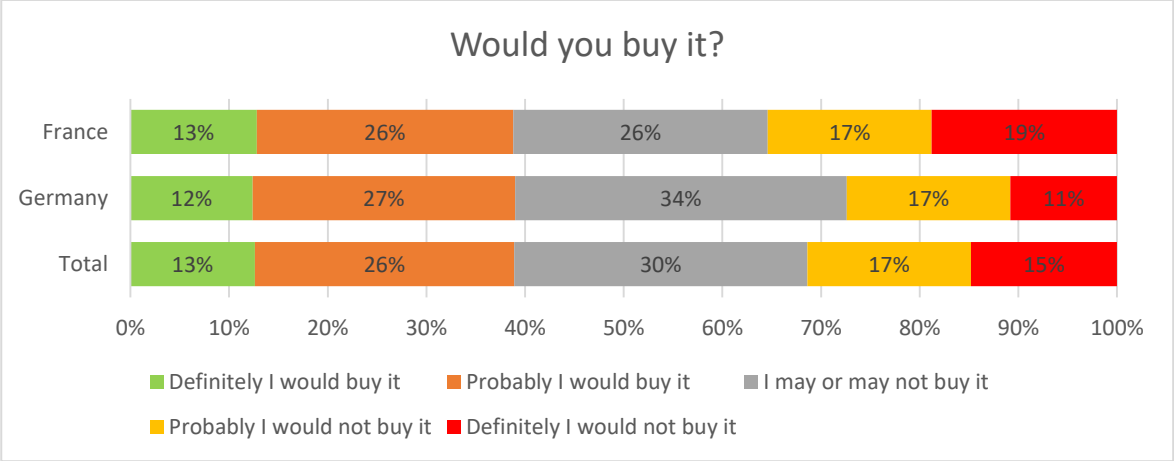

Figure 18: Percentage of consumers´ purchase intention after knowing some information about the sea and mountain burger. Data shown by country (France, Germany; N=1000, 500 per country).

4.2.4. Beliefs about improvement of the day-to-day options for fish consumption

Consumers were asked if sea and mountain burger would improve their day-to-day options for fish consumption, and 44 % thought that this product would improve it. This percentage was significantly higher for German consumers (p<0.05), since they chose in a higher percentage than French consumers the option "It would probably improve it" (33 % *vs.* 26 % respectively, Figure 19). As for the case of purchase intention, around 30 % of the consumers were undecided, this percentage being significantly higher for German consumers (p<0.05; Figure 19).

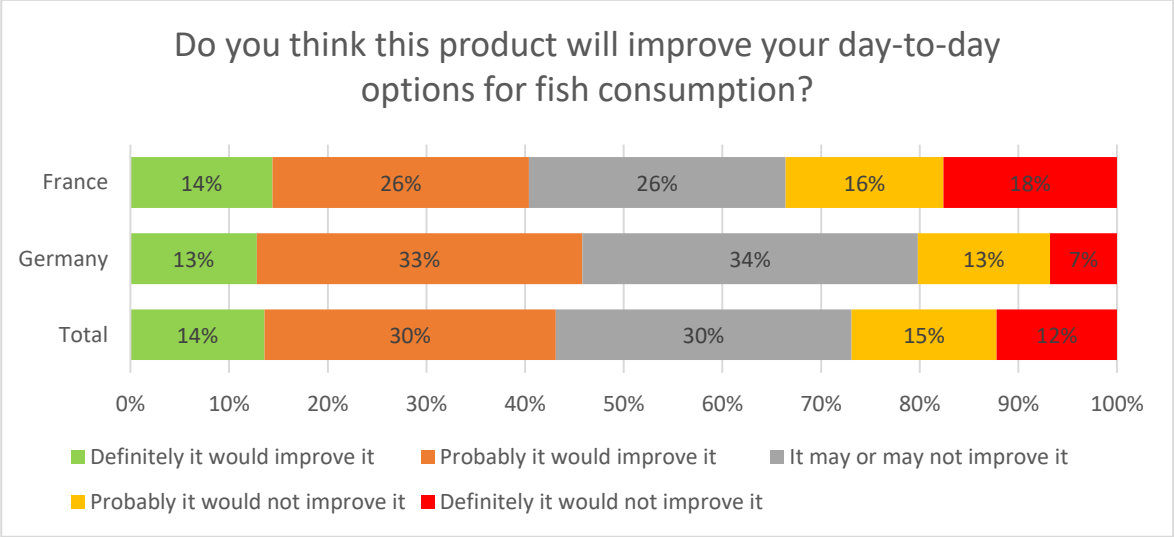

Figure 19: Percentage of consumers who considered that the sea and mountain burger would increase their daily intake of fish consumption. Data shown by country (France, Germany; N=1000, 500 per country).

4.2.5. Beliefs about increasing children´s fish intake (<16 years old)

In both countries (France and Germany) 63 % of the consumers considered that the sea and mountain burger would be interesting for children under 16 years old (Figure 20). No significant differences were observed between countries (p>0.05).

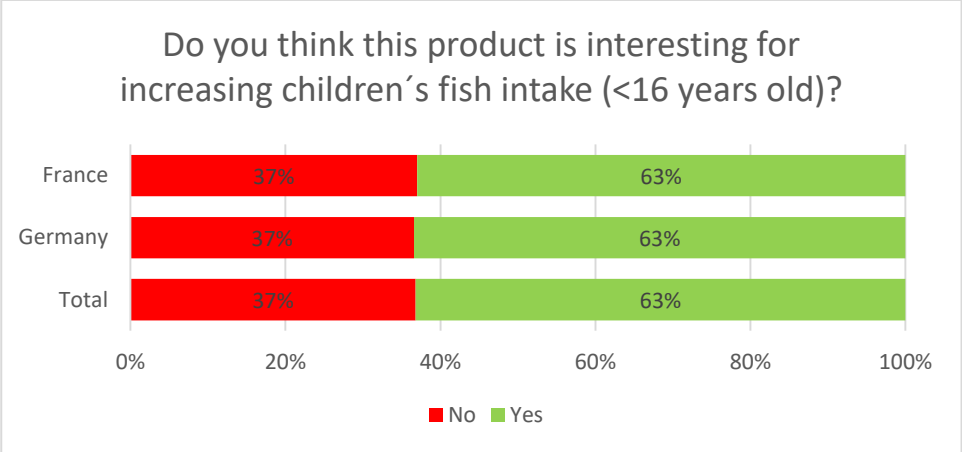

Figure 20: Percentage of consumers who considered that the sea and mountain burger was interesting for increasing children´s fish intake (< 16 years old). Data shown by country (France, Germany; N=1000, 500 per country).

4.3. Grilled seabass with lemon

4.3.1. Product associations

Some photographs of the grilled seabass with lemon were shown to consumers (Figure 21).

Figure 21: Photographs of grilled seabass with lemon shown to consumers.

In general, 47 % of the consumers would not like to taste the grilled seabass with lemon. This product seemed to be faddish for consumers since grilled seabass with lemon was familiar for just 22 % of the consumers. In addition, 44 % of the consumers though that they could prepare it easily. Moreover, 36 % of the consumers considered that they would like the taste. However, for this statement it was not a clear answer since the results were split almost in the same percentage for each category. Finally, 45 % of the consumers would not purchase this product, this percentage being higher than the percentage of consumers who would purchase it (33 %; Figures 22 and 23).

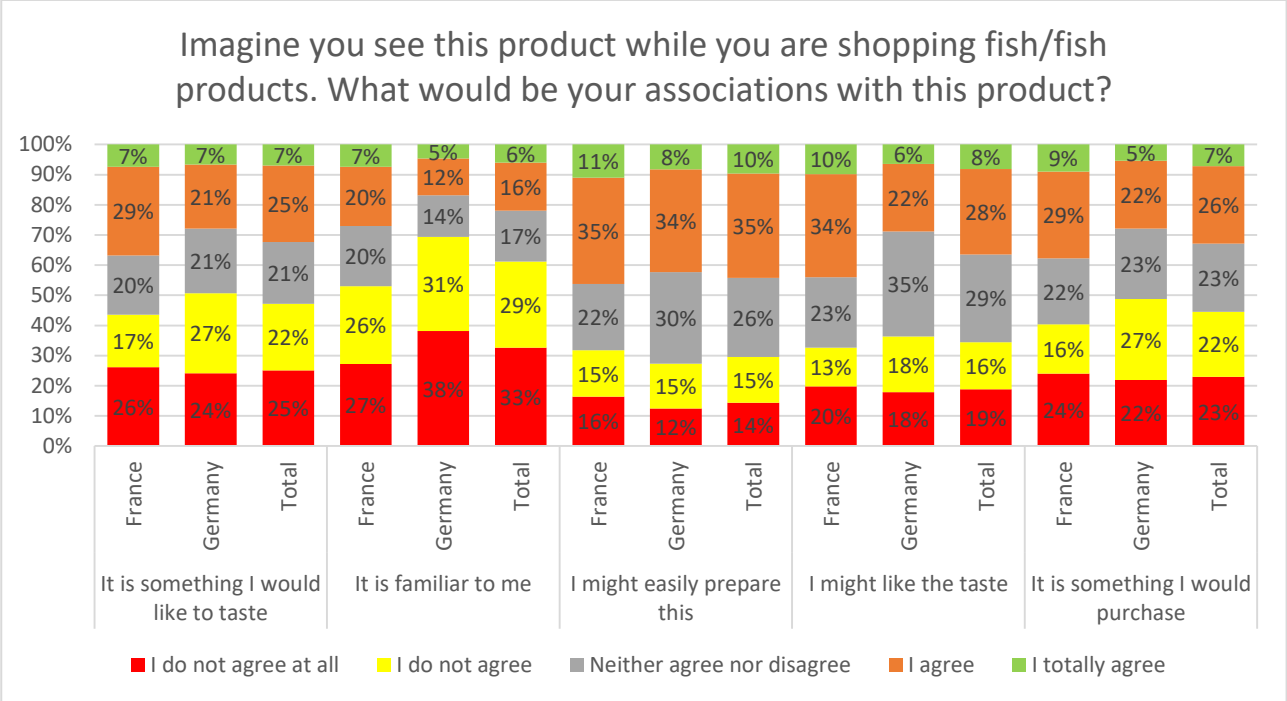

Figure 22: Percentage of selection for each statement regarding the association consumers made while they were buying grilled seabass with lemon. Consumers scored their (dis) agreement on a 5-point scale, anchored at 1 = "I do not agree at all" to 5 = "I totally agree". Data shown by country (France, Germany; N=1000, 500 per country).

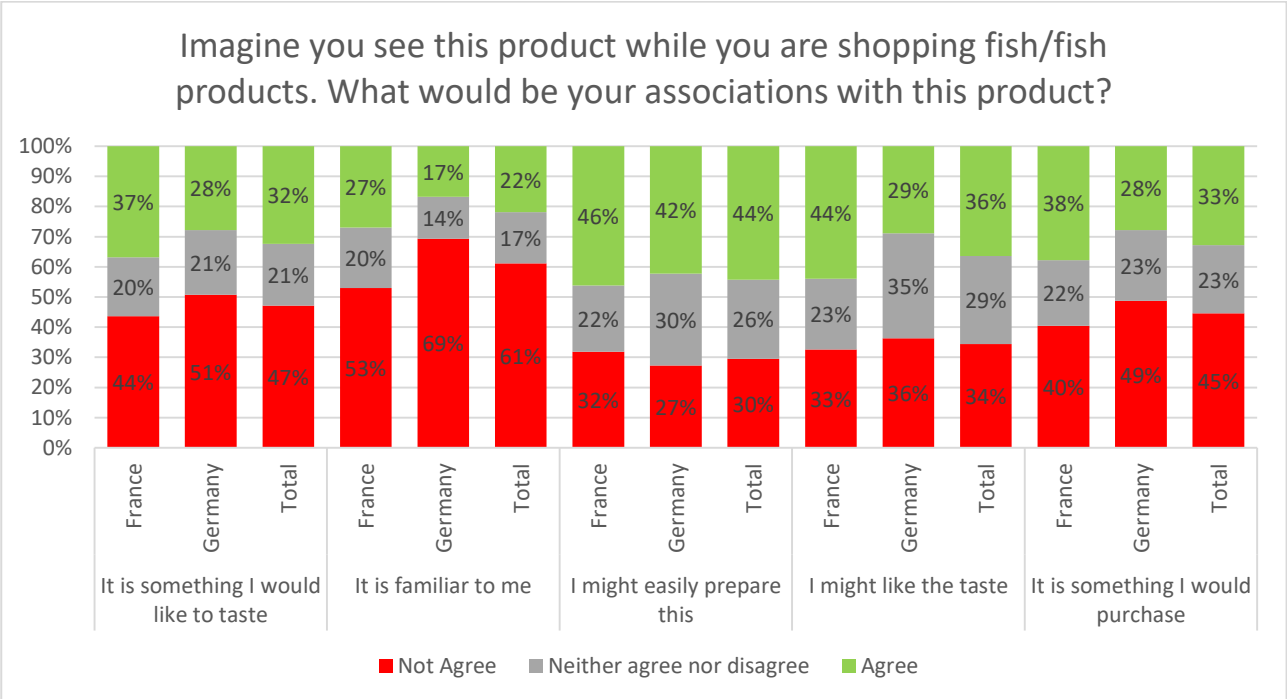

Figure 23: Percentage of selection for each statement regarding the associations consumers made while they were buying grilled seabass with lemon. Consumers scored their (dis) agreement on a 5-point scale, anchored at 1 = "I do not agree at all" to 5 = "I totally agree". Data shown by categories ("Not agree" (sum of percentage selected for 1 and 2), "Neither agree nor disagree" (percentage of 3) and "Agree" (sum of percentage selected for 4 and 5)) and by country (France, Germany; N=1000, 500 per country).

If we considered the aggregated results by the percentage of agreement of each statement and by country, significant differences (p<0.05) were found for all the statements except for “It might easily prepare this”. In all cases, French consumers selected in a significantly higher percentage “It is something I would like to taste”, “It is familiar to me”, I might like the taste”, and “It is something I would purchase” than German ones (Figure 23).

4.3.2. Product associations after product description

Product description was given to consumers regarding ingredients, percentage of aquaculture fish in the final recipe, storage conditions, servings and packing weight, product preparation, sensory description, suitability for consumers, Nutri-Score label, recipe suggestion and photographs of the cooked products (Figure 24).

PRODUCT DESCRIPTION:

This is a seabass mince roll. This product is boneless and skin-free product. It contains **66% aquaculture seabass**.

This product should be bought sliced ready to prepare.

This product should be stored in the fridge. The product weighs 400 g and it contains 6 servings. Ideal for a lunch or dinner.

Mild fishy taste and flavour. Fish flesh for the elaboration of different dishes and recipes.

It can be prepared grilled, in the pan or in the oven in just 10 minutes.

Suitable for children, senior and general consumers due to the nutritional value and safe use.

Figure 24: Product description of grilled seabass with lemon provided to consumers.

On a 5-point hedonic scale anchored at 1 = “strongly disagree” to 5 = “strongly agree”, consumers were asked how much they agreed with several statements based on several attributes of the fish product and packaging after knowing the product description (Figure 24). The percentage of consumers´ agreement was higher than the percentage of consumers´ disagreement for all the statements except for “The portions size are too small” (Figures 25 y 26). Over 50 % of the consumers felt that the product was easy to prepare (67 %), they liked the idea of a boneless product (64 %), they felt that the product took a short time to prepare (66 %) and it could be prepared in many ways (54 %). On the other hand, above 50 % of the consumers felt that grilled seabass with lemon seemed natural (47 %) and could be healthy for them (49 %). Meanwhile, consumers disagreed with statement that the size of the portions were too small (42 %). They also stated that the product had a good image (38 %). In addition, the consumers felt that the pack fitted their needs (40 %). Finally, they considered that the product seemed tasty (42 %; Figures 25 y 26).

Considering the data by country, significant differences (p<0.05) were found. German consumers felt that the product seemed natural (52 % *vs.* 41 %) in a significantly higher percentage than French consumers. By contrast, French consumers liked the idea of a boneless product significantly more than German consumers. Compared to German participants, French participants thought, in a higher proportion, that the product had a good image, that it took a short time to prepare, and that this product could be prepared in many ways (Figure 26).

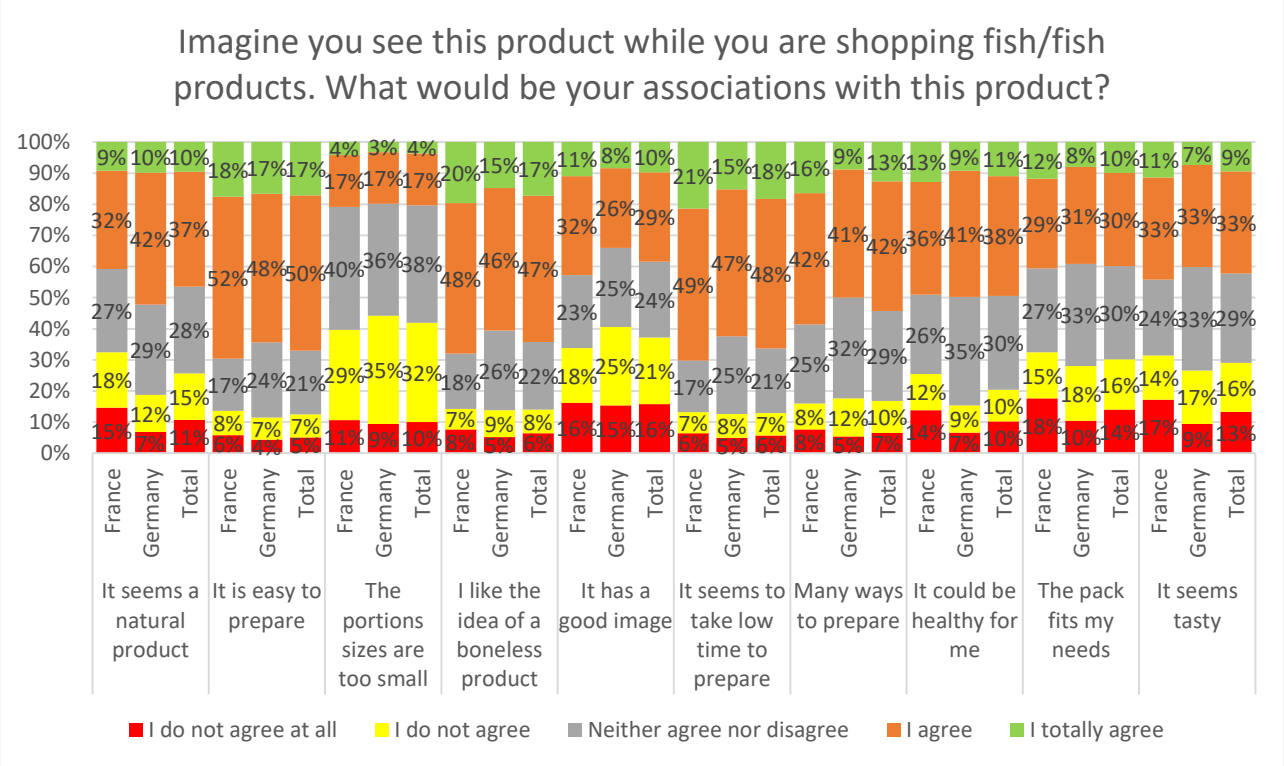

Figure 25: Percentage of selection for each statement regarding the associations consumers made while they were buying grilled seabass with lemon after knowing its description. Consumers scored their (dis) agreement on a 5-point scale, anchored at 1 = "I do not agree at all" to 5 = "I totally agree". Data shown by country (France, Germany; N=1000, 500 per country).

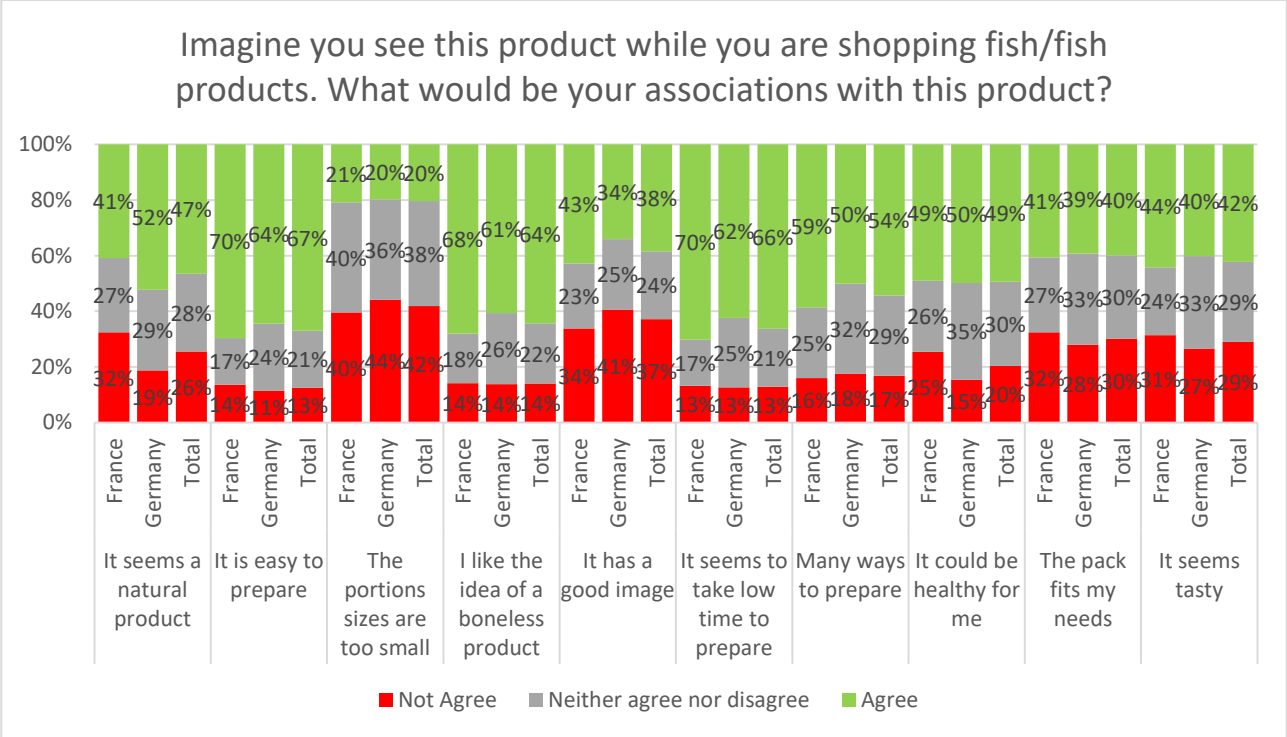

Figure 26: Percentage of selection for each statement regarding the associations consumers made while they were buying grilled seabass with lemon after knowing its description. Consumers scored their (dis) agreement on a 5-point scale, anchored at 1 = "I do not agree at all" to 5 = "I totally agree". Data showed by categories ("Not agree" (sum of percentage selected for 1 and 2), "Neither agree not disagree" (percentage of 3) and "Agree" (sum of percentage selected for 4 and 5)) and by country (France, Germany; N=1000, 500 per country).

4.3.3. Purchase intention

The purchase intention for both countries (France and Germany) was similar. These results suggest that participants were almost evenly split on their purchase intention for this product since 36 % of the consumers would buy this product (sum of definitely and probably would buy it) contrary to 39 % of consumers that would not buy it (sum of definitely and probably would not buy it; Figure 27).

Significant differences were not observed between French and German consumers (p>0.05).

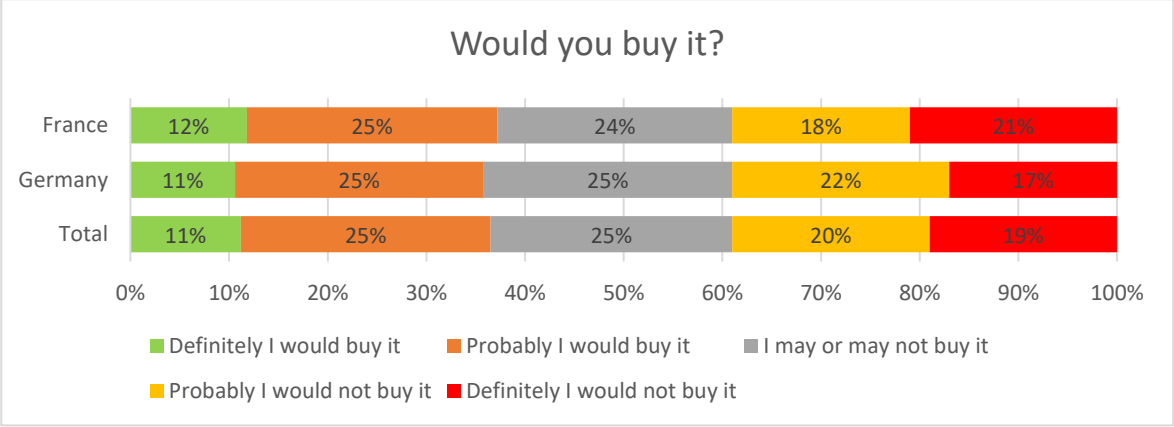

Figure 27: Percentage of consumers´ purchase intention after knowing some information about grilled seabass with lemon. Data shown by country (France, Germany; N=1000, 500 per country).

4.3.4. Beliefs about improvement of the day-to-day options for fish consumption

Consumers were asked if this product would improve their day-to-day options for fish consumption, and around 40 % felt that grilled seabass with lemon would improve it. This percentage was higher than the percentage of consumers who stated that this product would not increase their purchase intention (34 %; Figure 28).

Splitting the results by country, significant differences were obtained (p<0.05), French consumers being those who felt that this product would not improve their fish consumption in a higher proportion (38 % *vs.* 30 %; sum of definitely and probably it would not increase their fish consumption). These differences were based on the percentage of selection of the option "Definitely it would not improve it" (Figure 28). Around 25 % of the consumers were undecided, this percentage being significantly higher for German consumers (29 %; Figure 28).

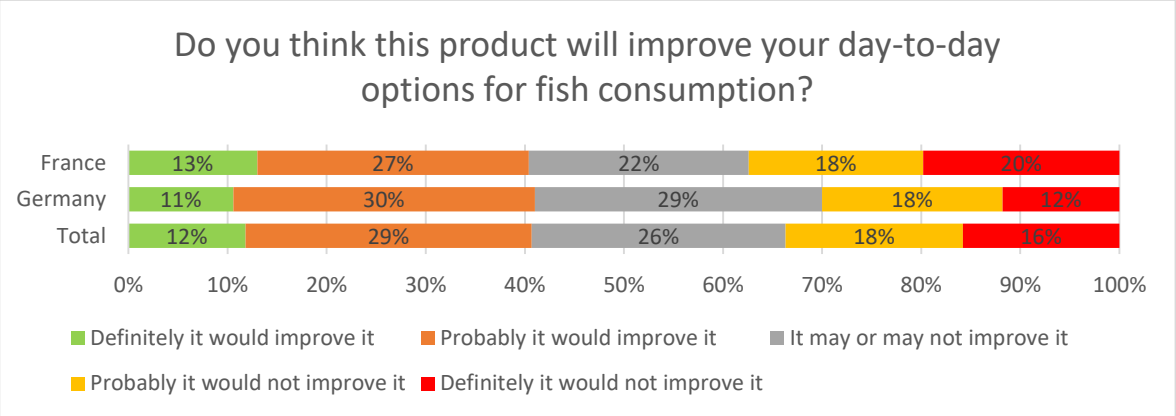

Figure 28: Percentage of consumers who considered that grilled seabass with lemon would increase their daily intake of fish consumption. Data shown by country (France, Germany; N=1000, 500 per country).

4.3.5. Beliefs about increasing children´s fish intake (<16 years old)

In general, around 50 % of the consumers believed that grilled seabass with lemon was interesting for increasing children´s fish intake (<16 years old). However, French consumers felt in a significantly higher percentage than German consumers that this product was interesting for increasing children´s fish intake (58 % *vs*. 49 % respectively; p<0.05; Figure 29).

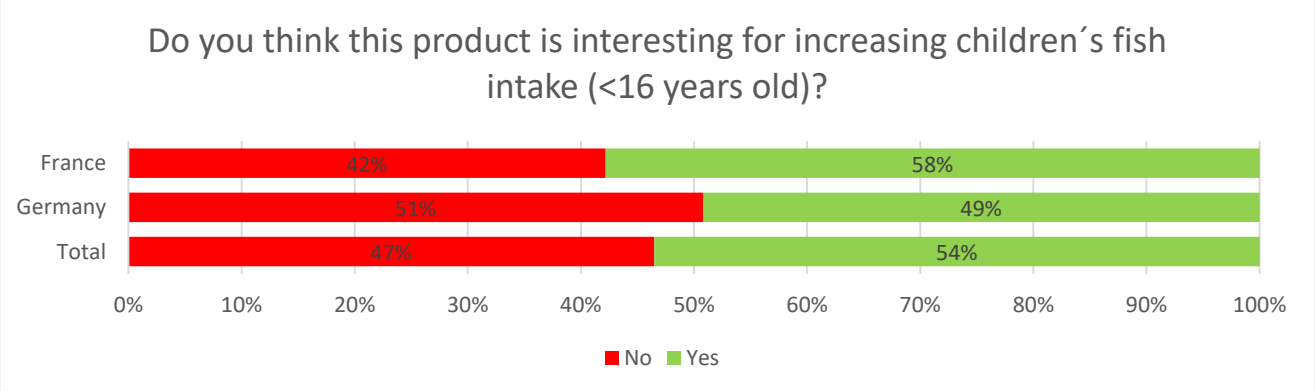

Figure 29: Percentage of consumers who considered that grilled seabass with lemon was interesting for increasing children´ fish intake (<16 years old). Data shown by country (France, Germany; N=1000, 500 per country).

4.4. Organic seabream with couscous

4.4.1. Product associations

Some photographs of the organic seabream with couscous were shown to consumers (Figure 30).

Figure 30: Photographs of organic seabream with couscous shown to consumers.

More than 50 % of the consumers would like to taste the organic seabream with couscous (55 %). This product could not be considered as a novel product since it seemed familiar for 49 % of the consumers. Considering the product preparation, 76 % of the consumers felt that they would prepare it easily. What is more, 63 % of the consumers considered that they would like the taste. Finally, 53 % of the consumers would purchase this product (Figures 31 and 32).

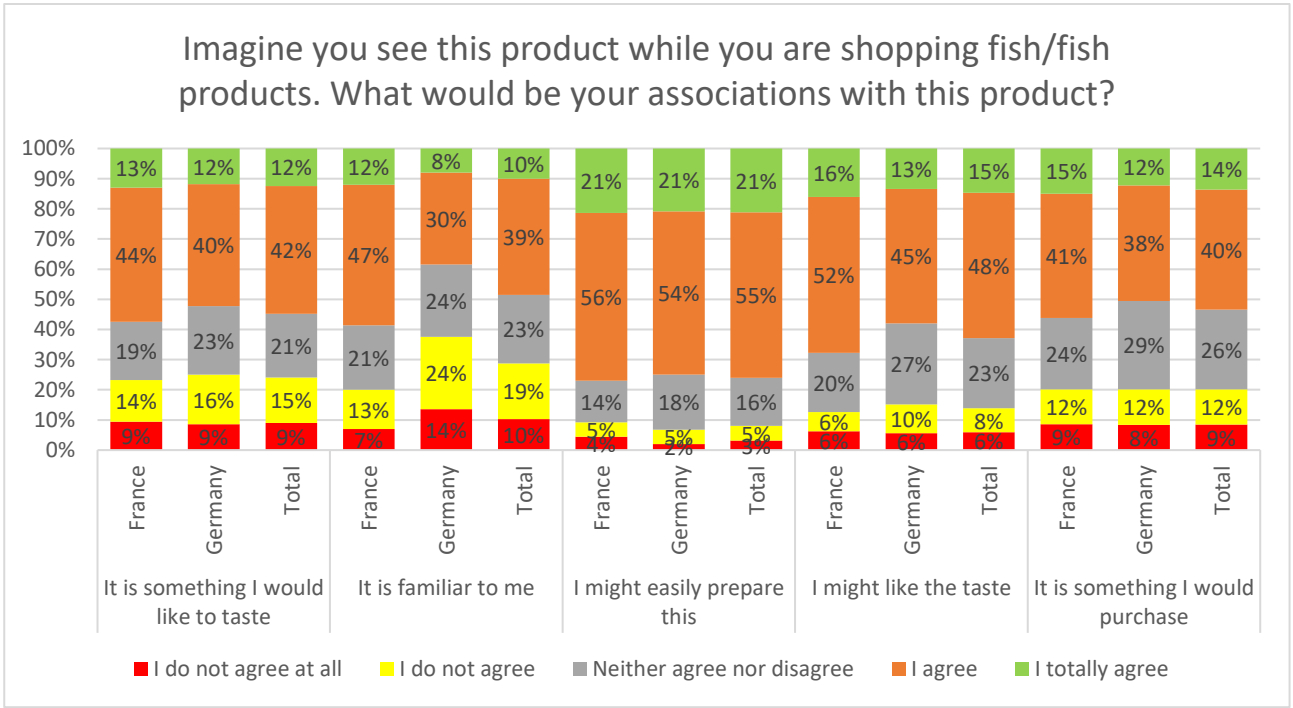

Figure 31: Percentage of selection for each statement regarding the associations consumers made while they were buying organic seabream with couscous. Consumers scored their (dis) agreement on a 5-point scale, anchored at 1 = "I do not agree at all" to 5 = "I totally agree". Data shown by country (France, Germany; N=1000, 500 per country).

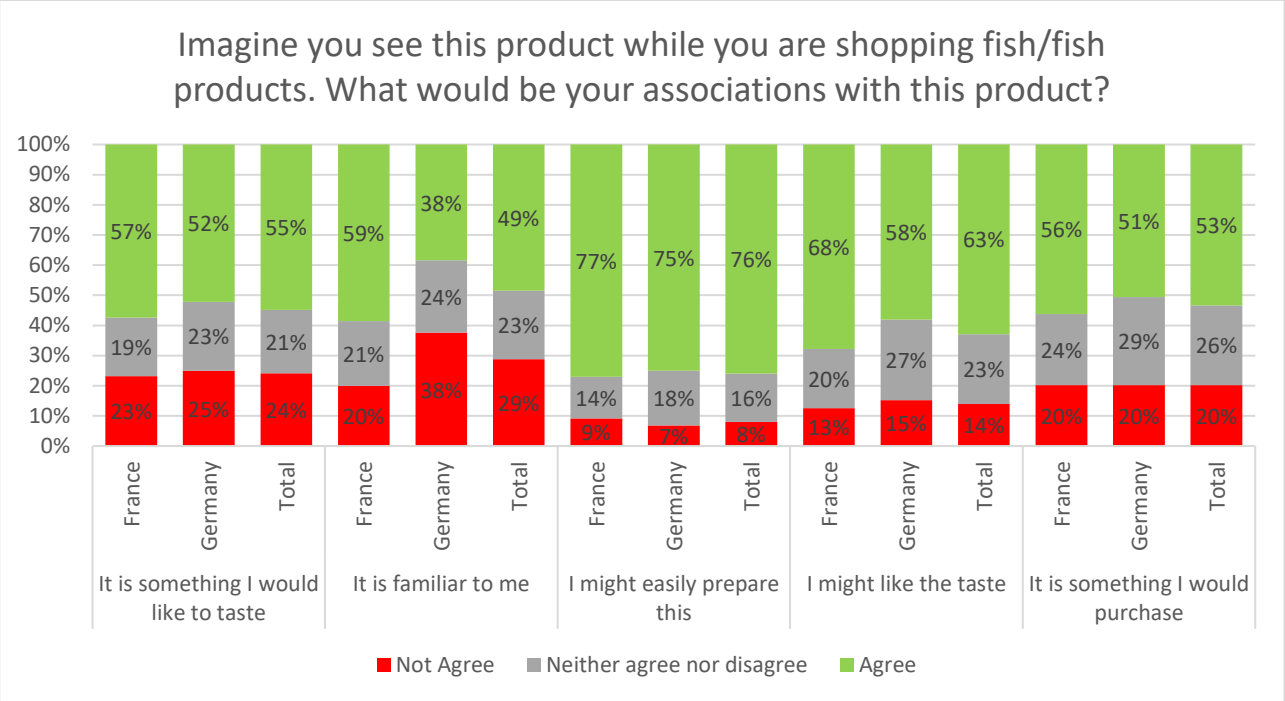

Figure 32: Percentage of selection for each statement regarding the associations consumers made while they were buying organic seabream with couscous. Consumers scored their (dis) agreement on 5-points scale, anchored at 1 = "I do not agree at all" to 5 = "I totally agree". Data shown by categories ("Not agree" (sum of percentage selected for 1 and 2), "Neither agree not disagree" (percentage of 3) and "Agree" (sum of percentage selected for 4 and 5)) and by country (France, Germany; N=1000, 500 per country).

If we considered the aggregated results by the percentage of agreement of each statement and by country, significant differences (p<0.05) were found. French consumers seemed to be significantly more familiarized with this product compared to their German counterparts. In addition, the percentage of French consumers who might like the taste was significantly higher than German consumers (Figure 32).

4.4.2. Product associations after product description

Product description was given to consumers regarding ingredients, percentage of aquaculture fish in the final recipe, storage conditions, servings and packing weight, product preparation, sensory description, suitability for consumers, Nutri-Score label, recipe suggestion and photographs of the cooked products (Figure 33).

PRODUCT DESCRIPTION:

This is a seabream fillet with couscous. This product is boneless. It is made with **organic 100% aquaculture fish (seabream)**.

This product should be stored in a cool chamber (4-5 ^{o}C). The product weighs 150-160 g and contains one serving. Ideal for lunch or dinner.

Ethnic recipe.

Ready-to-eat product for oven or microwave heating in its own packaging.

Suitable for children, senior and general consumers due to the nutritional value, taste, and easy cooking. Recycled packaging.

Figure 33: Product description of organic seabream with couscous provided to consumers.

On a 5-point hedonic scale anchored at 1 = "strongly disagree" to 5 = "strongly agree", consumers were asked how much they agreed with several statements based on several attributes of fish product and packaging after knowing the product description (Figure 33). Over 70 % of the consumers stated that the product seemed natural (73 %), it was easy to prepare (86 %) and it took a short time to prepare (82 %). Consumers also felt that the product could be healthy for them (72 %). Participants liked the idea of a boneless product (77 %). On the other hand, the results suggest that participants were almost evenly split on portion sizes. Also, the consumers felt that the pack fitted their needs (62 %). Regarding the image of the product, most consumers stated that organic seabream with couscous had a good image (68 %) and it seemed tasty (68 %). Finally, just 52 % of the participants felt that the product could be prepared in many ways (Figures 34 and 35).

Considering the data by country, significant differences (p<0.05) were found for all the statements except for three: "It seems a natural product", "It is easy to prepare" and "The portion sizes are too small". French participants showed for the remaining statements a significantly higher percentage of agreement than German participants ("I like the idea of a boneless product", "It has a good image", "It seems to take a short time to prepare", "Many ways to prepare", "It could be healthy for me", "The pack fits my needs" and "It seems tasty"; Figure 35).

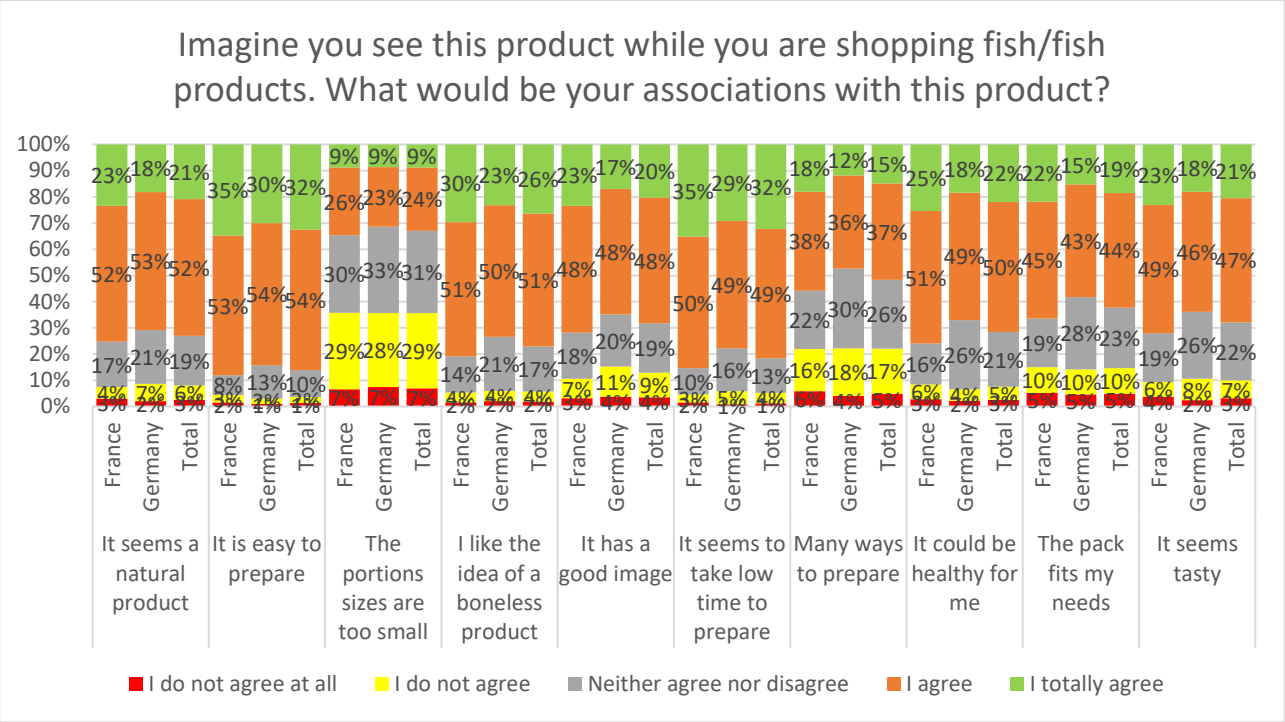

Figure 34: Percentage of selection for each statement regarding associations consumers made while they were buying organic seabream with couscous after knowing its description. Consumers scored their (dis) agreement on 5-point scale, anchored at 1 = "I do not agree at all" to 5 = "I totally agree". Data shown by country (France, Germany; N=1000, 500 per country).

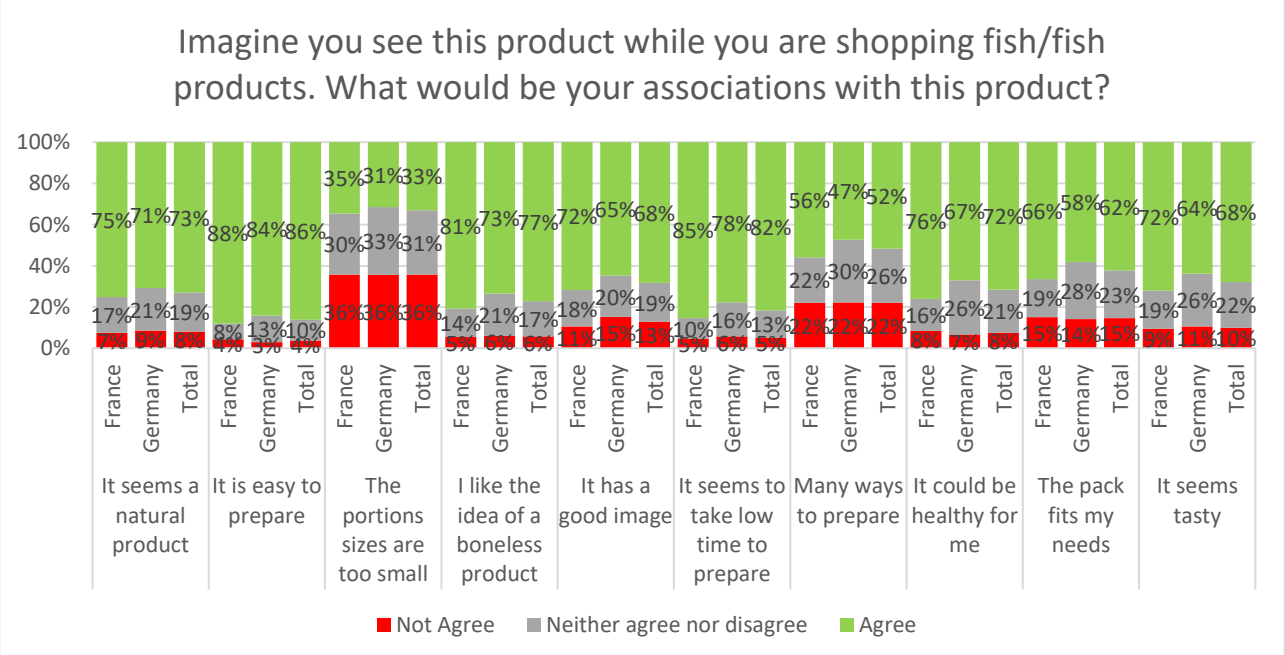

Figure 35: Percentage of selection for each statement regarding consumers´ associations while they were buying organic seabream with couscous after knowing its description. Consumers scored their (dis) agreement on 5-point scale, anchored at 1 = "I do not agree at all" to 5 = "I totally agree". Data shown by categories ("Not agree" (sum of percentage selected for 1 and 2), "Neither agree nor disagree" (percentage of 3) and "Agree" (sum of percentage selected for 4 and 5)) and by country (France, Germany; N=1000, 500 per country).

4.4.3. Purchase intention

Most consumers would buy this product (58 %; sum of definitely and probably would buy it). However, around 1 out of 4 consumers were undecided (Figure 36). French participants stated that they probably would buy the product in a significant higher percentage than German participants (60 % *vs.* 55 %, sum of definitely and probably would buy it, respectively; Figure 36).

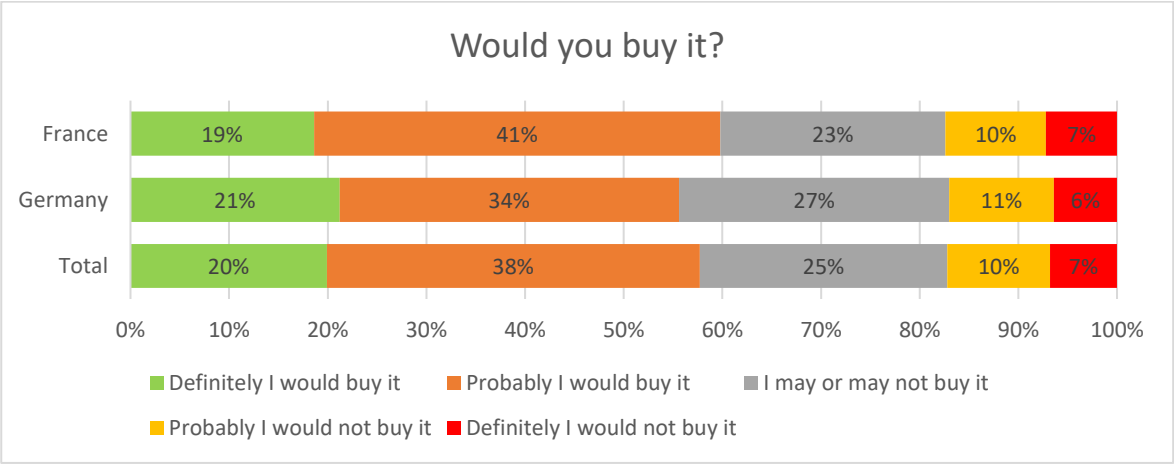

Figure 36: Percentage of consumers´ purchase intention after knowing some information about organic seabream with couscous. Data shown by country (France, Germany; N=1000, 500 per country).

4.4.4. Beliefs about improvement of the day-to-day options for fish consumption

More than 50 % of the consumers stated that this product would improve their day-to-day fish consumption (61 %; sum of ”Definitely it would improve it” and ”Probably it would improve it” (Figure 37).

Splitting the results by country, no significant differences were obtained (p>0.05).

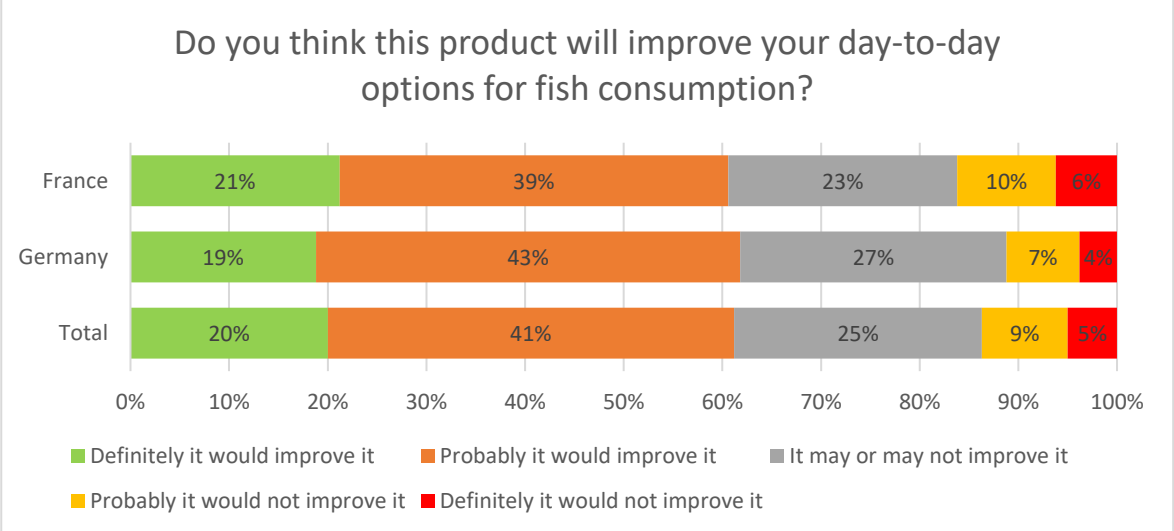

Figure 37: Percentage of consumers who considered that organic seabream with couscous would increase the daily intake of fish consumption. Data shown by country (France, Germany; N=1000, 500 per country).

4.4.5. Beliefs about increasing children´s fish intake (<16 years old)

In general, around 63 % of the consumers believed that organic seabream with couscous was interesting for increasing children´s fish intake (<16 years old).

Comparing the results by country, significant differences were observed (p<0.05). A significantly higher percentage of French consumers thought that this product was interesting for increasing children´s fish intake (69 % *vs*. 59 % respectively; Figure 38).

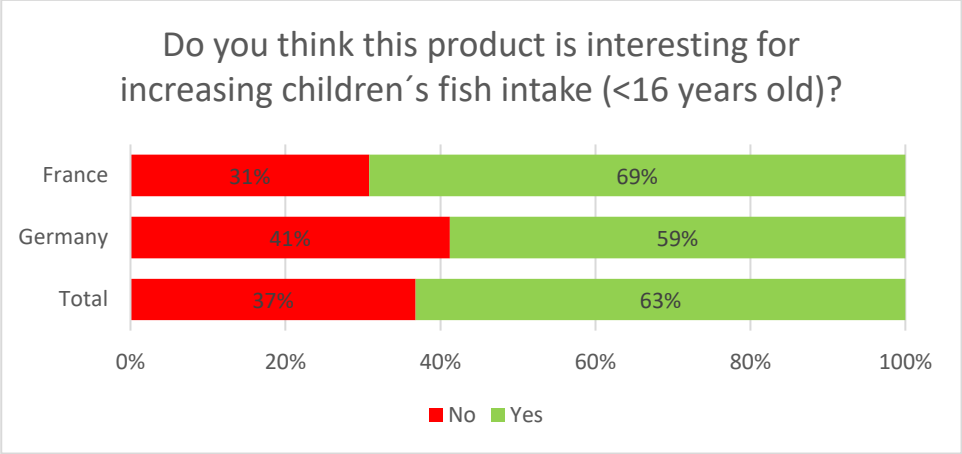

Figure 38: Percentage of consumers who considered that organic seabream with couscous was interesting for increasing children´s fish intake (<16 years old). Data shown by country (France, Germany; N=1000, 500 per country).

4.5. Seabream breaded bites

4.5.1. Product associations

Some photographs of the seabream breaded bites were shown to consumers (Figure 39).

Figure 39: Photographs of seabream breaded bites shown to consumers.

After viewing the photographs, more than 50 % of the consumers stated that they would like to taste the seabream breaded bites (53 %), they would prepare it easily (69 %), they would like the taste (59 %), and they would purchase this product (54%). However, this product seemed familiar for 42 % of the consumers (Figures 40 and 41).

If we consider the aggregated results by the percentage of agreement of each statement and by country, significant differences (p<0.05) were found. French consumers compared to German consumers were significantly more familiar with this product (58 % *vs.* 49 % respectively). However, German consumers would like to taste and purchase the seabream breaded bites in a significantly higher percentage than French consumers (Figure 41).

Figure 40: Percentage of selection for each statement regarding the associations consumers made while they were buying seabream breaded bites. Consumers scored their (dis) agreement on 5-points scale, anchored at 1 = "I do not agree at all" to 5 = "I totally agree". Data shown by country (France, Germany; N=1000, 500 per country).

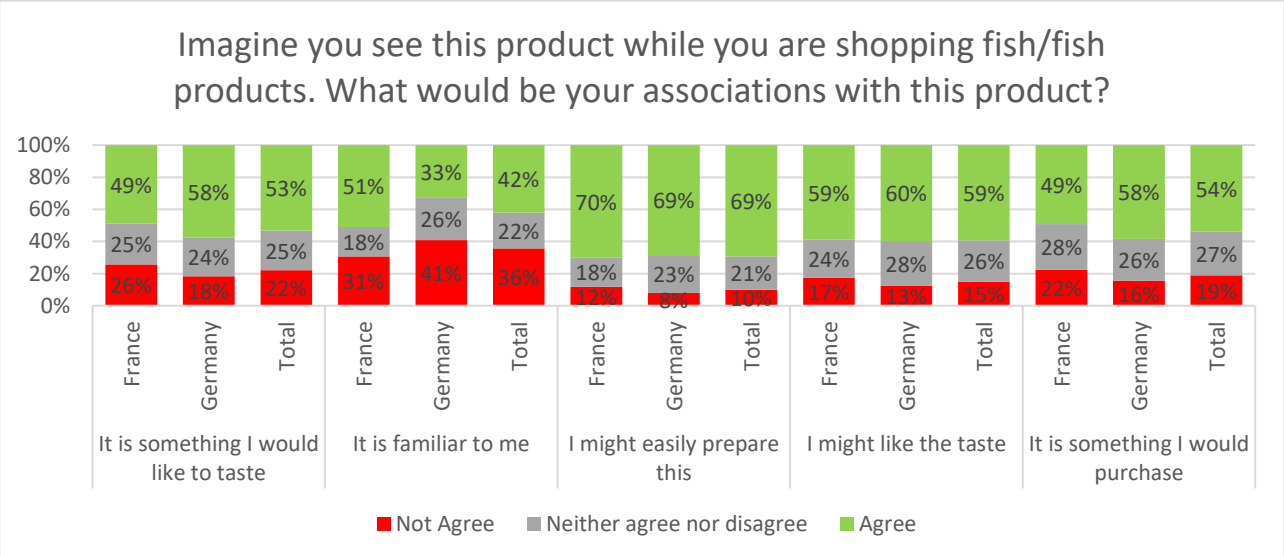

Figure 41: Percentage of selection for each statement regarding the associations consumers made while they were buying seabream breaded bites. Consumers scored their (dis) agreement on 5-point scale, anchored at 1 = "I do not agree at all" to 5 = "I totally agree". Data showed by categories ("Not agree" (sum of percentage selected for 1 and 2), "Neither agree nor disagree" (percentage of 3) and "Agree" (sum of percentage selected for 4 and 5)) and by country (France, Germany; N=1000, 500 per country).

4.5.2. Product associations after product description

The product description was given to consumers regarding ingredients, percentage of aquaculture fish in the final recipe, storage conditions, servings and packing weight, product preparation, sensory description, suitability for consumers, Nutri-Score label, recipe suggestion and photograph of the cooked products (Figure 42).

PRODUCT DESCRIPTION:

This is a seabream filet portions that form a stick breaded bites coated with thin pea flakes. This product is boneless. It is made with natural ingredients. It contains **73% aquaculture fish (seabream)**.

This product should be stored in freezing (-18 ºC). The pack has 180-190 g and it contains three servings. Ideal for dipping as a meal or snack.

Crunchy texture and mild taste.

It can be prepared in a heating oven or frying in just 10 minutes.

Suitable for children, senior and general consumers due to the nutritional value and safe use.

Figure 42: Product description of seabream breaded bites provided to consumers.

On a 5-point hedonic scale anchored at 1 = “strongly disagree” to 5 = “strongly agree”, consumers were asked how much they agreed with several statements based on several attributes of the fish product and packaging after knowing the product description (Figure 42). Most consumers stated that the product seemed to be easy to prepare (80 %) and to take a short time to prepare (79 %). In addition, consumers liked the idea of a boneless product (75 %). Over 50 % of the consumers felt that the product could be healthy for them (62 %) and that seemed natural (59 %). On the other hand, the results suggest that participants were almost evenly split on portion size although the consumers felt that the pack fitted their needs (56 %). Regarding the image of the product, most consumers affirmed that seabream breaded bites had a good image (63 %) and it seemed tasty (67 %). Finally, 55 % of the participants felt that the product had many ways to prepare (Figures 43 and 44).

Considering the data by country, significant differences (p<0.05) were found. German consumers felt in a higher percentage than French consumers that the product seemed natural (63 % *vs*. 55 % respectively). By contrast, a higher percentage of French consumers compared to German ones stated that the product had many ways to prepare it (59 % *vs*. 50 % respectively, Figure 44).

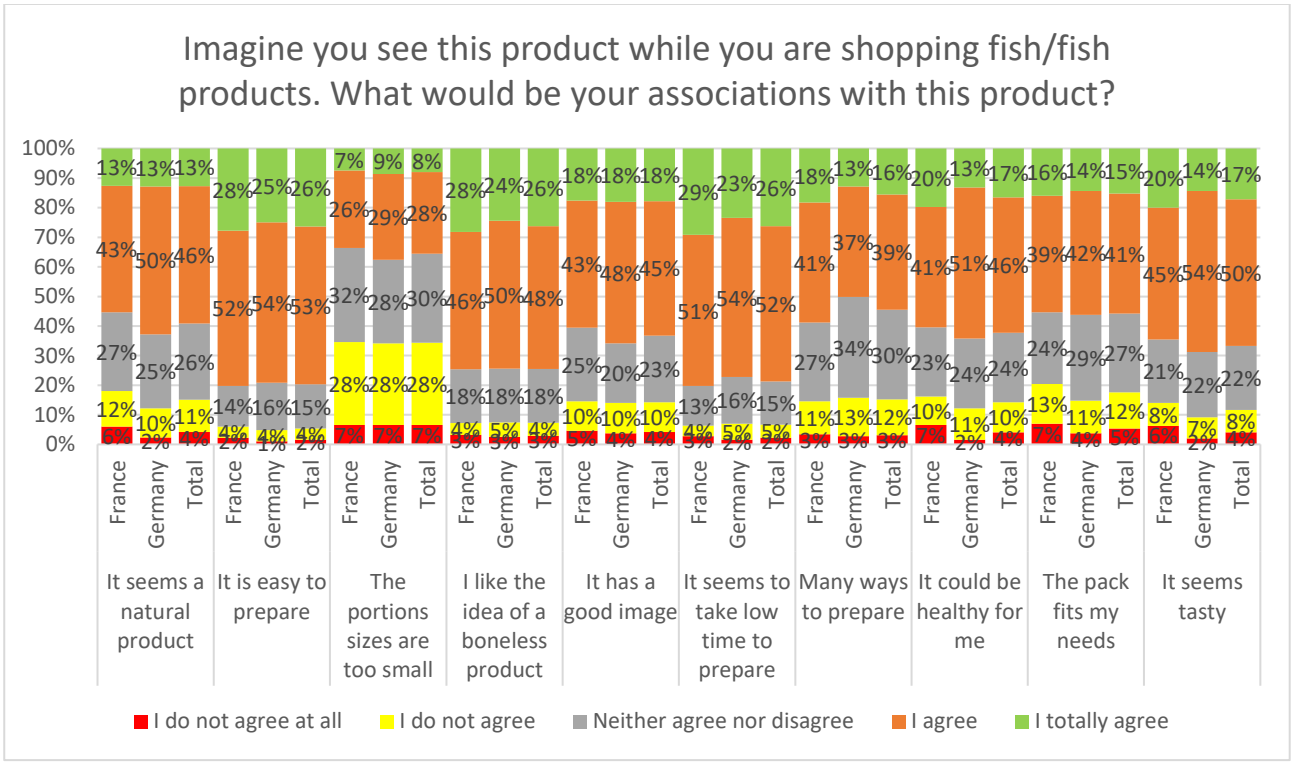

Figure 43: Percentage of selection for each statement regarding the associations consumers made while they were buying seabream breaded bites after knowing their description. Consumers scored their (dis) agreement on 5-point scale, anchored at 1 = "I do not agree at all" to 5 = "I totally agree". Data showed by country (France, Germany; N=1000, 500 per country).

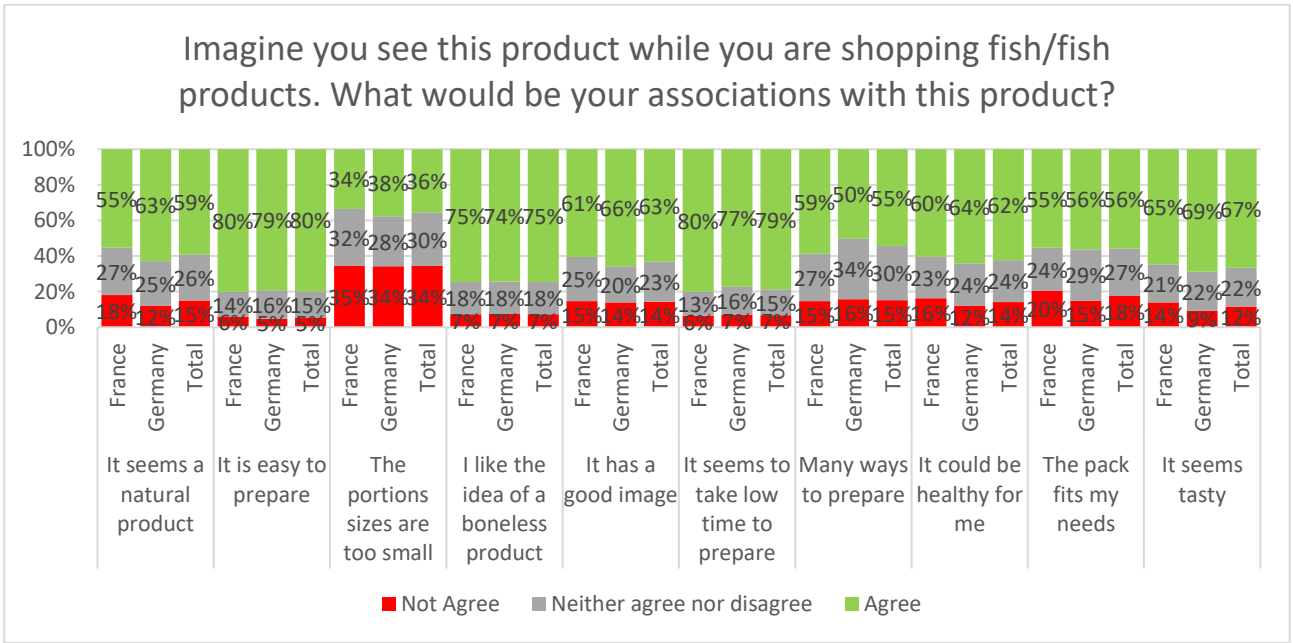

Figure 44: Percentage of selection for each statement regarding the associations consumers made while they were buying seabream breaded bites after knowing their description. Consumers scored their (dis) agreement on 5-point scale, anchored at 1 = "I do not agree at all" to 5 = "I totally agree". Data showed by categories ("Not agree" (sum of percentage selected for 1 and 2), "Neither agree nor disagree" (percentage of 3) and "Agree" (sum of percentage selected for 4 and 5)) and by country (France, Germany; N=1000, 500 per country).

4.5.3. Purchase intention

Over 50 % of the consumers would buy this product (56 %; sum of definitely and probably would buy it). However, there were 28 % of the consumers who were undecided (Figure 45).

Splitting the results by country, no significant differences (p>0.05) were shown for each alternative. However, if the aggregated data were considered, significant differences were obtained (p<0.05). German participants stated that they would probably buy the product in a significant higher percentage than French participants (sum of definitely and probably would buy it; 60 % *vs.* 51 respectively; Figure 45).

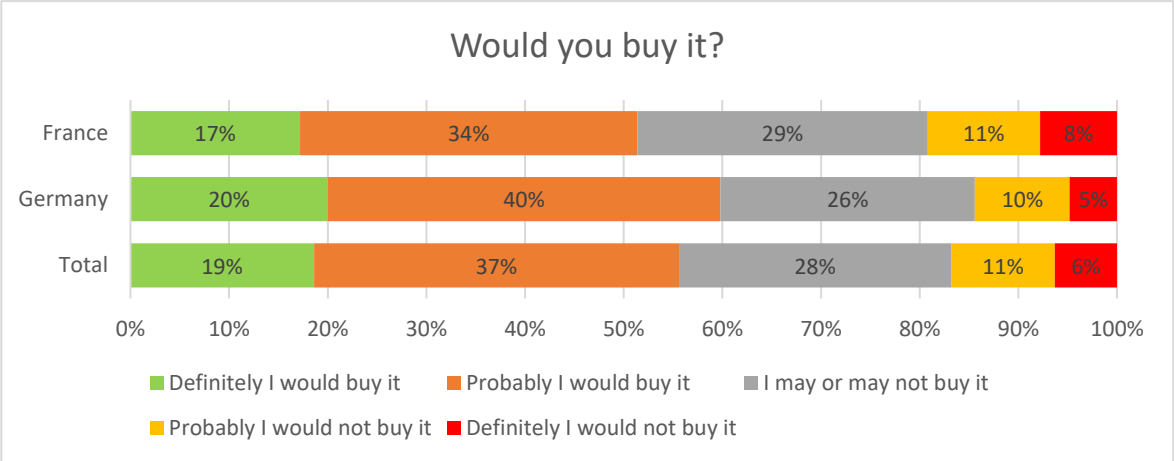

Figure 45: Percentage of consumers' purchase intention after knowing some information about seabream breaded bites. Data shown by country (France, Germany; N=1000, 500 per country).

4.5.4. Beliefs about improvement of the day-to-day options for fish consumption

More than 50 % of the consumers felt that this product would improve their day-to-day fish consumption (56 %; sum of "Definitely it would improve it" and "Probably it would improve it"; Figure 46).

Splitting the results by country, significant differences were obtained (p<0.05). German consumers stated in a higher percentage than French consumers that the seabream breaded bites would improve their day-to-day fish consumption (61 % *vs*. 52 % respectively; sum of definitely and probably would improve it; Figure 46). These differences were based on the percentage of selection of the option "Probably it would improve it". By contrast, French consumers stated that this product would not increase their fish consumption in a higher percentage than German consumers (19 % *vs*. 10 % respectively, sum of definitely and probably would not improve it; Figure 46). These differences were based on the percentage of selection of the option "Definitely it would not improve it" (Figure 46).

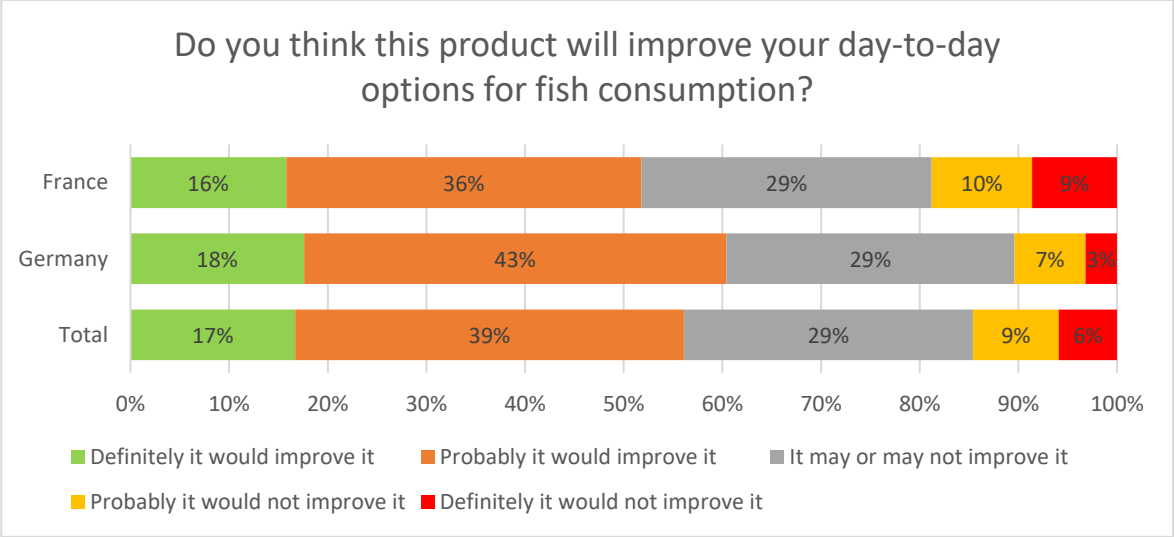

Figure 46: Percentage of consumers who considered that seabream breaded bites would increase the daily intake of fish consumption. Data shown by country (France, Germany; N=1000, 500 per country).

4.5.5. Beliefs about increasing children´s fish intake (<16 years old)

In general, around 80 % of the consumers believed that seabream breaded bites was interesting for increasing children´s fish intake (Figure 47). No significant differences were found between countries (p>0.05).

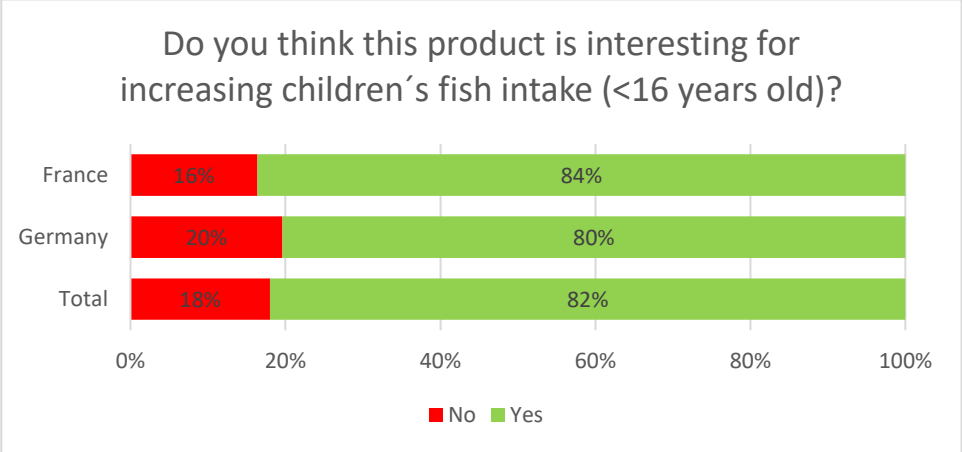

Figure 47: Percentage of consumers who considered that seabream breaded bites were interesting for increasing children´s fish intake (< 16 years old). Data shown by country (France, Germany; N=1000, 500 per country).

4.6. Consumers´ profile

4.6.1. General data

A total of N = 1000 questionnaires (500 from France and 500 from Germany) were completed in an online survey and the data collection took place from 18th December 2020 to 22nd December 2020. Participants were recruited by We Are Testers, an external consumer recruitment agency. Fixed quotas were set for each country to generate a sample to be as representative as possible regarding the criteria specified.

The sample turned out to be largely representative of the population of each country with regard to age, gender and geographical area of each country. The key demographic characteristics of the sample is shown in Table 3.

Table 3: Socio-demographic data of the participant. Data shown by country (France, Germany; N=1000, 500 per country).

		France	Germany	Total	*p*-value*
Sample size		n = 500	n = 500	N = 1000	n.s.
Gender (% Female)		52%	51%	52%	n.s.
Age (in years; mean ± SD)		44.36 ± 11.2	44.66 ± 11.09	44.51 ± 11.14	n.s.
Household members (mean ± SD)		2.98 ± 1.92	2.47 ± 1.25	2.73 ± 1.25	< 0.0001
Percentage of participants who lived in couples with children under 18 years old		52%	24%	38%	< 0.0001
Community size [1]	**Small town less than 1,000 inhabitants**	11%	9%	10%	n.s.
	Small town from 1,000 to 5,000 inhabitants	21%	12%	17%	0.0002
	Town from 5,000 to 10,000 inhabitants	11%	9%	10%	n.s.
	City from 10,000 to 50,000 inhabitants	25%	26%	25%	n.s.
	Big city more than 50,000 inhabitants	31%	44%	38%	< 0.0001
Education	**Under a high school diploma**	10%	1%	5%	< 0.0001
	Bachelor´s degree	21%	17%	19%	n.s.
	High school diploma or equivalent	47%	62%	55%	< 0.0001
	Master´s degree	17%	19%	18%	n.s.
	Doctorate	5%	1%	3%	0.0014
Household income	**Less than 13,000 €**	8%	8%	8%	n.s.
	13,000 € - 19,499 €	14%	9%	11%	0.0086
	19,500 € - 38,999 €	35%	25%	30%	< 0.0001
	39,000 € - 64,999 €	28%	26%	27%	n.s.
	65,000 € - 79,999 €	3%	15%	9%	< 0.0001
	80,000 € - 100,000 €	4%	6%	5%	n.s.
	More than 100,000 €	2%	5%	3%	0.0079
	I do not know / Prefer not to answer	6%	6%	6%	n.s.

[1]Based on self-assessment of participants.

***** Significant data ($p<0.05$). Not significant (n.s.; $p>0.05$).

4.6.2. Gender and age

Regarding the gender of participant, 52 % were women and 48 % were men. Both countries showed approximately the same gender proportion (Figure 48).

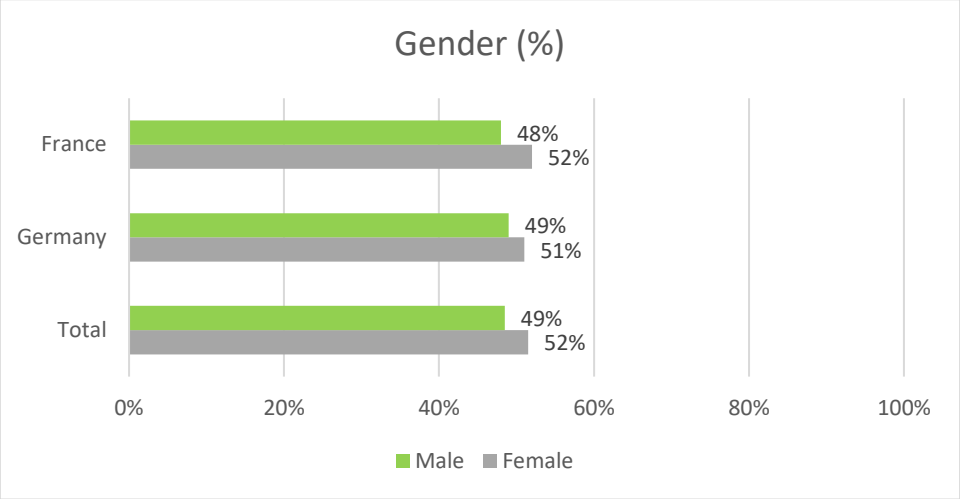

Figure 48: Gender of the participants. Data shown by country (France, Germany; N=1000, 500 per country).

Regarding the age, the participants involved in this study were between 25 and 65 years old, the mean age being around 45 years old (44.51± 11.14 years old). By country, French consumers were 44.36±11.20 years old and German consumers 44.66±11.09 years old (Mean data ± Standard Deviation). The group age by gender and country were shown in Figure 49. No significant differences were found, either between mean age or between the proportion of groups of age (p>0.05).

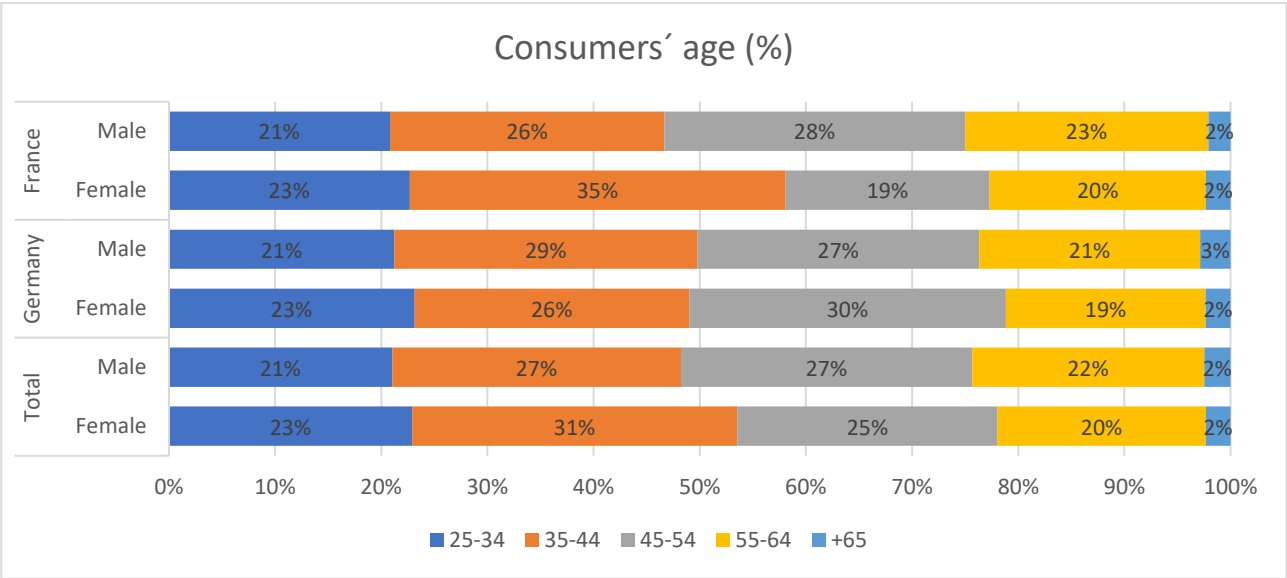

Figure 49: Groups of age of the participants. Data n by gender and country (N=1000, 500 per country).

4.6.3. Household characteristics

Regarding the **type of household**, most participants lived with their partner and with children under 18 years (38 %). Although significant differences were observed for the percentage of selection of all the options (p<0.05). In France, most participants were couples with children under 18 years (52 %). However, in

Germany, there were participants in around the same percentage that lived alone, lived with household members older than 18 years or dependent people and couples with children under 18 years (30 %, 26 % and 24 % respectively; Figure 50).

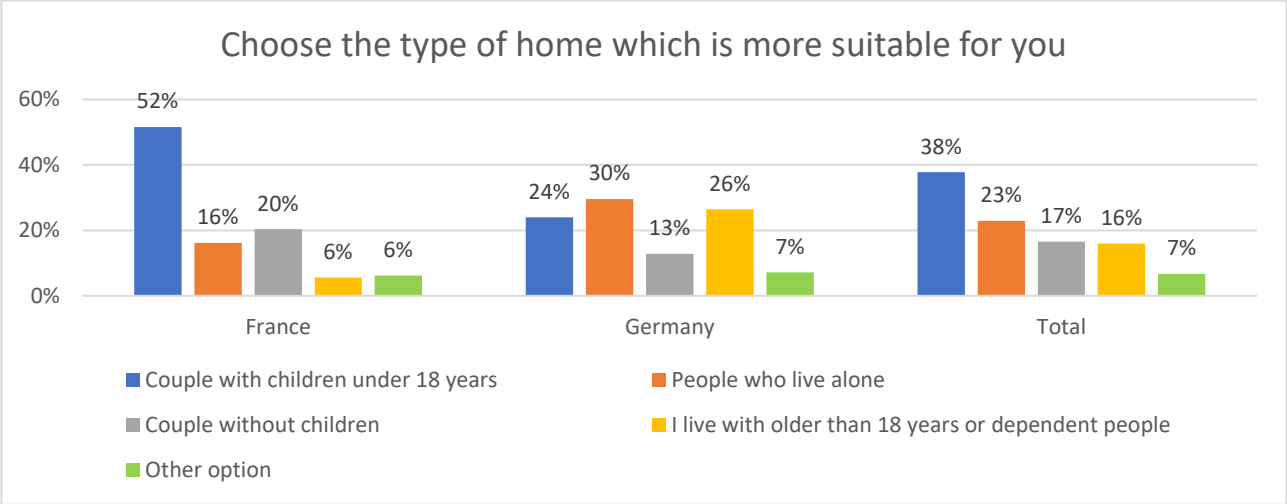

Figure 50: Percentage of selection of each statement considering the participant's household type. Data shown by country (France, Germany; N=1000, 500 per country).

Considering the **household size**, in general, almost half of all respondents lived in a two-person household (47 %). Overall, 92 % of the participants lived in a household with up to four members. However, the household size differed significantly between countries. Meanwhile the households with 1 and 2 members were more frequent in Germany, the households with 4 or 5 members were more frequent in France (p<0.05; Figure 51).

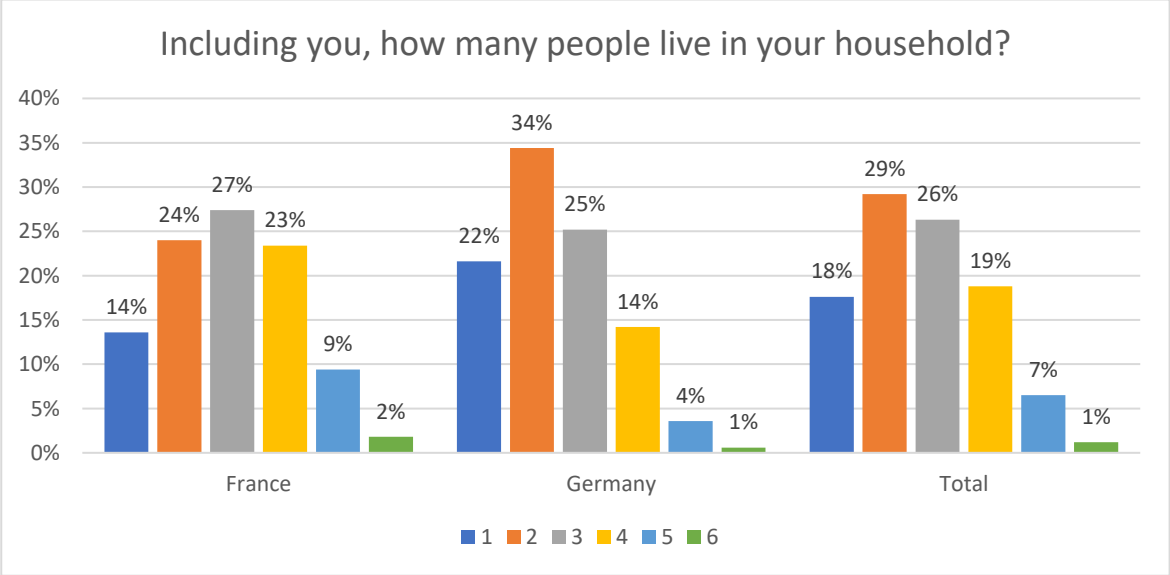

Figure 51: Percentage of selection of each statement considering the household size. Data shown by country (France, Germany; N=1000, 500 per country).

Participants were asked how many of the people who lived in the household were **children** (under 18 years old). Most participants lived with one child (55 %). However, the number of children living in the household differed significantly between countries (p<0.05). The households with 1 child were more frequent in

Germany, meanwhile the households with no child, with 2 or with 3 children were more frequent in France (p<0.05; Figure 52).

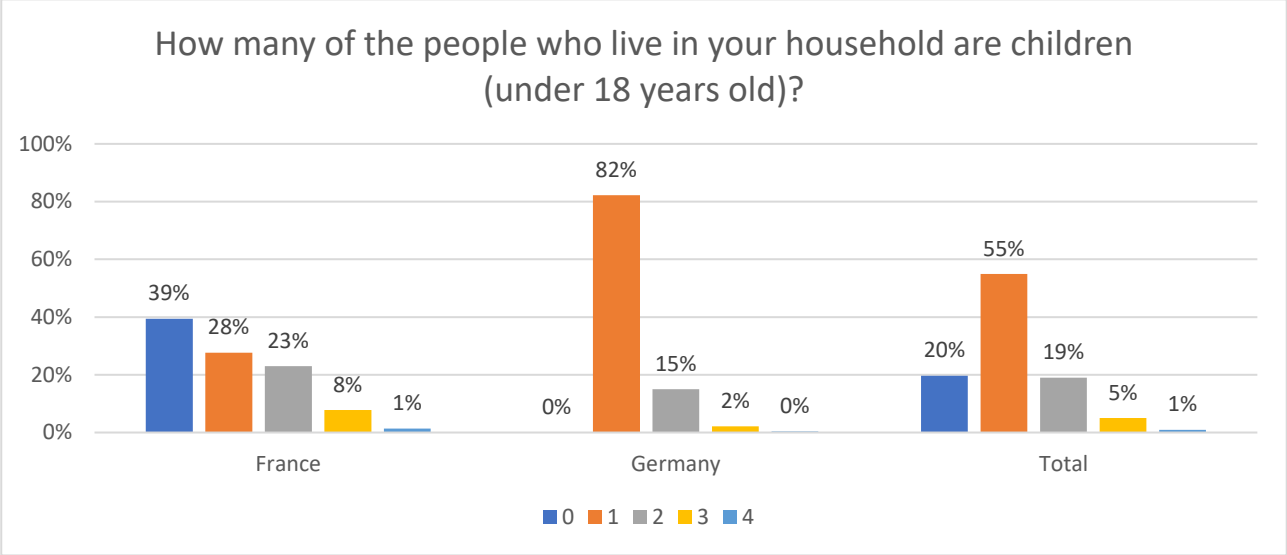

Figure 52: Percentage of selection of each statement considering the number of children living in the household. Data shown by country (France, Germany; N=1000, 500 per country).

4.6.4. Characteristic of the place of residence

Overall, 69 % of the participants lived in an inland area. However, significant differences were found for the percentage of people that stated that they lived in coastal and intercoastal areas (p<0.05). A higher percentage of French participants lived in a coastal area. In contrast, a higher percentage of German participants lived in an intercoastal area (Figure 53).

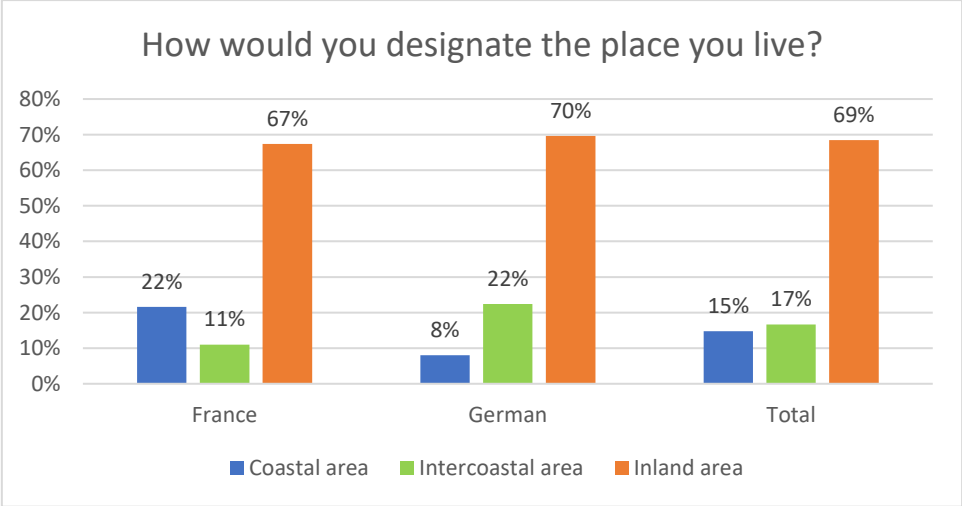

Figure 53: Percentage of selection of each statement regarding the designation of the place where the participants lived. Data shown by country (France, Germany; N=1000, 500 per country).

Considering the **inhabitants of the participants´ place of residence**, most of them lived in a big city (more than 50,000 inhabitants), followed by city with 10,000 to 50,000 inhabitants and small town from 1,000 to 5,000 inhabitants (Figure 54). However, there were significant differences between countries for the

percentage of participants that stated that they lived in big cities and in small towns from 1,000 to 5,000 inhabitants (p<0.05; Figure 54; Table 3).

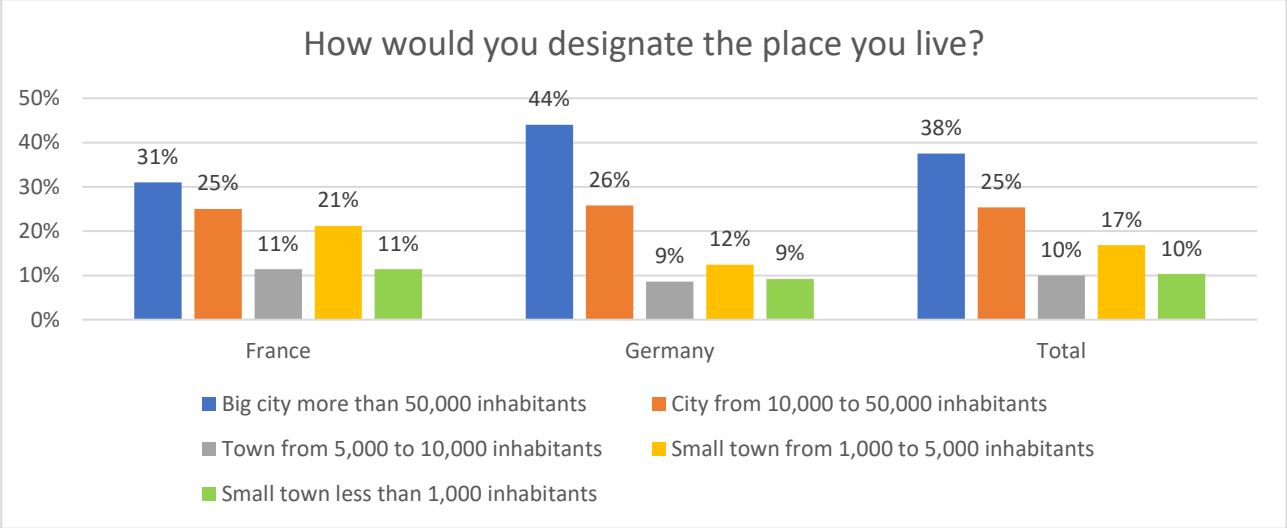

Figure 54: Percentage of selection of each statement considering the number of inhabitants of the place where the participants live. Data shown by country (France, Germany; N=1000, 500 per country).

4.6.5. Level of education

Around 55 % of all the participants held a high school diploma or equivalent, this percentage being significantly different between countries (p<0.05). A higher percentage of German participants held a high school diploma or equivalent than French participants (62 % *vs*. 47 %; Figure 55). However, a significantly higher percentage of French participants held a doctorate than German participants (5 % *vs*. 1 %; Figure 55). In addition, there was a significantly higher percentage of French participants with an education level under a high school diploma than German participants (Figure 55; Table 3).

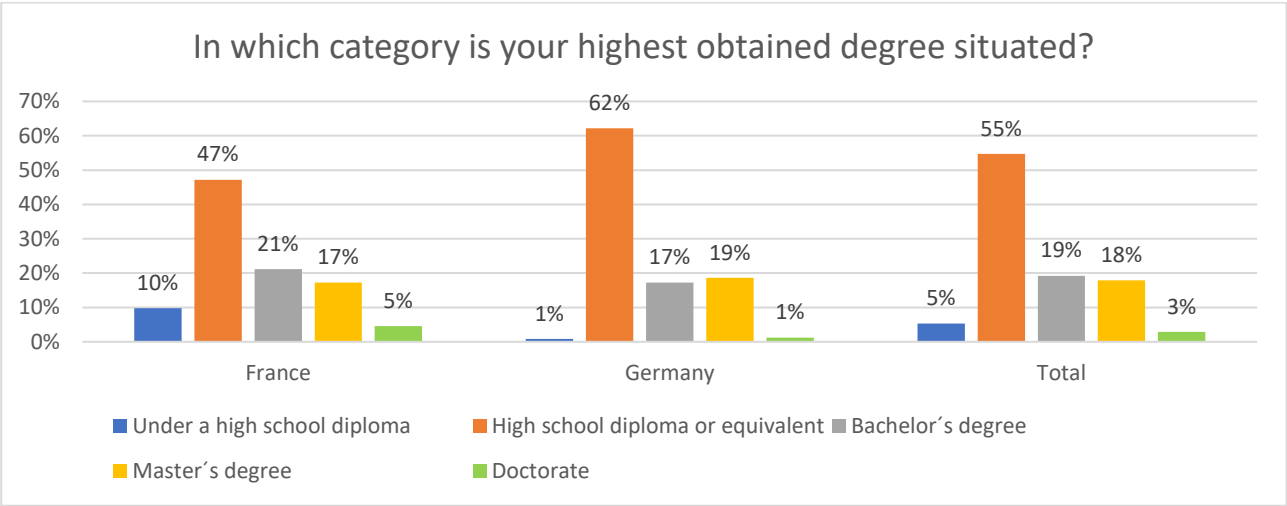

Figure 55: Level of education of the participants. Data shown by country (France, Germany; N=1000, 500 per country).

4.6.6. Household income

On average, around 60 % of the participants stated that their household income was between 19,500€ and 64,999€. However, the income distribution between countries differed significantly (p<0.05). In France, there were more participants that stated both that their income per year was between 13,000€ and 19,499€, and between 19,500€ and 38,999€. In contrast, a higher percentage of German participants stated that their household income per year was between 65,000€ and 79,999€ (Figure 56).

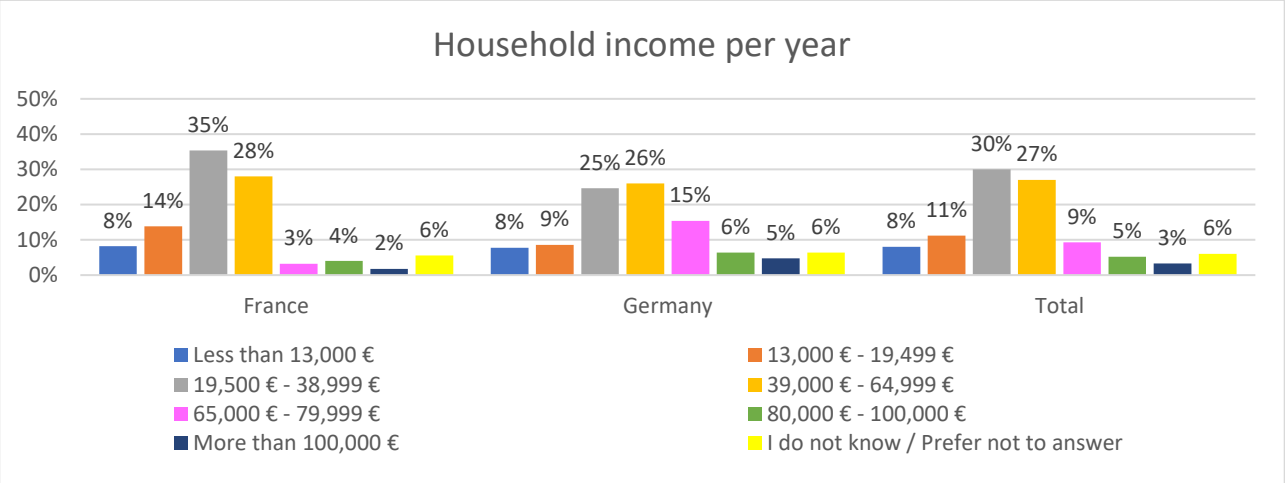

Figure 56: Percentage of selection of each statement considering the type of the participant's household. Data shown by country (France, Germany; N=1000, 500 per country).

Consumers were asked about the **amount available for grocery shopping** and overall, 11 % stated that "There is a need to consider prices carefully, which limits many choices when purchasing food". However, 90 % of all the participants were split between the options "There is enough money to buy foods" and "There is some need to consider prices, which limits some choices when buying food" (Figure 57).

Considering the data by country, significant differences were found for all the statements (p<0.05). The results pointed out than French consumers showed higher money limitations for grocery shopping than German consumers (Figure 57), since there was a higher percentage of participants who selected the option "There is a need to consider prices carefully, which limits many choices when purchasing food" and lower percentage of selection of "There is enough money to buy the foods you want" (Figure 57). This data seems to be related to household income per year.

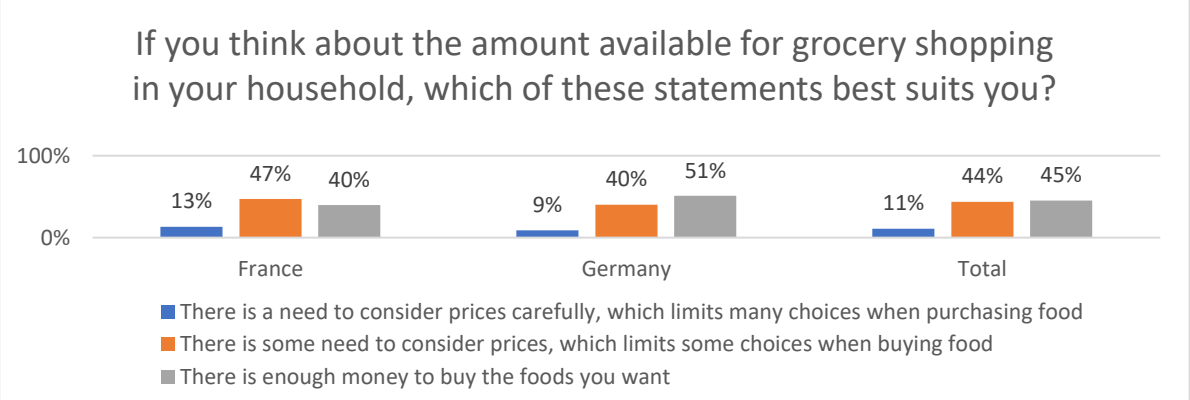

Figure 57: Percentage of selection of each statement. Data shown by country (France, Germany; N=1000, 500 per country).

4.6.7. Responsibility for food-related activities in the household

Consumers were asked to what extent they were responsible for food shopping and cooking in the household. In both countries, participants were the main household member responsible for both shopping and cooking (23 % and 77 % respectively; Figure 58). Significant differences were not found between countries (p>0.05).

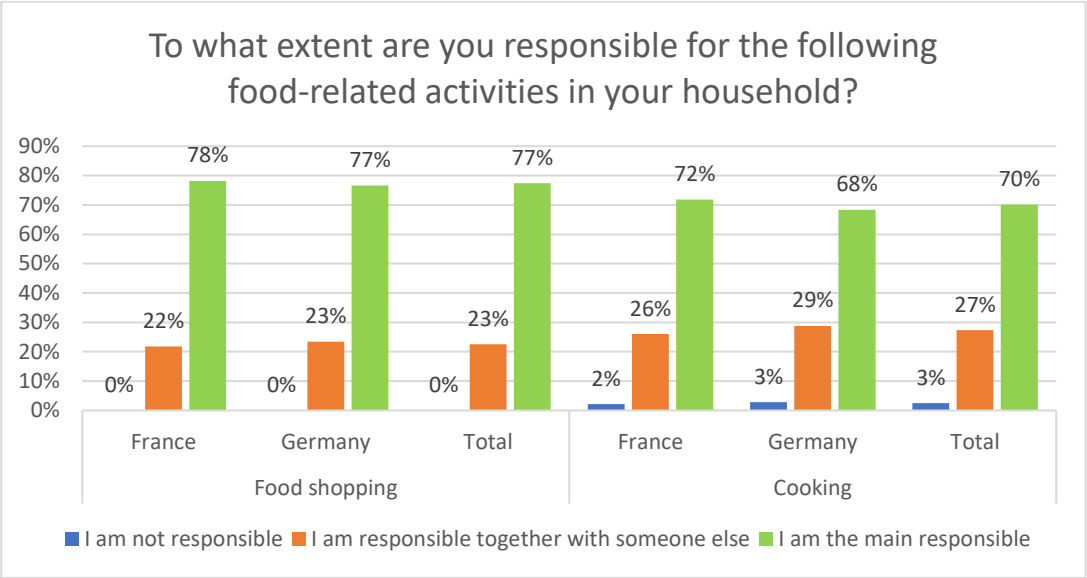

Figure 58: Percentage of selection of each statement regarding food shopping and cooking responsibility in the household. Data shown by country (France, Germany; N=1000, 500 per country).

4.7. Changes in purchase intention

The purchase intention of consumers was asked twice, one without additional information about product characteristics and another one with. The information provided to consumers included ingredients, percentage of aquaculture fish in the final recipe, storage conditions, servings and packing weight, product preparation, sensory description, suitability for consumers, Nutri-Score label, recipe suggestion and photographs of the cooked product. Comparing the purchase intention before and after the information was given to consumers, changes in the purchase intention were observed, the purchase intention being higher after providing information to consumers. The purchase intention increased up to 13 % (Table 4). Significant differences (p<0.05) were observed for the purchase intention of sea and mountain burger in both countries (France and Germany) and grilled seabass with lemon for German consumers (Table 4).

Table 4: Comparison between the purchase intention before and after providing product information to consumers. The information provided to consumers included ingredients, percentage of aquaculture fish in the final recipe, storage conditions, servings and packing weight, product preparation, sensory description, suitability for consumers, Nutri-Score label, recipe suggestion and photographs of the cooked product (N=1000; 500 per country).

Product	Information	Country	Purchase intention		
			Would buy it	May or may not buy it	Would not buy it
Sea and mountain burger	Before information	France	28.20%	20.80%	51.00%
	After information	France	38.80%	25.80%	35.40%
		p-value	**< 0.0001**	n.s.	**< 0.0001**
	Before information	Germany	25.60%	28.20%	46.20%
	After information	Germany	39.00%	33.60%	27.40%
		p-value	**< 0.0001**	n.s.	**< 0.0001**
Grilled seabass with lemon	Before information	France	37.80%	21.80%	40.40%
	After information	France	37.20%	23.80%	39.00%
		p-value	n.s.	n.s.	n.s.
	Before information	Germany	27.86%	23.45%	48.70%
	After information	Germany	35.80%	25.20%	39.00%
		p-value	**0.007**	n.s.	**0.002**
Organic seabream with couscous	Before information	France	56.20%	23.60%	20.20%
	After information	France	59.80%	22.80%	17.40%
		p-value	n.s.	n.s.	n.s.
	Before information	Germany	50.60%	29.20%	20.20%
	After information	Germany	55.60%	27.40%	17.00%
		p-value	n.s.	n.s.	n.s.
Seabream breaded bites	Before information	France	49.20%	28.40%	22.40%
	After information	France	51.40%	29.40%	19.20%
		p-value	n.s.	n.s.	n.s.
	Before information	Germany	58.40%	26.00%	15.60%
	After information	Germany	59.80%	25.80%	14.40%
		p-value	n.s.	n.s.	n.s.

*Values in **bold** showed significant differences (p<0.05); n.s. not significant (p>0.05).*

4.8. Statements correlated to purchase intention

4.8.1. Before information

When some photographs of the products were shown to participants, without giving them additional information regarding product characteristics, the statements “It is something I would like to taste”, “It is familiar to me”, “I might easily prepare this” and “I might like the taste” were positively correlated to “It is something I would purchase” (p<0.05; Table 5). The higher the agreement scores of each of the statements, the higher the purchase intention observed. These correlations were stronger for “It is something that I would like to taste” and “I might like the taste” (Table 5). Thus, the more the participants would like to taste the products, the higher the purchase intention observed. Similar results were obtained by country. However,

the statements “It is familiar to me” and “I might easily prepare this” were more determinant for increasing purchase intention for French participants than for German participants (Table 5). Hence, the purchase intention of French participants seems to be more closely linked to the existence of similar products on the market.

Table 5: Correlation matrix (Spearman (ρ)) regarding several statements with the purchase intention before product characteristics were given to participants (N=1000; 500 per country).

Variables	It is something I would purchase		
	France	Germany	Total
It is something I would like to taste	0.851	0.847	0.849
I might like the taste	0.839	0.826	0.832
It is familiar to me	0.682	0.623	0.650
I might easily prepare this	0.638	0.570	0.606

Values in green were different from 0 with a significance level alpha=0.05

4.8.2. After information

When information about product characteristics were given to consumers (ingredients, percentage of aquaculture fish in the final recipe, storage conditions, servings and packing weight, product preparation, sensory description, suability for consumers, Nutri-Score label, recipe suggestion and photographs of the cooked product), the statements “It seems a natural product”, “It is easy to prepare”, “The portions sizes are too small”, “I like the idea of a boneless product”, “It has a good image”, “It seems to take a short time to prepare”, “Many ways to prepare”, “It could be healthy for me”, “The pack fits my needs”, “It seems tasty” were correlated positively to purchase intention (p<0.05; Table 6). The higher the agreement scores of each of the statements, the higher the purchase intention observed. In addition, the correlations with purchase intention were stronger for “It seems tasty”, “The pack fits my needs”, “It has a good image” and “It could be healthy for me”. Although the order of correlation statements was very similar in both countries, differences in the correlation index were observed by country. For example, the statement “It seems tasty” was very closely correlated to purchase intention in both countries (France and Germany), but it was much more determinant for purchase intention for French participants than for German participants. (Table 6). Similar results were obtained for the statements “The pack fits my needs”, “It has a good image” and “It could be healthy for me” (Table 6).

Table 6: Correlation matrix (Spearman (ρ)) regarding several statements with the purchase intention after product characteristics were given to participants (N=1000).

Variables	Purchase intention		
	France	Germany	Total
It seems tasty	0.781	0.702	0.743
The pack fits my needs	0.751	0.662	0.708
It has a good image	0.713	0.684	0.698
It could be healthy for me	0.673	0.566	0.622
It seems a natural product	0.589	0.464	0.529
Many ways to prepare	0.478	0.462	0.466
I like the idea of a boneless product	0.445	0.422	0.432
It seems to take low time to prepare	0.449	0.368	0.406
It is easy to prepare	0.446	0.365	0.405
The portions sizes are too small	0.159	0.152	0.155

Values in green were different from 0 with a significance level alpha=0.05

5. Main findings

WHEN ONLY SOME PHOTOGRAPHS OF THE PRODUCTS DEVELOPED WERE SHOWN TO CONSUMERS

- In general, **fish was more consumed** than fish products followed by fish from aquaculture. In general, French participants consumed fish more frequently than German participants. It should be noted that **25 % of the French and 17 % of the German participants stated that they have never consumed fish from aquaculture**. These results were **in line with the results obtained regarding fish purchase frequency**.
- Concerning the **origin of the fish**, almost half of the consumers consumed both **wild fish and fish from aquaculture**, this frequency being higher for German participants.
- The **species selected as an ingredient in the product developed** (i.e. seabass, gilthead seabream and meagre) were **more consumed in Germany than in France**.
- The fish **most consumed at home were fresh fish, frozen fish and fish fillets**, the fresh fish and the whole fish being consumed more frequently by French consumers. By contrast, German participants consumed sushi, canned, fish fillets and frozen fish more frequently.
- **Participants prepared the fish at home more frequently pan/fried followed by grilling/oven and steaming**. However, differences were observed between countries, since the most frequent way to prepare the fish at home in France was grilling/oven (41 %) meanwhile in Germany it was in the pan/fried (60%).
- **Most participants trusted new food, liked to try new food and felt that innovations in food technology could help us produce foods sustainably**. German consumers trusted new food and stated that innovations in food technology can help us produce foods sustainably in a higher proportion than French consumers.
- **French and German consumers identified taste, healthy product and percentage of fish contained as the three most important aspects for buying fish**. Inversely, Mediterranean origin, organic ingredients and the product is from aquaculture were identified as the least important characteristic for buying fish products.
- After some pictures were shown to consumers, **more than half of them would like to taste and felt that they would like the taste of seabream breaded bites and organic seabream with couscous**, meanwhile

around 30 % of them would like to taste grilled seabass with lemon and sea and mountain burger. These results were in line with their **purchase intention**.

- Regarding the easiness of preparation, **participants stated than they might easily prepare the products developed**, especially organic seabream with couscous and seabream breaded bites.
- Considering the results obtained when novelty of the products was evaluated, it should be noted that around **half of French consumers stated that organic seabream with couscous and seabream breaded bites were familiar for them**, meanwhile grilled seabass with lemon and sea and mountain burger were the least familiar. Similar results were obtained for German participants, however, the percentage of consumers that considered that these products were familiar were much smaller.
- Considering all the statements after showing some photographs to participants, **French consumers evaluated grilled seabass with lemon much better than German consumers**.
- Before information about product characteristics was shown to consumers, the results showed that **the more the participants would like to taste the products and felt that would like the taste, the greater the purchase intention observed**. In addition, the purchase intention of French participants seemed to be more closely linked to the existence of similar products on their market than their German counterparts.

WHEN INFORMATION OF THE DEVELOPED PRODUCTS WERE SHOWN TO CONSUMERS:

- The **information provided to consumers** included ingredients, percentage of aquaculture fish in the final recipe, storage conditions, servings and packing weight, product preparation, sensory description, suitability for consumers, Nutri-Score label, recipe suggestion and photographs of the cooked product.
- Consumers felt that **organic seabream with couscous was the more natural product, followed by seabream breaded bites, sea and mountain burger and grilled seabass with lemon**.
- Concerning the image of the products, **consumers considered organic seabream with couscous and seabream breaded bites to be more attractive**. These two products were also considered by consumers as tastier.
- Regarding the product portions, consumers **did not know if the products portions were too small for them** since their answers were split between all the alternatives. However, **almost half of the participants considered that the pack fitted their needs**, especially organic seabream with couscous.
- In general, **consumers evaluated very positively that the products did not contain bones**.
- Participants considered that **all the products were very easy to prepare and that it seemed to take a short time to prepare them**. However, between all the products studied, consumers felt that the **grilled seabass with lemon was the most difficult product to prepare** and the one that seemed to take the **most time to prepare**.
- Around **half of the participants felt that there were many ways to prepare the fish products**. Compared to German participants, a higher percentage of French participants found that the products could be prepared in many ways.
- **Half of the consumers stated that the products could be healthy for them, especially organic seabream with couscous for French participants**.
- **More than half of the consumers would buy organic seabream with couscous and seabream breaded bites** (58 % and 56 %). However, these percentages decreased to 39 % and 36 % for sea and mountain burger and grilled seabass with lemon, respectively. For all the products developed, **the purchase intention after information was given to consumers was higher compared to before the information was given to them**, these increments ranging up to 13 %. It should be noted that the percentage of hesitation for product

purchase intention was around 25 %, except the sea and mountain burger whose percentage increased to 34 %, being the highest percentage of hesitation obtained.

- **More than half of the consumers stated that the organic seabream with couscous and seabream breaded bites would improve their day-to-day fish intake**.
- Consumers thought that **seabream breaded bites was the most interesting product for increasing children's fish intake (<16 years old)**, following by sea and mountain burger, organic seabream with couscous and grilled seabass with lemon.
- Considering the results obtained, **the most suitable product for French consumers is organic seabream with couscous and for German consumers, seabream breaded bites**.
- When additional information about product characteristics was given to consumers, it should be noted that **the more the participants felt that the product seemed tasty, that the pack fitted their needs and that it had a good image, the higher the purchase intention observed**.

Product-market matching

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Table of contents

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1. Introduction and background

As the aquaculture market is increasingly globalized, the Mediterranean aquaculture industry is facing challenges especially in terms of its competitiveness. In this context, innovations in production are highly relevant.

WP5 (Product development, market and consumer assessment) in the MedAID project aims to contribute towards enhancing the competitiveness of Mediterranean aquaculture by improving its market performance through a supply chain-wide, market-oriented design of diversified or new types of added-value fish products for EU consumers and food supply actors.

In order to increase the chances that such innovations in production will be successful on the market, there is a need to understand consumer behaviour towards innovative aquaculture products. Choice experiments enable us to assess the value of various product attributes in consumer choices. Such an approach can provide insights into the way new aquaculture products can be marketed in order to bring added-value to potential consumers. Discrete choice experiments can help towards identifying the best market positioning for the new high added-value products developed in Task 5.3.

The objective of Task 5.4 was to identify the optimal product configuration in terms of extrinsic, added-value-giving attributes in order to satisfy relevant product requirements of consumers in three European countries (Spain, France, and Germany – similar to previous tasks in WP5).

Food-related lifestyle plays an important role in people's self-reported intention to buy new aquaculture fish products as shown in Task 5.2.1 (Deliverable 5.2). Therefore, in the current study we measured people's food-related lifestyles in order to identify and profile segments of consumers based on their lifestyle. Furthermore, these segments can then be linked with the choice patterns identified in the choice experiment. This novel approach that combines segmentation based on food-related lifestyle and a choice experiment provides important insights regarding the preferences of different consumer segments on the market.

The current task (Task 5.4) has been designed and carried out with input from our partners (especially HCMR, AZTI, IRTA) and has built on previous tasks in MedAID WP5, namely:

- Task 5.1 where new product ideas were developed from selected species, by incorporating input from producers, retailers and commercial actors.
- Task 5.2 where promising segments of consumers for new aquaculture fish products were identified.
- Task 5.3 where prototypes of selected new aquaculture products were developed.

2. Method

The study in Task 5.4 has used a discreet choice experiment as this is a suitable experimental methodology to address the purpose of the task. As mentioned in the introduction, previous work in WP5 and the input from our partners have been used in making decisions regarding the methodology as detailed hereafter.

Data has been collected in collaboration with a market research agency in November 2020. The partners in WP5, which were native speakers, translated the survey into the native languages. Some of the scales came from the study conducted in Task 5.2.1 where translations were done by a market research agency and checked by native speakers. In this task (Task 5.4), native speakers have checked the translations of the complete questionnaire to make sure the original English meaning was retained. An online survey was developed in Qualtrics (see measures included in the questionnaire in Appendix 1) for data collection.

2.1. Participants

A priori power analysis (see Appendix 2) was used to determine the number of respondents necessary for this study. Results of the power analysis and prior literature suggesting a rule of thumb of 500 respondents for choice experiments, led to the decision to collect data from N=180 participants per country. This allows us to find the effects of the attributes of interest in consumers' choices.

The participants had to meet the following ***eligibility criteria*** to be included in the study:

- Participants from Spain, Germany, & France
- 180 participants per country
- Adults between 18 and 75 years old
- Responsible/co-responsible for grocery shopping
- Buy fish at least once a month
- Consume fish at least once a month

2.2. Product selection

The selection of new aquaculture fish products to be used in the choice experiment conducted in Task 5.4 was based on input from our partners (HCMR, AZTI, IRTA) and drew on findings from ***Task 5.1*** (where new product ideas from selected species, by incorporating input from producers, retailers and commercial actors) as well as ***Task 5.3*** (where prototypes of selected new aquaculture products were developed).

Three fish-based dishes were selected for the choice experiment: sea & mountain meagre burger, organic seabream fillet with couscous, and grilled seabass with lemon. AZTI provided the pictures of the three products and information about these products based on Task 5.3 (Figures 1 to 3). Each product packaging that was shown to the participants was edited in Photoshop (only the first picture in table below) to include the attributes that were varied in this study.

Figure 1: Sea & mountain meagre burger (Product 1).

Figure 2: Organic seabream with couscous (Product 2).

Figure 3: Grilled seabass with lemon (Product 3).

2.3. Attributes & levels

In the choice experiment, the three selected products (shown above) varied in a number of attributes that were deemed relevant based on findings from previous work in WP5, especially Deliverable 5.1, input from our partners (HCMR, AZTI, IRTA) as well as previous literature (Banovic, Reinders, Claret, Guerrero, & Krystallis, 2019; Cantillo, Martín, & Román, 2020).

Table 1: Attributes and levels used in the experimental design.

Attributes	Levels		
ASC label	Absent	Present	
NutriScore	Absent	Present	
Country of origin	Absent	Domestically produced	Produced in the EU
Health claim	Absent	Improves heart function	Improves brain function
Price	Low	Medium	High

The different price levels for all three countries that correspond to a low, medium, and high price have been based on input from partners as well as an examination of fish prices from online grocery stores. The value for each level depended on what product was shown, because the three products differed in terms of weights (total amount in grams). Below you can see an overview of what value was displayed for each product depending on the country.

Table 2: Price levels per product and country

Country	Product	Levels		
Germany	Product 1 (180g)	1.50	2.50	3.50
	Product 2 (160g)	1.00	2.00	3.00
	Product 3 (1000g)	9.00	13.00	17.00
Spain	Product 1 (180g)	2.00	3.00	4.00
	Product 2 (160g)	2.00	2.50	3.00
	Product 3 (1000g)	12.00	17.00	22.00
France	Product 1 (180g)	2.00	3.00	4.00
	Product 2 (160g)	2.00	3.00	4.00
	Product 3 (1000g)	13.00	18.00	23.00

2.4. Experimental design

The experimental design has been developed in close collaboration and with extensive input from HCMR. AZTI and IRTA have contributed as well.

The selected attributes and levels chosen for the choice experiment corresponds to a full factorial design with $2^2 x\ 3^3$ possible profile combinations, which we considered as inefficient to implement. Therefore, we carried out a fractional factorial design by means of JMP, statistical software provided by SAS institute. The fractional factorial design consisted of 12 choice sets with three profiles in each choice set. In addition to the attributes and levels shown on the previous page, the type of product was used as a blocking factor with a size of three because we assumed that the type of product would have an effect on the experimental outcome. An overview of which products were used in the three different blocks can be seen in the table below.

Table 3: Product corresponding to each block in the choice experiment.

Block	Product
One	Sea & mountain meagre burger
Two	Organic sea bream fillet with couscous
Three	Grilled sea bass with lemon

Each participant was randomly allocated to one of the three blocks. Thus, they were only presented with twelve choice sets, each of which consisted of three different profiles. Due to our budget constraints, we decided not to include a no-choice option. However, this means that a non-zero value will be estimated for people who would not choose one of the alternatives. This is known as hypothetical bias where the estimates are overstated. To mitigate this, we applied an ex-ante approach called cheap talk prior to the presentation of the choice experiment where we asked the participants to think about their decision in the hypothetical situation as if they were in a situation involving a real cash payment at the supermarket.

Furthermore, since some of the level combinations were not realistic for the market place, we included the two prohibitions in the construction of the experimental design based on input from HCMR. Therefore, the participants were not shown a medium or high price when any of the other attributes were non-existing.

2.5. Measures

The choice experiment enabled us to assess consumers' preferences for new aquaculture fish products.

In addition to the choice experiment, the questionnaire included several socio-demographic and psychographic measures drawn from the segmentation survey conducted in Task 5.2.1 (results were reported

in Deliverable 5.2). The measure of food-related lifestyle (using the core dimensions of food-related lifestyle instrument developed by Brunsø et al. (2021), applied in Task 5.2.1 to segment the market) will allow us to understand which attributes the promising consumer segments value. The psychographic and socio-demographic measures enabled us to identify the profile of consumer segments based on lifestyle and their choice patterns. Appendix 1 contains the questionnaire with all the measures included and the reliabilities of the psychographics.

3. Results

3.1. Participants

A total of 583 participants completed the questionnaire. The participants who filled in the survey too fast (i.e. 5 % with a duration time of less than 266.5 seconds; N= 30) were excluded from the data analysis. The final sample consisted of 553 respondents whose socio-demographic characteristics can be seen in Table 4.

Table 4: Socio-demographic characteristics of respondents.

	Spain (n = 186)	Germany (n = 183)	France (n = 184)	Total (n = 553)
Age (Mean (SD)) *(18 to 75 years old)*	28.0 (11.0)	32.6 (14.1)	34.8 (13.2)	31.8 (13.1)
Household size (Mean (SD)) *(excluding respondent; 0 to 7 or more)*	2.7 (1.0)	2.2 (1.2)	2.6 (1.2)	2.5 (1.1)
Gender (%)				
Male (1)	50.5	50.8	48.4	49.9
Female (2)	49.5	49.2	51.6	50.1
Education (%)				
Primary school (1)	1.1	1.6	1.1	1.3
Secondary school (High School and Professional Training) (2)	47.3	61.2	47.8	52.1
University (3)	50.5	34.4	47.8	44.3
Other (4)	1.1	2.8	3.3	2.3
Civil status (%)				
Married (1)	41.9	44.8	61.4	49.4
Cohabiting (2)	30.1	18.6	15.8	21.5
Single (3)	28.0	36.6	22.8	29.1
Income (%)				
How often is it a struggle to have enough money to go shopping for food (Mean (SD)) *(On a scale from Never (1) to Everytime (7)*	2.2 (1.2)	1.9 (1.3)	3.1 (1.7)	2.4 (1.5)

3.2. Segments of consumers based on food-related lifestyle

Based on the core dimensions of the modular food-related lifestyle instrument (Brunsø et al., 2021) (food involvement, food innovativeness and food responsibility) we conducted a LatentGold multilevel latent class cluster analysis where country was the grouping variable. The best fitting model identified four segments of consumers based on their lifestyle and one country group (where Spain, France and Germany belong to the same group).

The "Foodies" (11 %) were consumers highly involved in food, were highly innovative and cared about responsibility in food systems. The "Adventurous" (44%) consumers were also interested in all these dimensions, though to a lesser degree than the "Foodies". The "Moderate/conservative" (40%) segment

represented those consumers that scored above average on all these dimensions. The fourth segment consisted of those who were "Uninvolved" (6 %) as they scored very low on all food-related lifestyle dimensions.

Table 5: Segment means and share of respondents.

	Segment 1 Adventurous	Segment 2 Moderate/ Conservative	Segment 3 Foodies	Segment 4 Uninvolved
Segment Size	44%	40%	11%	6%
Food Responsibility	5.6	4.7	6.8	2.8
Food Innovation	6.1	4.7	6.8	2.2
Food Involvement	6.3	5.4	6.9	3.2

3.3. Profile of consumer segments based on lifestyle

The identified consumer segments based on their lifestyle were profiled with the socio-demographic and psychographic measures. For the profiling, we carried out a number of ANOVA with F-tests or cross-tabulations with Chi-square statistical tests in the open-source environment, R. Shapiro-Wilk's method was chosen for normality test, followed by Levene's test for homogeneity of variance across groups. Depending on the Levene's test result, either a one-way ANOVA test or a Kruskal-Wallis test was used to determine if there was a significant difference between segments. If there was an overall difference between segments, a post-hoc test was performed to determine which segments differed from one another. Here we used either a Dunn multiple comparison test with adjusted p-values by the Benjamini-Hochberg method or a Tukey's Honest Significant Difference test.

The identified segments did not differ according to socio-demographics (Table 6).

Table 6: Profiling with socio-demographics.

	Adventurous	Moderate/ Conservative	Foodies	Uninvolved	Sig.
Age	47.3	48.9	46.2	46.7	.393
Household size	2.6	2.4	2.7	2.4	.063
Income	2.5	2.4	2.3	2.0	.392
Gender					.731
Male	49%	52%	48%	42%	
Female	51%	48%	52%	58%	
Civil status					.110
Married	47%	52%	53%	42%	
Cohabiting	26%	19%	12%	16%	
Single	27%	28%	35%	42%	
Education					
Primary school	0.4%	2.4%	1.7%	0%	
Secondary school	48.6%	56.4%	50%	54.8%	
University	48.2%	39.8%	45%	42.0%	
Other	2.8%	1.4%	3.3%	3.2%	

Three one-way Anova with F-tests were conducted with segments as a fixed factor to determine significant differences between groups in terms of age, household size and income. Cross-tabulation with Chi-square statistical tests were used to test for differences between segments for gender, civil status and education level.

The segments differed in terms of several psychographics. The "Foodies" were the most involved with the fish category and with health, and were most open to innovativeness in the area of fish products. They were followed by the "Adventurous", the "Moderate/Conservative", and lastly by the "Uninvolved". For reluctance in relation to the area of fish products, there was no difference detected between the four segments.

Table 7: Profiling with selected psychographics

	Adventurous	Moderate/ Conservative	Foodies	Uninvolved	Sig.
Category Involvement	5.8[b]	5.0[c]	6.8[a]	3.4[d]	<.001
Domain Innovativeness Openness	5.0[b]	4.0[c]	5.5[a]	2.8[d]	<.001
Domain Innovativeness Reluctance	3.6	3.8	3.3	3.9	=.121
Health Involvement	6.4[b]	5.8[c]	6.9[a]	4.0[d]	<.001

Scale end-points: 1 = "strongly disagree", 7 = "strongly agree". Four Kruskal-Wallis and H-statistics tests were conducted with segments as a fixed factor to determine significant differences between groups in terms of core dimensions of food-related lifestyle. We applied Dunn's post hoc test of multiple comparisons with Benjamini-Hochberg adjustment. Means with different letters were significantly different, p<.05.

The segments differed in relation to their motives to choose aquaculture fish products. The "Foodies" showed the highest concern for health, whereas the "Uninvolved" had the lowest score, again with "Adventurous" and "Moderate/Conservative" in between. For convenience, the "Adventurous" and the "Foodies" did not differ and both segments had a high score. "Moderate/Conservative" differed from both "Adventurous" and "Foodies", but did not differ from the "Uninvolved". The "Uninvolved" had the lowest score compared to the other two segments. In terms of price, the "Foodies" and the "Adventurous" had similar scores, whereas the "Moderate/Conservative" differed from the other three segments as did the "Uninvolved". For the last four items, taste pleasure, respect for the environment, product geographic origin and availability, all segments differed from each other.

Table 8: Profiling with choice motives.

	Adventurous	Moderate/ Conservative	Foodies	Uninvolved	Sig.
Concern for health	5.8[b]	5.2[c]	6.3[a]	3.7[d]	<.001
Convenience	5.5[a]	5.0[b,c]	5.6[a]	4.5[c]	<.001
Price	5.5[a]	5.1[b]	5.6[a]	4.4[c]	<.001
Taste pleasure	6.2[b]	5.8[c]	6.5[a]	4.3[d]	<.001
Respect for the environment	5.7[b]	5.0[c]	6.6[a]	3.6[d]	<.001
Product geographic origin	5.7[b]	5.1[c]	6.5[a]	3.5[d]	<.001
Availability	5.7[b]	5.2[c]	6.5[a]	3.2[d]	<.001

Scale end-points: 1 = "not at all important", 7 = "extremely important". Six Kruskal-Wallis with H-statistics tests and one one-way ANOVA with F-statistics were conducted with segments as a fixed factor to determine significant differences between groups in terms of core dimensions of food-related lifestyle. We applied Dunn's post hoc test of multiple comparisons with Benjamini-Hochberg adjustment after the Kruskal-Wallis tests, whereas Tukey's Honest Significant Difference post hoc test was used following the significant one-way ANOVA test. Means with different letters are significantly different at p<.05.

Given these profiles and drawing on Deliverable 5.2., we can expect the “Foodies” and “Adventurous” consumers to be the most promising for the aquaculture market, followed by the “Moderate/Conservative”.

In the following we investigated consumers’ choice patterns and then linked the segments based on lifestyle with the choice patterns to gain insights into the attributes valued by the promising consumer segments.

3.4. Consumer preferences for new aquaculture products

Choice analysis conducted in LatentGold enabled us to capture the heterogeneity in consumers’ choices for the new aquaculture fish products. The model that identified five overall choice patterns was considered best fitting. Thus, consumers’ choices showed five different patterns.

All the attributes considered were significant and influenced people’s preferences towards the chosen new aquaculture fish products (Table 9), however, consumers in the five choice patterns differed in the importance placed on the different attributes (Figure 1). Those consumers in the “Price orientation” choice pattern cared most about price when making choices. Those in the “Textual information orientation” placed highest importance on the country of origin, the health claim and the price. In the “nutrition orientation”, people cared most about the Nutri-Score label when making choices. For the “environmental orientation”, the ASC label was the most important attribute. Lastly, the “ethnocentric orientation” refers to the choice pattern where the country of origin was most important.

Table 9. Choice parameters.

	Price orientation	Environmental orientation	Textual information orientation	Ethnocentric orientation	Nutrition orientation	Overall					
R^2	0.59	0.41	0.07	0.71	0.55	0.51					
$R^2(0)$	0.63	0.42	0.07	0.72	0.57	0.52					
Attributes	**Price orientation**	**Environmental orientation**	**Textual information orientation**	**Ethnocentric orientation**	**Nutrition orientation**	**Wald (0)**	**p-value**	**Wald(=)**	**p-value**	**Mean**	**Std.Dev.**
ASC											
Absent	-0.55	-1.29	-0.05	-0.23	-0.71	452.049	1.80E-95	297.037	4.70E-63	-0.580	0.427
Present	0.55	1.29	0.05	0.23	0.71					0.580	0.427
NUTRI											
Absent	-0.27	-0.52	-0.02	-0.39	-1.79	227.456	3.80E-47	140.155	2.60E-29	-0.478	0.502
Present	0.27	0.52	0.02	0.39	1.79					0.478	0.502
COO											
Absent	-0.16	-0.28	-0.35	-1.10	-0.37	545.133	9.90E-111	380.002	3.50E-77	-0.406	0.329
Domestic	0.21	0.57	0.22	2.03	0.39					0.628	0.657
From EU	-0.06	-0.29	0.13	-0.93	-0.03					-0.221	0.351
HEALTH											
Absent	-0.29	-0.23	-0.33	-0.21	-0.38	111.482	2.70E-19	7.214	0.51	-0.279	0.054
Brain function	0.17	-0.02	0.17	0.11	0.08					0.109	0.074
Heart function	0.12	0.25	0.16	0.10	0.29					0.171	0.069
PRICE											
High	2.46	0.14	-0.04	0.13	0.32	564.830	6.00E-115	524.995	3.00E-108	0.857	1.092
Low	0.52	0.23	0.28	0.13	0.33					0.323	0.143
Medium	-2.98	-0.37	-0.24	-0.25	-0.65					-1.180	1.225

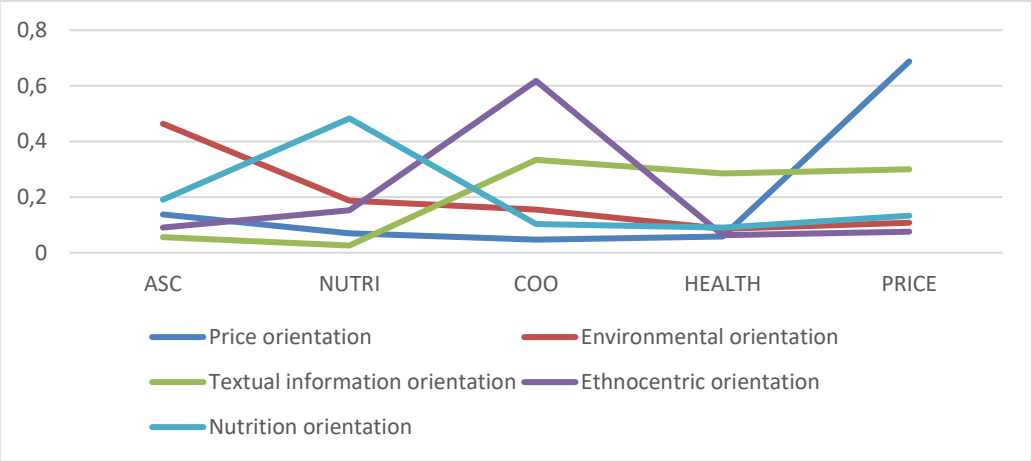

Figure 1. Attribute importance by choice pattern

We further estimated people's willingness to pay for the different product attributes across the choice patterns (Table 10). For the ASC label, all choice patterns showed an increased WTP when the eco-label was present but having an "environmental orientation" led to the highest increase. For the Nutri-Score, the presence of the label also led to higher WTP for all choice patterns, but especially so for the "nutrition orientation". For the COO, it is clear that having an "ethnocentric orientation" increased the WTP to a large extent when the product is domestic compared to all the other choice patterns. For a product produced within EU, the WTP decreased for the majority of choice patterns except for when having a "textual information orientation". For the health claims, the "textual information orientation" had the most interest in paying more for a product that carried any of the health claims.

Table 10. Willingness to pay by choice pattern.

	Price orientation	Environmental orientation	Textual information orientation	Ethnocentric orientation	Nutrition orientation
ASC					
Absent	-0.201	-5.033	-0.481	-1.206	-1.450
Present	0.201	5.033	0.481	1.206	1.450
NUTRI					
Absent	-0.101	-2.029	-0.224	-2.041	-3.667
Present	0.101	2.029	0.224	2.041	3.667
COO					
Absent	-0.058	-1.078	-3.549	-5.794	-0.751
Domestic	0.079	2.223	2.238	10.670	0.807
From EU	-0.021	-1.146	1.311	-4.875	-0.056
HEALTH					
Absent	-0.106	-0.894	-3.271	-1.101	-0.773
Brain function	0.063	-0.076	1.665	0.579	0.174
Heart function	0.043	0.970	1.607	0.522	0.598

3.5. Relationship between consumer segments based on food-related lifestyle and their choice patterns

There was a highly significant relationship between the consumer segments based on food-related lifestyle and the choice groups based on people's new aquaculture product choices. The "Foodies" were especially prevalent in the choice groups that valued the ASC label and the Nutri-Score, but also domestic products with a health benefit and medium prices. The "Adventurous" preferred the ASC label as well as the NutriScore, but the former was of higher interest for them. They also preferred domestic products with a health benefit, but price was their top priority thereby products targeted towards this segment should be low to medium priced. The "Moderate/Conservative" shared some of their preferences with the "Adventurous" but in addition they were more prevalent in the group that did not value the ASC label but liked the Nutri-Score, EU products with a health benefit and especially products with low prices. Lastly, the "Unninvolved" consumers were more prevalent in the choice group that was mostly interested in domestic products that are medium priced, they disliked the Nutri-Score but placed some value on the ASC label. The profiling of the lifestyle segments had shown that the "Foodies", "Adventurous" and to some extent even the "Moderate/Conservative" would be interesting targets for new aquaculture fish products. The results presented here show which product attributes are especially valued by these segments.

Table 11. Relationship between segments of consumers based on lifestyle and the choice patterns based on the choice experiment.

Intercept	Price orientation	Environmental orientation	Textual information orientation	Ethnocentric orientation	Nutrition orientation	Wald	p-value
	0.3033	0.2165	-0.1348	-0.0981	-0.2869	9.3023	0.054
Covariates	**Price orientation**	**Environmental orientation**	**Textual information orientation**	**Ethnocentric orientation**	**Nutrition orientation**	**Wald**	**p-value**
Segments							
Adventurous	0.3012	-0.0192	0.0466	-0.1381	-0.1905	29.4081	0.0034
Moderate/ Conservative	0.3441	-0.4107	0.3054	0.1994	-0.4382		
Foodies	-0.6306	0.6716	-0.7971	0.3299	0.4263		
Uninvolved	-0.0147	-0.2417	0.4451	-0.3912	0.2024		
Covariates ClusterFour	**Price orientation**	**Environmental orientation**	**Textual information orientation**	**Ethnocentric orientation**	**Nutrition orientation**		
Adventurous	**0.3406**	**0.2266**	0.1704	0.1469	0.1155		
Moderate/ Conservative	**0.3467**	0.1493	0.2153	0.2009	0.0878		
Foodies	0.1207	**0.4088**	0.0656	**0.2118**	**0.1932**		
Uninvolved	**0.2567**	0.1871	**0.2625**	0.1171	0.1765		

4. Conclusions

The present study took a novel approach by combining data on consumer segmentation based on food-related lifestyles relevant for consumer behaviour in relation to aquaculture products and consumer choice data. Our findings show that there are different consumer segments with relevance for the aquaculture market and these segments vary in the attributes valued when making choices of new aquaculture fish products. Even though all the studied attributes were relevant for consumers' choices, different segments of consumers placed different importance on the attributes. Therefore, our results show which attributes should be emphasized depending on the consumer segments that are targeted for the new aquaculture products. The "Foodies" and the "Adventurous" consumers, but also to some extent the "Moderate/Conservative" consumers can be interesting targets for new fish products from aquaculture. Emphasizing the attributes relevant to each segment that is targeted by new aquaculture fish products can contribute to the success of new innovative initiatives on the market.

Appendix 1 – Reliabilities & questionnaire

Reliabilities of the main psychographic constructs

Construct	Q	Items	Cronbach's α
Food Innovation	Q9_6: Q9_8: Q9_13: Q9_15:	Recipes and articles on food from other culinary traditions encourage me to experiment in the kitchen I like to try out new recipes I like to try new foods that I have never tasted before I love to try recipes from different countries	0.92
Food Responsibility	Q9_1: Q9_4: Q9_5: Q9_7: Q9_14:	I try to choose food that is produced in a sustainable way I try to buy organically produced foods if possible I am concerned about the conditions under which the food I buy is produced I try to choose food produced with minimal impact on the environment It is important to understand the environmental impact of our eating habits	0.90
Food Involvement	Q9_2: Q9_9: Q9_10: Q9_11: Q9_12:	Food and drink is an important part of my life I just love good food Eating and drinking are a continuous source of you for me Decisions on what to eat and drink are very important for me Eating and food is an important part of my social life	0.91
Category involvement	Q10_1: Q10_2: Q10_3:	I am very concerned about what fish or fish products I purchase I care a lot about what fish or fish products I consume Generally, choosing the right fish or fish products is important to me	0.91
Domain innovativeness - openness	Q11_2: Q11_4: Q11_6:	If I heard that new fish products were available through a local store, I would be interested enough to buy them I would be ready to buy/consider buying new fish products, even if I had not heard of them yet I know more about new fish products than other people do	0.72
Domain innovativeness - reluctance	Q11_1: Q11_3: Q11_5:	In general, I am among the last in my circle of friends to purchase new fish products Compared to my friends, I do little shopping for new fish products In general, I am the last in my circle of friends to know the latest trends of fish products	0.80
Health involvement	Q12_1: Q12_2: Q12_3: Q12_4:	Health is very important to me I care a lot about health Health means a lot to me I appreciate healthy food very much	0.92

Introduction

Dear participant,

Welcome to our survey. In this survey, we are interested in finding out about your opinions and choices, which are important to us in order to understand peoples' beliefs and behaviours regarding newly developed fish products. The survey is undertaken by MAPP Research Centre at Aarhus University and is a part of a larger European project, Mediterranean Aquaculture Integrated Development (MedAID), which is funded by the Horizon 2020 Research and Innovation programme of the European Union. The goal of MedAID is to increase the overall competitiveness and sustainability of the Mediterranean marine fish-farming sector, throughout the whole value chain.

Before you start the survey, please carefully read the following:

- Your participation is entirely voluntary and you are under no obligation to participate
- You have the right to refuse to participate
- You can withdraw from the survey at any time
- You give Aarhus University and the research partners of MedAID permission to use your data for research purposes

We will handle your data with utmost confidentiality in accordance with EU Data Protection Rules 2019, and it will be stored electronically and processed anonymously. Any information that you provide is confidential and no information that you disclose will lead to the identification of any individual in the reports on the project, either by the researcher or by any other party.

It will take approximately 10-15 minutes to fill out the survey questions. You can consult your progress with the progress bar displayed on each page.

If you have any questions or comments about the survey, you are welcome to contact … at e-mail…

Thank you in advance for your help!

Best regards,

Aarhus University (Denmark)

MAPP Research Centre

On behalf of the MedAID Consortium

Informed consent

Q1: Informed consent

I confirm that:

- I am 18 years old or older, I have read and understood the above information, and I agree to participate in the survey.
- I do not want to participate in the survey.

** If the last statement is selected, then exclude the participant.*

Screening questions

Q2: To what extent are you responsible for the following activity in your household?

	I am responsible for all or most of it (Q2_1)	I am responsible for about half of it (Q2_2)	Someone else is responsible for all or most of it (Q2_3)
Food shopping (Q2_1)			

** If (Q2_3) is selected, then exclude the participant.*

Q3: How often do you buy fish or fish products?

- Daily or almost every day (Q3_1)
- 3-4 times a week (Q3_2)
- 2 times a week (Q3_3)
- Once a week (Q3_4)
- 2-3 times a month (Q3_5)
- Once a month (Q3_6)
- Less than once a month (Q3_7)
- Never (Q3_8)

** If (Q3_7 or Q3_8) is selected, then exclude the participant.*

Q4: How often do you eat fish or fish products?

- Daily or almost every day (Q4_1)
- 3-4 times a week (Q4_2)
- 2 times a week (Q4_3)
- Once a week (Q4_4)
- 2-3 times a month (Q4_5)
- Once a month (Q4_6)
- Less than once a month (Q4_7)
- Never (Q4_8)

** If (Q4_7 or Q4_8) is selected, then exclude the participant.*

Notice that each participant has to fulfill **all** the criteria. This means that participants, who select one out of the five exclusion response categories (Q2_3, Q3_7, Q3_8, Q4_7 or Q4_8) in the above three questions will not be included in the study.

Validity/manipulation check

Q5: Please indicate to what extent you know the following labels.

	Not at all (1)	(2)	(3)	(4)	(5)	(6)	Extremely well (7)
Aquaculture Stewardship Council (ASC)							
Nutri-Score							
Health claims							

Information

You will now be presented with twelve different pairs of a fish-based dish. Each fish-based dish comes with a **price** and one or more of the below characteristics. In the table, you can find an elaboration of the characteristics.

Name	Explanation	Label
Aquaculture Stewardship Council (ASC)	The ASC is a certification that guarantees an environmentally sustainable and socially responsible breeding of fish. The certification programme includes minimizing impacts on the local ecosystem, the use of wild fish as an ingredient for feed, pollution, disease outbreaks, energy consumption and greenhouse gas emissions.	
Nutri-Score	The health authorities in your country recommend the Nutri-Score. It is a nutrition label, which converts the nutritional value of a fish product into 5 classes (expressed by a colour and a letter) to distinguish foods that are healthier from those that are less healthy. The nutritional value of the fish product has been calculated based on the product's nutritional declaration for 100 g, specifically it's amount of energy, sugar, saturated fats, and salt as well as its amount of fibre, protein, fruit, vegetables and nuts, rapeseed oil, walnut oil and olive oil.	
Country of origin	The fish product can be produced domestically or from the EU. Domestic means that the fish has been caught in your own country, whereas from the EU means that the fish has been caught in a country within the EU.	
Health claim	A health claim states the relation between the intake of a particular food or a component of the food and its effect on your health. E.g. *"improves heart function*" indicates that the intake of the fish product that includes fatty acids and amino acids has been found to improve the heart function.	

Hypothetical bias strategy

Before the survey will proceed, please read the following carefully. You have to imagine that you are in the supermarket and have to make your decisions about which fish-based dish you prefer to buy.

We know that the following twelve choices that you are going to make are hypothetical decisions, i.e. not real decisions because you will not pay any money for the fish-based dishes that you choose. In this situation, people tend to **overrate** how much they are actually willing to pay.

Therefore, we politely ask you to respond to the decisions as if the result of your preferences would involve a real cash payment at the supermarket.

Choice experiment: Block 1

Choice_1.1: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	**Profile 2**	**Profile 3**
ASC	Absent	Present	Absent
NutriScore	Absent	Present	Present
Origin	From EU	Absent	Domestic
Health Claim	Heart function	Brain function	Absent
Price	Low	Medium	High

Choice_1.2: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	**Profile 2**	**Profile 3**
ASC	Present	Present	Absent
NutriScore	Absent	Present	Absent
Origin	Domestic	Absent	From EU
Health Claim	Absent	Heart function	Brain function
Price	Low	High	Medium

Choice_1.3: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	**Profile 2**	**Profile 3**
ASC	Present	Absent	Absent
NutriScore	Present	Absent	Present
Origin	From EU	Absent	Domestic
Health Claim	Brain function	Absent	Heart function
Price	Medium	Low	High

Choice_1.4: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	**Profile 2**	**Profile 3**
ASC	Absent	Present	Present
NutriScore	Present	Absent	Absent
Origin	Absent	From EU	Domestic
Health Claim	Brain function	Absent	Heart function
Price	Low	High	Medium

Choice_1.5: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	**Profile 2**	**Profile 3**
ASC	Present	Present	Absent
NutriScore	Present	Absent	Absent
Origin	Absent	Domestic	From EU
Health Claim	Absent	Brain function	Heart function
Price	Low	Medium	High

Choice_1.6: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	**Profile 2**	**Profile 3**
ASC	Absent	Present	Absent
NutriScore	Present	Absent	Present
Origin	Domestic	Absent	From EU
Health Claim	Heart function	Absent	Brain function
Price	Medium	High	Low

Choice_1.7: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	**Profile 2**	**Profile 3**
ASC	Absent	Absent	Present
NutriScore	Absent	Present	Present
Origin	Absent	Domestic	From EU
Health Claim	Brain function	Absent	Heart function
Price	High	Medium	Low

Choice_1.8: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	**Profile 2**	**Profile 3**
ASC	Present	Present	Absent
NutriScore	Present	Absent	Absent
Origin	Absent	Domestic	From EU
Health Claim	Heart function	Brain function	Absent
Price	**Low**	**High**	**Medium**

Choice_1.9: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	Profile 2	Profile 3
ASC	Absent	Present	Absent
NutriScore	Absent	Present	Present
Origin	Absent	From EU	Domestic
Health Claim	Brain function	Absent	Heart function
Price	**High**	**Medium**	**Low**

Choice_1.10: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	Profile 2	Profile 3
ASC	Present	Present	Absent
NutriScore	Present	Absent	Absent
Origin	From EU	Domestic	Absent
Health Claim	Brain function	Absent	Heart function
Price	**High**	**Low**	**Medium**

Choice_1.11: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	Profile 2	Profile 3
ASC	Present	Absent	Present
NutriScore	Absent	Present	Present
Origin	From EU	Absent	Domestic
Health Claim	Heart function	Absent	Brain function
Price	Low	Medium	High

Choice_1.12: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	Profile 2	Profile 3
ASC	Absent	Present	Absent
NutriScore	Absent	Absent	Present
Origin	Domestic	Absent	From EU
Health Claim	Brain function	Heart function	Absent
Price	**Low**	**Medium**	**High**

Choice experiment: Block 2

Choice_2.1: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	**Profile 2**	**Profile 3**
ASC	Absent	Present	Absent
NutriScore	Absent	Present	Present
Origin	From EU	Absent	Domestic
Health Claim	Heart function	Brain function	Absent
Price	Low	Medium	High

Choice_2.2: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	**Profile 2**	**Profile 3**
ASC	Present	Present	Absent
NutriScore	Absent	Present	Absent
Origin	Domestic	Absent	From EU
Health Claim	Absent	Heart function	Brain function
Price	**Low**	**High**	**Medium**

Choice_2.3: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	**Profile 2**	**Profile 3**
ASC	Present	Absent	Absent
NutriScore	Present	Absent	Present
Origin	From EU	Absent	Domestic
Health Claim	Brain function	Absent	Heart function
Price	Medium	Low	High

Choice_2.4: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	**Profile 2**	**Profile 3**
ASC	Absent	Present	Present
NutriScore	Present	Absent	Absent
Origin	Absent	From EU	Domestic
Health Claim	Brain function	Absent	Heart function
Price	Low	High	Medium

Choice_2.5: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	**Profile 2**	**Profile 3**
ASC	Present	Present	Absent
NutriScore	Present	Absent	Absent
Origin	Absent	Domestic	From EU
Health Claim	Absent	Brain function	Heart function
Price	**Low**	**Medium**	**High**

Choice_2.6: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	**Profile 2**	**Profile 3**
ASC	Absent	Present	Absent
NutriScore	Present	Absent	Present
Origin	Domestic	Absent	From EU
Health Claim	Heart function	Absent	Brain function
Price	Medium	High	Low

Choice_2.7: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	**Profile 2**	**Profile 3**
ASC	Absent	Absent	Present
NutriScore	Absent	Present	Present
Origin	Absent	Domestic	From EU
Health Claim	Brain function	Absent	Heart function
Price	High	Medium	Low

Choice_2.8: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	**Profile 2**	**Profile 3**
ASC	Present	Present	Absent
NutriScore	Present	Absent	Absent
Origin	Absent	Domestic	From EU
Health Claim	Heart function	Brain function	Absent
Price	Low	High	Medium

Choice_2.9: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	**Profile 2**	**Profile 3**
ASC	Absent	Present	Absent
NutriScore	Absent	Present	Present
Origin	Absent	From EU	Domestic
Health Claim	Brain function	Absent	Heart function
Price	High	Medium	Low

Choice_2.10: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	**Profile 2**	**Profile 3**
ASC	Present	Present	Absent
NutriScore	Present	Absent	Absent
Origin	From EU	Domestic	Absent
Health Claim	Brain function	Absent	Heart function
Price	High	Low	Medium

Choice_2.11: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	**Profile 2**	**Profile 3**
ASC	Present	Absent	Present
NutriScore	Absent	Present	Present
Origin	From EU	Absent	Domestic
Health Claim	Heart function	Absent	Brain function
Price	Low	Medium	High

Choice_2.12: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	**Profile 2**	**Profile 3**
ASC	Absent	Present	Absent
NutriScore	Absent	Absent	Present
Origin	Domestic	Absent	From EU
Health Claim	Brain function	Heart function	Absent
Price	**Low**	**Medium**	**High**

Choice experiment: Block 3

Choice_3.1: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	**Profile 2**	**Profile 3**
ASC	Absent	Present	Absent
NutriScore	Absent	Present	Present
Origin	From EU	Absent	Domestic
Health Claim	Heart function	Brain function	Absent
Price	Low	Medium	High

Choice_3.2: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	**Profile 2**	**Profile 3**
ASC	Present	Present	Absent
NutriScore	Absent	Present	Absent
Origin	Domestic	Absent	From EU
Health Claim	Absent	Heart function	Brain function
Price	Low	High	Medium

Choice_3.3: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	**Profile 2**	**Profile 3**
ASC	Present	Absent	Absent
NutriScore	Present	Absent	Present
Origin	From EU	Absent	Domestic
Health Claim	Brain function	Absent	Heart function
Price	Medium	Low	High

Choice_3.4: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	**Profile 2**	**Profile 3**
ASC	Absent	Present	Present
NutriScore	Present	Absent	Absent
Origin	Absent	From EU	Domestic
Health Claim	Brain function	Absent	Heart function
Price	Low	High	Medium

Choice_3.5: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	**Profile 2**	**Profile 3**
ASC	Present	Present	Absent
NutriScore	Present	Absent	Absent
Origin	Absent	Domestic	From EU
Health Claim	Absent	Brain function	Heart function
Price	Low	Medium	High

Choice_3.6: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	**Profile 2**	**Profile 3**
ASC	Absent	Present	Absent
NutriScore	Present	Absent	Present
Origin	Domestic	Absent	From EU
Health Claim	Heart function	Absent	Brain function
Price	**Medium**	**High**	**Low**

Choice_3.7: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	**Profile 2**	**Profile 3**
ASC	Absent	Absent	Present
NutriScore	Absent	Present	Present
Origin	Absent	Domestic	From EU
Health Claim	Brain function	Absent	Heart function
Price	High	Medium	Low

Choice_3.8: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	**Profile 2**	**Profile 3**
ASC	Present	Present	Absent
NutriScore	Present	Absent	Absent
Origin	Absent	Domestic	From EU
Health Claim	Heart function	Brain function	Absent
Price	Low	High	Medium

Choice_3.9: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	Profile 2	Profile 3
ASC	Absent	Present	Absent
NutriScore	Absent	Present	Present
Origin	Absent	From EU	Domestic
Health Claim	Brain function	Absent	Heart function
Price	High	Medium	Low

Choice_3.10: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	Profile 2	Profile 3
ASC	Present	Present	Absent
NutriScore	Present	Absent	Absent
Origin	From EU	Domestic	Absent
Health Claim	Brain function	Absent	Heart function
Price	**High**	**Low**	**Medium**

Choice_3.11: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	Profile 2	Profile 3
ASC	Present	Absent	Present
NutriScore	Absent	Present	Present
Origin	From EU	Absent	Domestic
Health Claim	Heart function	Absent	Brain function
Price	Low	Medium	High

Choice_3.12: Imagine you are in the supermarket and have to choose between the following three products. Which one of them would you choose to purchase?

	Profile 1	Profile 2	Profile 3
ASC	Absent	Present	Absent
NutriScore	Absent	Absent	Present
Origin	Domestic	Absent	From EU
Health Claim	Brain function	Heart function	Absent
Price	Low	Medium	High

Questions related to the base product

When the participants have finished the choice experiment, they will be asked to evaluate the fish-based dish they have been shown in the twelve choice sets. Thus, they will only be evaluating one product depending on which block they were allocated to. To remind the participant that they have to do the evaluation for that particular fish-based dish, a picture of the product without any attributes will be shown as the first thing before they have to answer the questions.

Q6: Please rate the following statements in relation to the fish-based dish shown in the picture above.

	Strongly disagree (1)	(2)	(3)	Neither disagree nor agree (4)	(5)	(6)	Strongly agree (7)
a) I would like to taste it (Q6_1)							
b) It is familiar to me (Q6_2)							
c) I might easily prepare this (Q6_3)							
d) It is something I would purchase (Q6_5)							

Q7: Please indicate how you perceive the packaging of the fish-based dish shown in the picture above.

	Strongly disagree (1)	(2)	(3)	Neither disagree nor agree (4)	(5)	(6)	Strongly agree (7)
The packaging is appropriate for a fish product (Q7_4)							
The packaging is typical for a fish product (Q7_5)							
The packaging is attractive for a fish product (Q7_6)							

Q8: Please indicate how you perceive the fish-based dish shown in the picture above.

	Strongly disagree (1)	(2)	(3)	Neither disagree nor agree (4)	(5)	(6)	Strongly agree (7)
The fish-based dish is of high quality (Q8_1)							
The fish-based dish is of high value (Q8_2)							
The fish-based dish is new (Q8_3)							
The fish-based dish is modern (Q8_4)							

Other questions - Psychographics

Q9: On a scale from 1 to 7, where 1 is “strongly disagree“ and 7 is “strongly agree“, how much do you agree with the following statements?

	Strongly disagree (1)	(2)	(3)	Neither disagree nor agree (4)	(5)	(6)	Strongly agree (7)
I try to choose food that is produced in a sustainable way (Q9_1)							
Food and drink is an important part of my life (Q9_2)							
I look for ways to prepare unusual meals (Q9_3)							
I try to buy organically produced foods if possible (Q9_4)							
I am concerned about the conditions under which the food I buy is produced (Q9_5)							
Recipes and articles on food from other culinary traditions encourage me to experiment in the kitchen (Q9_6)							
I try to choose food produced with minimal impact on the environment (Q9_7)							
I like to try out new recipes (Q9_8)							
I just love good food (Q9_9)							
Eating and drinking are a continuous source of joy for me (Q9_10)							
Decisions on what to eat and drink are very important for me (Q9_11)							
Eating and food is an important part of my social life (Q9_12)							
I like to try new foods that I have never tasted before (Q9_13)							
It is important to understand the environmental impact of our eating habits (Q9_14)							
I love to try recipes from different countries (Q9_15)							

Q10: On a scale from 1 to 7, where 1 is “strongly disagree” and 7 is “strongly agree“, how much do you agree with the following statements?

	Strongly disagree (1)	(2)	(3)	Neither disagree nor agree (4)	(5)	(6)	Strongly agree (7)
I am very concerned about what fish or fish products I purchase (Q10_1)							
I care a lot about what fish or fish products I consume (Q10_2)							
Generally, choosing the right fish or fish products is important to me (Q10_3)							

Q11: On a scale from 1 to 7, where 1 is “strongly disagree” and 7 is “strongly agree“, how much do you agree with the following statements?

	Strongly disagree (1)	(2)	(3)	Neither disagree nor agree (4)	(5)	(6)	Strongly agree (7)
In general, I am among the last in my circle of friends to purchase new fish product (Q11_1)							
If I heard that new fish products were available through a local store, I would be interested enough to buy it (Q11_2)							
Compared to my friends, I do little shopping for new fish products (Q11_3)							
I would be ready to buy / consider buying new fish products, even if I had not heard of it yet (Q11_4)							
In general, I am the last in my circle of friends to know the latest trends of fish products (Q11_5)							
I know more about new fish products than other people do (Q11_6)							

Q12: On a scale from 1 to 7, where 1 is “strongly disagree” and 7 is “strongly agree“, how much do you agree with the following statements?

	Strongly disagree (1)	(2)	(3)	Neither disagree nor agree (4)	(5)	(6)	Strongly agree (7)
Health is very important to me (Q12_1)							
I care a lot about health (Q12_2)							
Health means a lot to me (Q12_3)							
I appreciate healthy food very much (Q12_4)							

Q13: To what extent do you know the following aquaculture fish species?

	Not at all (1)	(2)	(3)	(4)	(5)	(6)	Extremely well (7)
Seabream (Q13_1)							
Seabass (Q13_2)							
Meagre (Q13_3)							

Q14: How often do you buy the following aquaculture fish species?

	Daily or almost every day (1)	3-4 times a week (2)	2 times a week (3)	Once a week (4)	2-3 times a month (5)	Once a month (6)	1-5 times every 6 months (7)	Less frequently (8)	Never (9)
Seabream (Q14_1)									
Seabass (Q14_2)									
Meagre (Q14_3)									

Q15: How important, if at all, are the following factors for your choice of aquaculture fish or fish products?

	Not at all important (1)	(2)	(3)	(4)	(5)	(6)	Extremely important (7)
Health concern (Q15_1)							
Convenience (e.g., easy cooking, no bones) (Q15_2)							
Price (Q15_3)							
Taste pleasure (Q15_4)							
Product traceability (Q15_5)							
Respect for the environment (Q15_6)							
Product geographic origin (Q15_7)							
Availability (seasonality) (Q15_8)							

Socio-demographic questions

Q16: How old are you? (Please indicate a number)

Q17: What is your gender?

- ○ Female (Q17_1)
- ○ Male (Q17_2)

- ○ Non-binary (Q17_3)

Q18: What is your civil status?

- ○ Married (Q18_1)
- ○ Cohabiting (Q18_2)
- ○ Single (Q18_2)

Q19: What is the highest level of studies that you have completed?

- ○ Primary school (Q19_1)
- ○ Secondary school (High School and Professional Training) (Q19_2)
- ○ University (Q19_3)
- ○ Other (Q19_4)

Q20: How often is it a struggle to have enough money to go shopping for food?

- ○ Never
- ○ Very rarely
- ○ Rarely
- ○ Sometimes
- ○ Often
- ○ Very often
- ○ Every time

Q21: Currently, how many people live in your household?

- ○ 1, I live alone (Q21_1)
- ○ 2 (Q21_2)
- ○ 3 (Q21_3)
- ○ 4 (Q21_4)
- ○ 5 (Q21_5)
- ○ 6 (Q21_6)
- ○ 7 or more (Q21_7)

Thank you!

Thank you very much for your participation and interest in this survey.

If you have any questions or comments, you are welcome to contact … at …

Thank you very much for your help.

Best regards,

Aarhus University (Denmark)

MAPP Research Centre

On behalf of the MedAID Consortium

Appendix 2 – Power analysis

The aim of this analysis was to carry out a power analysis for Subtask 5.4 to examine how many respondents were needed for the discrete choice experiment. The choice data from the discrete choice experiment were analysed by means of a conditional logit model as well as a Latent Class model to account for preference heterogeneity, which can exist across the different segments for aquaculture products.

Attributes

The attributes used in the experimental design were derived from an examination of previous literature as well as a review of the results of the previous work packages. The following preferences among consumers were implemented in the effect sizes needed for the calculations.

ASC	Consumers are willing to pay premiums for sustainable produced products that incorporate ecolabels.
NutriScore	Specific certified labelled products are preferred over those that do not have any type of certification.
Origin	Local products are preferred over imported products.
Health claim	Labels that highlight health and nutritional benefits i.e., a high content of omega 3 or improvement of the heart function are preferred over those that do not include such information.
Price	A higher price will have a negative influence.

Power

All the calculations were based on a preferred power of 80 %. This value was chosen to balance the proportion between making type I and type II errors. The associated alpha was set to 0.025 for a two-sided test.

Number of classes (only for Latent Class model)

In the area of interest, it was found that the theoretically expected numbers of clusters is four. To see how an unequal class distribution affect the power, the overall class distribution (35/30/15/20) was applied.

Results: Multinomial logit model

These are the results for a pooled sample of the three products calculated for each country.

GERMANY		
Attribute	**Beta coefficient**	**Sample size (N)**
ASC	0.351	31
Nutri-score	0.239	76
Origin	0.655	3
Health claim	0.072	225
Price	-0.317	13

FRANCE		
Attribute	**Beta coefficient**	**Sample size (N)**
ASC	0.114	115
Nutri-score	0.182	187
Origin	0.832	2
Health claim	0.050	385
Price	-0.344	12

SPAIN		
Attribute	**Beta coefficient**	**Sample size (N)**
ASC	0.212	82
Nutri-score	0.068	916
Origin	0.597	4
Health claim	0.145	56
Price	-0.419	8

Results: Latent class model (Pooled data)

These are the results for a pooled sample for the three product as well as for the countries.

Attribute	**Response distribution**	**Sample size for Wald (0)**
ASC	(30/70)	100
	(30/70)	
	(80/20)	
	(30/70)	
NutriScore	(30/70)	100
	(30/70)	
	(80/20)	
	(30/70)	
Origin	(10/50/40)	100
	(10/70/20)	
	(50/20/30)	
	(10/60/30)	

Health claim	(10/60/30)	408
	(30/50/20)	
	(70/20/10)	
	(20/50/30)	
Price	(10/60/30)	472
	(20/50/30)	
	(80/10/10)	
	(10/50/40)	

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Packaging and sustainability dimensions validated through neuroscience

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Table of contents

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1. Background

Some activities carried out within this Deliverable were slightly modified, especially those within Task 5.4.1, due to the Coronavirus-19 outbreak.

To complement the results obtained within Task 5.4, two extra activities were carried out focusing on two of the fish products developed by AZTI within Task 5.3 using the consumers' needs and ideas generated in Task 5.1, Task 5.2, and Task 5.3 as inputs. On the one hand, the optimization of the packaging attributes and the validation of the results obtained through neuroscience, and on the other hand, a choice experiment with a combination of implicit and explicit methods was used to assess the relevance of different dimensions of sustainability (environmental, social, and animal welfare) for the consumer.

2. Introduction

Fish packaging is no longer a mere structural element but also a powerful marketing tool able to affect product perception and consumers' food choices (Ares and Deliza, 2010). In fact, packaging can be the most direct and influential communication element at the point of purchase, where most purchasing decisions are made. Although the New Product Development (NPD) process is usually a firm-centred activity, including later stages (i.e., packaging design), incorporating consumers during NPD is a key aspect that could favour the new product success in the market (Moon et al., 2018).

Packaging design could be divided in two main domains depending on whether attributes are: (1) visual, which draw attention and transmit non-verbal information (e.g. shape, colour); or (2) textual, which transmit verbal or numerical information (e.g. claims). The combination of visual and textual attributes of the packaging enable us to build up the final design of the packaging.

In order to assure that packaging designed through a co-creation process with consumers is the most suitable, a validation is usually necessary. Among the various methodologies available to carry out the validation process implicit methods are worth mentioning, including physiological and emotional measures. These measures can be useful to understand the role of perception, attention, and emotion in decision-making processes. The combination of implicit approaches with self-reported measures will allow a more complete evaluation of consumer preferences in relation to packaging.

Improving aquaculture fish packaging could allow differentiation of the product from the competing products (both within the fish market and other markets of protein sources). This improvement translates into an increase in the competitiveness of the aquaculture sector and in an increase in its economic revenues.

Another strategy of differentiation when launching new aquaculture fish products is to encompass added-value-giving attributes that have an impact on consumers' choices. Drawing on findings from previous discrete choice experiments carried out within Task 5.4.2, it was observed that sustainably produced products that incorporated an ecolabel had a significant impact on the consumers' choices.

To the extent that consumers are increasingly more reflexive in their food decisions and have broadened their comprehension of sustainability (Mintel Food & Drink Industry Trend, 2020), mixing implicit and explicit methods focusing on the relevance of the different dimensions of sustainability in food choice can be useful to develop new aquaculture fish products aligned with their values.

3. Objective

This task had a three-fold goal, one per each of the activities carried out:

1) To select the combination of visual and textual packaging attributes that best fitted consumers' preferences and expectations. To use the knowledge gathered to design the packaging prototypes through photo edition of a fish burger developed within Task 5.3.
2) To validate the packaging prototypes designed against two commercial options well established in the market through neuroscience.
3) To determine the relevance for consumers of different sustainability dimensions in new aquaculture fish products.

To allow a better understanding of each of the three activities carried out, materials and methods and results sections will be presented in different subsections: 1) Packaging designed by consumers; 2) Validation of the packaging through neuroscience; and 3) Relevance of sustainability dimensions.

4. Material and methods

4.1 Packaging designed by consumers

A sample of 200 participants was recruited in Spain. Probabilistic sampling was applied, including quotas for gender (50 % women and 50 % men) and age (between 18 and 64 years). All participants consumed fish at least once a month, were responsible for or shared the responsibility of food purchasing and preparation within their household, and were not involved in the food or the fish industry.

Respondents were asked to choose which packaging attributes (visual and textual) they preferred for a 'meagre fish burger with mushrooms (sea & mountain recipe)' and 'fish sticks coated with pea flakes (seabream breaded bites)', both fish products developed by AZTI within Task 5.3 using the consumers' needs and ideas generated in Task 5.1, Task 5.2, and Task 5.3 as inputs.

Visual attributes of the packaging included the type of container (4 options), colour (61 options), window presence and type (16 options), image presence and type (6 options), typeface (15 options), package presentation (3 options), and product quantity (4 options).

Textual attributes of the packaging were divided into three groups according to the three dimensions of the quality (searched, experienced, and credential). Three conjoint analyses were performed, one per each quality dimension, and four factors were included in each one: (1) convenience, price, presentation (e.g., individually wrapped), and recyclability (searched quality), (2) freshness, texture, flavour, and novelty (experienced quality), and (3) health, natural, animal welfare, and sustainability (credential quality). Two levels were tested within each factor, informative and interpretative. The only levels that differed between fish products were those belonging to the 'texture' factor, 'juicy' was selected for the burgers and 'crunchy' for the breaded sticks. The relative importance of each factor in consumers' purchase intention per each conjoint analysis was measured on an 11-point probability scale, ranged from 0 = 'absolutely no chance' to 10 = 'absolute certain to buy' (Juster, 1966).

After reviewing the visual and textual attributes preferred by respondents, only the packaging for the meagre fish burger with mushrooms was validated. To do so, two packagings were designed with photo edition. The first packaging design comprised the visual and textual attributes preferred by consumers, while the second packaging design gathered the attributes preferred in second place.

4.2 Validation of the packaging through neuroscience

A sample of 40 participants was recruited in Spain, 15 were men and 25 were women ranging from 23 to 73 years, with a mean age average of 42 years. All participants consumed fish at least once a week, were responsible for or shared the responsibility of food purchasing and preparation within their household, and were not involved either in the food or the fish industry. Furthermore, the specific criteria to take part in the implicit experiment included recruiting participants not wearing glasses (except for monofocal), not having had eye surgery, nor suffering from some eye disorders or diseases (e.g. strabismus, amblyopia (lazy eye), mydriasis (permanently dilated pupils), daltonism (colour blindness), cataract, or glaucoma). In addition, participants were not allowed to wear items covering their face (e.g. bushy beard, facial tattoos, thick-rimmed glasses) or items or substances that hindered their facial mobility (e.g. Botox).

The validation process of the packaging carried out used four edited photos of different packaging as inputs (Appendix 1). The first two packagings were the ones designed by consumers, that, is the preferred combination of visual and textual attributes in the first and in the second place (see Section 5.1). On the other hand, the two packagings that were used as a control were two commercial fish burgers already available in the Spanish market. The first belonged to an own brand from the Spanish supermarket with the higher sales share. The second one belonged to the most known and well-established brand of fish products in Spain. Nevertheless, the two products used as a control were slightly modified to ensure that participants focused on the packaging rather than the product. For that purpose, the two packagings were photographed and photo edited (e.g. salmon fish burgers were replaced by a meagre fish burger with mushrooms to prevent respondents from making their decisions based on the fish species).

The interview with participants gathered both explicit and implicit measurements. Eye tracking (ET) was used for measuring visual attention, Galvanic Skin Response (GSR) for emotional intensity, and Automatic Facial Expression Analysis (AFEA) as a means of emotion direction measurement (implicit measurements). Explicit measurements were gathered on participants' preferences by means of ranking, acceptability, and purchase probability, but a short interview was also included.

The first task carried out by respondents was to look at the four packaging images presented simultaneously for 30 seconds, in an attempt to emulate a real situation on a supermarket shelf (implicit measurement). To avoid the effect of the presentation order of the images, four balanced orders were established following William's Latin square. Afterwards, respondents were asked to rank from 1 to 4 all images, but also to score their acceptability of each one on a scale from 0 to 10, where 0 was the lowest acceptability and 10 the maximum (explicit measurement). After that, respondents were presented sequentially with each image individually for 10 seconds to let them see the packaging details (implicit measurement). Afterwards, they were asked, for each packaging, which was their purchase intention measured on an 11-point probability scale, ranging from 0 = 'absolutely no chance' to 10 = 'absolute certain to buy' (explicit measurement). Finally, more in-depth questions were formulated for each packaging to inquire into consumers' perceptions (i.e. what aspects attracted their attention first, what they liked the most and the least) (explicit measurement).

4.3 Relevance of sustainability dimensions

A combination of implicit and explicit methods was used simultaneously in the course of a ranking-based conjoint analysis which included 'meagre fish burger with mushrooms (sea & mountain recipe)' and 'fish sticks coated with pea flakes (seabream breaded bites)', both fish products developed by AZTI within Task 5.3 using the consumers' needs and ideas generated in Task 5.1, Task 5.2, and Task 5.3 as an input.

A sample of 64 participants was recruited in Spain, 32 were men and 32 were women ranging from 19 to 65 years, with a mean age average of 47 years. All participants consumed fish at least once a week, were responsible for or shared the responsibility of food purchasing and preparation within their household and were not involved either in the food or the fish industry. Specific criteria to take part in the implicit experiment were already described (see Section 4.2). The study included an experimental and a control group, and participants were split into two groups with similar socio-demographic distributions. After checking the reliability of the explicit measures, four participants were excluded as a result of the poor eye tracking data quality. Finally, 30 participants ranked the fish burger (16 in control and 14 in experimental conditions) and the other 30 ranked the fish sticks (15 in control and 15 in experimental conditions).

The experimental manipulation consisted of the viewing, previous to the choice experiment, of a video with informative messages about aquaculture. The video had two different versions, differing in the information displayed: general facts about aquaculture for the control group and positive outcomes of aquaculture in relation to sustainability for the experimental group.

After the video and before starting the choice experiment, participants were informed about general characteristics of the products including product description, storage, fish species, product weight, units per packaging, and directions for use. Also, to ensure the common understanding of the different sustainability dimensions, a short definition of each attribute was provided.

In the choice experiment participants were presented on the screen with one choice set with six distinct versions of one of the products, 'meagre fish burger with mushrooms' or 'fish sticks coated with pea flakes'. They ranked the profiles in relation to their preference for factors such as environmental impact, impact on animal welfare, social impact, and origin with different levels of information (Table 1).

Table 1. Factors and levels used in the conjoint analysis design.

Factor	Level
Environmental Impact	Fish farmed respecting the environment
	No information about impact on environment
Animal Welfare	Fish farmed respecting the fish welfare
	No information about impact on fish welfare
Social Impact	Positive impact of fish farmed on local communities
	No information about social impact
Origin	Spain
	EU
	Non-EU

A short evaluation questionnaire of each of the products and the Single-item Food Choice Questionnaire (FCQ) (Onwezen et al., 2019) were also provided to gain more information about consumers' stated preferences. The 7-point FCQ scale ranged from 1 = "Not at all important" to 7 = "Very important". Spanish versions of Prosocialness Scale for Adults (Martínez-pampliega et al., 2018) and New Environmental Paradigm Scale (Vozmediano Sanz and San Juan Guillén, 2005) were used to assess individual differences in prosocialness and environmental orientation of the participants. Implicit approach included the use of an eye tracker to determine the participants' visual attention. After the ranking task, participants were asked to assess their willingness to try and buy the fish products, as well as product familiarity, healthiness, and convenience using a 7-point Likert scale ranging from 1 = "Completely Disagree" to 7 = "Completely Agree".

5. Results

5.1 Packaging designed by consumers

5.1.1 Visual attributes

The visual attributes of the packaging preferred by respondents for both fish products, the meagre burger and the fish sticks, are presented in Table 2. Regarding the fish burger, the tray was the most widely selected option, maybe because it is the most common container for fresh burgers in Spanish supermarkets. White and light blue colours were similarly liked. Participants showed a preference for seeing the raw product through a window on the package, but also, for seeing the dish ready-to-eat or the raw ingredients printed on the package. The typeface most selected was 'Arial Rounded'. The preferred products' presentation was packaged per serving (two burgers per serving), closely followed by individually-packaged burgers. Finally, two and four servings were the most popular options in relation with the quantity of the package.

Regarding the fish sticks, some similarities were found with the fish burger. Box and tray were the most preferred options. Light blue and white colours were also liked, similar to the fish burgers. Most participants also preferred to see the raw product through a window on the package as well as a picture on the label of the dish ready-to-eat or the raw ingredients. The most chosen typeface was also 'Arial Rounded'. In contrast, the presentation and the quantity of the product were the attributes that most differed from the fish burger. Respondents demanded packaging without divisions, that is, all fish sticks together inside the package, or packaged per serving (four sticks per serving). Lately, bigger packages were selected, in particular four, two, or more than four servings.

Table 2. Three most frequently chosen options (%) within each visual attribute of the packaging

Attribute	%	Fish burger	%	Fish stick
Container	66.5	Tray	43.5	Box
	20.5	Box	33.5	Tray
	7.0	Bowl	19.0	Bag
Colour	12.5	White	13.5	Blue
	10.0	Blue	11.5	White
	6.0	Dark blue	9.5	Yellow
Window	29.5	Full	32.0	Full
	12.0	Large left side	8.5	Medium left side
	10.0	Circular central	8.0	No window
Image	48.0	Dish ready-to-eat	50.0	Dish ready-to-eat
	35.5	Ingredients	29.5	Ingredients
	8.0	Other	10.0	People
Typeface	17.0	Arial Rounded MT Bold	15.0	Arial Rounded MT Bold
	11.5	Rage Italic	10.5	Brush Script MT
	10.5	Edwardian Script ITC	10.5	Trajan
Presentation	43.0	Packed per serving	45.5	Without divisions
	36.5	Individually packed	32.5	Packed per serving
	20.5	Without separations	22.0	Individually packed
Quantity	45.0	2 servings	35.5	4 servings
	38.0	4 servings	32.5	2 servings
	9.0	1 serving	27.5	More than 4 servings

5.1.2 Textual attributes

The textual attributes of the packaging preferred by participants for the meagre burger and the fish sticks are presented in Table 3, although small differences were found between both products. Within the searched quality dimension, 'Recyclability' and 'Price' factors played the most relevant role for both fish products. 'Freshness' was the most important factor for experienced quality, as this attribute is regarded a critical aspect of fish quality due to its high perishability, but also important was the 'Novelty' factor. It is worth mentioning that 'Texture' factor from fish burgers had significantly lower relative importance than for the fish sticks. Finally, 'Animal welfare', 'Health', and 'Sustainability' stood out as factors of credence quality. Animal welfare and ethical issues have been gaining attention over the last decades and nowadays play a critical role in consumers' food choices. In contrast, health, has been a driver of fish consumption for a long-time.

For fish burgers, results showed that five of the 12 factors presented significant differences among levels, the informative claims always being the most preferred (Table 4). For searched quality, the most appreciated informative messages were 'now 5 % cheaper' and '80 % recyclable packaging' for 'Price' and 'Recyclability' factors, respectively. Experienced quality only showed significant differences for the 'Novelty' factor; participants favoured the informative claim 'New product' over the interpretative 'Enjoy something new'. Finally, for credential quality, the informative messages of 'Animal welfare' and 'Sustainability', were significantly preferred over the interpretative version.

Table 3. Importance (%) of the factors from the textual analysis grouped by quality dimension.

Searched quality			Experienced quality			Credential quality		
Factor	**Burger**	**Stick**	**Factor**	**Burger**	**Stick**	**Factor**	**Burger**	**Stick**
Convenience	18.87^{b}	21.31^{b}	**Freshness**	29.82^{a}	29.68^{a}	**Health**	25.14^{ab}	25.34^{ab}
Price	29.31^{a}	28.51^{a}	**Texture**	19.27^{c}	23.02^{b}	**Natural**	20.72^{b}	22.13^{b}
Presentation	22.46^{b}	21.03^{b}	**Flavour**	23.52^{bc}	22.25^{b}	**Animal welfare**	31.05^{a}	28.78^{a}
Recyclability	29.36^{a}	29.14^{a}	**Novelty**	27.39^{ab}	25.06^{ab}	**Sustainability**	23.09^{b}	23.75^{ab}

Superscript a–c: different letters in the same column differ significantly ($p < 0.05$).

Table 4. Mean utility of the levels of the factors from the textual analysis grouped by quality dimension.

Quality	Factor	Information type	Level	Utility mean	
				Burger	Stick
Searched	Convenience	Informative	Ready in 5 minutes	-0.09	-0.07
		Interpretative	Quick to prepare	0.09	0.07
	Price	Informative	Now 5 % cheaper	0.23[a]	0.14
		Interpretative	Your wallet will appreciate it	-0.23[b]	-0.14
	Presentation	Informative	Contains 4 individually wrapped portions	0.05	0.08
		Interpretative	Packaging adapted to your pace of life	-0.05	-0.08
	Recyclability	Informative	80 % recyclable packaging	0.36[a]	0.40[a]
		Interpretative	For a world with less plastic	-0.36[b]	-0.40[b]
Experienced	Freshness	Informative	Freshly filleted, processed, and packed	0.11	0.10
		Interpretative	Unique freshness	-0.11	-0.10
	Texture	Informative	Juicy (B) / crispy (S)	-0.01	-0.10
		Interpretative	Incredibly juicy (B) / crispy (S)	0.01	0.010
	Flavour	Informative	With all the fish flavour	0.10	0.10[a]
		Interpretative	Delicious	-0.10	-0.10[b]
	Novelty	Informative	New product	0.15[a]	0.02
		Interpretative	Enjoy something new	-0.15[b]	-0.02
Credential	Health	Informative	Over 0.6 g of Omega-3 fatty acids	-0.01	-0.08
		Interpretative	Protects your heart	0.01	0.08
	Natural	Informative	No colourant or preservatives	-0.02	-0.11[b]
		Interpretative	Only natural ingredients	0.02	0.11[a]
	Animal welfare	Informative	Guaranteed animal welfare	0.38[a]	0.37[a]
		Interpretative	Our fish are happy and you can tell	-0.38[b]	-0.37[b]
	Sustainability	Informative	Sustainable fish	0.17[a]	0.15[a]
		Interpretative	Fish for today and tomorrow	-0.17[b]	-0.15[b]

Superscript a–b: different letters in the same column within the same factor indicate statistically significant differences ($p < 0.05$).
B: burger; S: stick.

Not many differences in visual and textual attributes have been seen between fish burger and fish sticks. It may be speculated that it is because both are fish products, it being possible that if differences between products were greater (e.g., fish and meat), attributes preferred for the packaging would be different. Therefore, for the validation process only the fish burger packaging was considered.

5.2 Validation of the packaging through neuroscience

The validation process of the packaging carried out through neuroscience used four edited photos of four different packagings available in Appendix 1 as inputs, namely: 1) Packaging of the preferred combination of visual and textual attributes chosen by consumers; 2) Packaging of the second preferred combination of visual and textual attributes chosen by consumers; 3) Photo-edited packaging from an own brand of the Spanish supermarket with higher sales share; and 4) Photo-edited packaging from the most known and well-established brand of fish products in Spain.

5.2.1 Visual attention - Simultaneous packaging presentation

The heatmap presented in Figure 1 shows the visual attention paid of the four packaging images presented simultaneously measured with the eye tracker. The packaging that caught the most attention were the white tray and the blue carton.

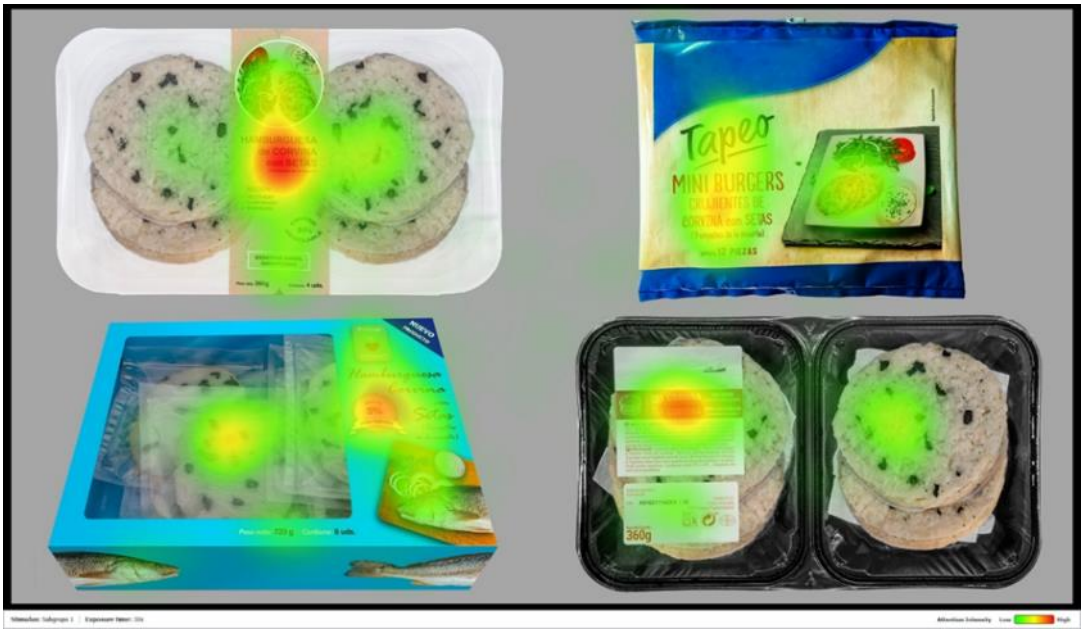


Figure 1. Heat map for the four packaging images presented simultaneously (Text is in Spanish).

Visual attention can also be measured quantitatively by using eye tracking metrics. Attention at first glimpse is derived from Time to First Fixation (TTFF) that indicates the amount of time that it takes on average to look at a specific Area of Interest (AOI), in the case described, at each of the packaging designs. The shorter the TTFF, the faster the packaging gets attention. Both packaging options designed by consumers (white tray and blue carton) cuaght participants' attention first, with the lower TTFF (Table 5).

Table 5. Eye tracking metrics for the four packaging images presented simultaneously.

Packaging	TTFF (ms)	Fixation count	Revisit count
White tray	6955.04	723	161
Blue carton	7073.16	937	164
Bag	7755.21	755	135
Black tray	7710.72	757	146

Total attention can be derived from fixation count (i.e., the count of all gazes fixated more than 100 ms inside the AOI), and the revisit count (i.e., the re-examination of the information). Fixations and revisit counts were higher for the blue carton, proving that it was *that* packaging that elicited higher attention (Table 5).

5.2.2 Visual attention - Individual packaging presentation

When individual packaging images were presented, the larger size of the pictures permitted the display of a greater level of detail. The individual heatmap of the four packages are presented in Figures 2-5.

For the white tray and the blue box, the packaging options designed by consumers, claims derived from informational attributes (freshly filleted, processed, and packed; 80 % recyclable packaging; guaranteed animal welfare; now 5 % cheaper; and protects your heart) caught more attention.

For the photo-edition of competitors' products on the market, the mushroom name: black trumpet mushrooms, which in Spanish can be literally translated to 'Trumpets of death', attracted most of the attention together with the Ready-to-eat picture, serving suggestion text, fish species, and instructions for use.

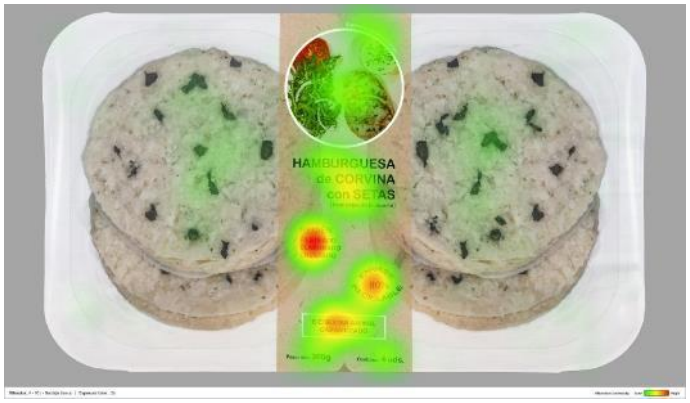


Figure 2. Heat map for the white tray packaging (individual presentation).

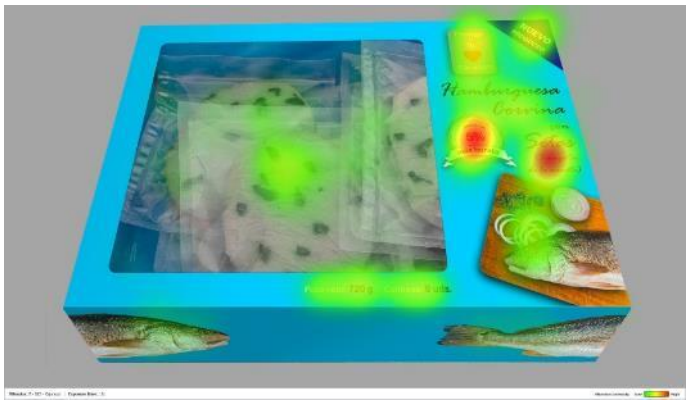


Figure 3. Heat map for the blue carton packaging (individual presentation).

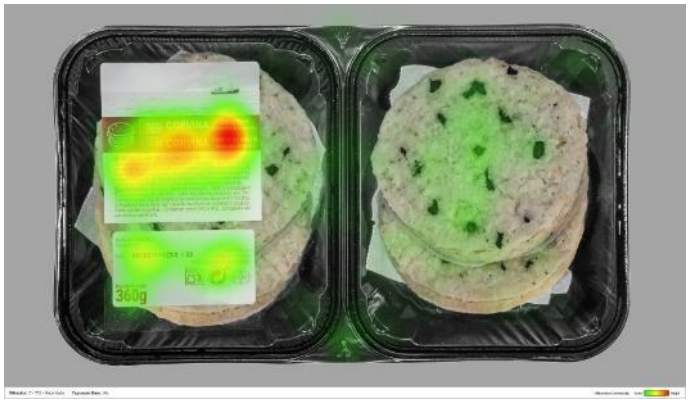


Figure 4. Heat map for the black tray (individual presentation).

Figure 5. Heat map for the bag packaging (individual presentation).

5.2.3 Emotional response

Moving to physiological and emotional measures elicited by the packaging, the emotional intensity was measured using GSR and emotional valence was measured by means of AFEA. In relation to emotional intensity, the peaks per minute indicated, on average, how many emotional events had occurred every 60 seconds. The higher the number, the more emotional response the participants had during the stimulus presentation. About AFEA, a threshold of 30 % probability was applied for facial response detection in accordance with the moderate facial response expected due to the kind of stimuli. Valence is expressed as time percentage in relation to the total time recorded for the stimuli. Expressions that increase the likelihood of positive valence include smile and raised cheek, while the ones that increase the likelihood of negative valence include internal brow lift, brow furrow, nose wrinkles, upper lip lift, lip corner depressor, chin lift, lip press, and lip suction.

The packaging options designed by consumers showed higher emotional intensity and more positive emotions (Figure 6). The white tray packaging elicited higher positive emotions, while the bag elicited the higher negative emotions.

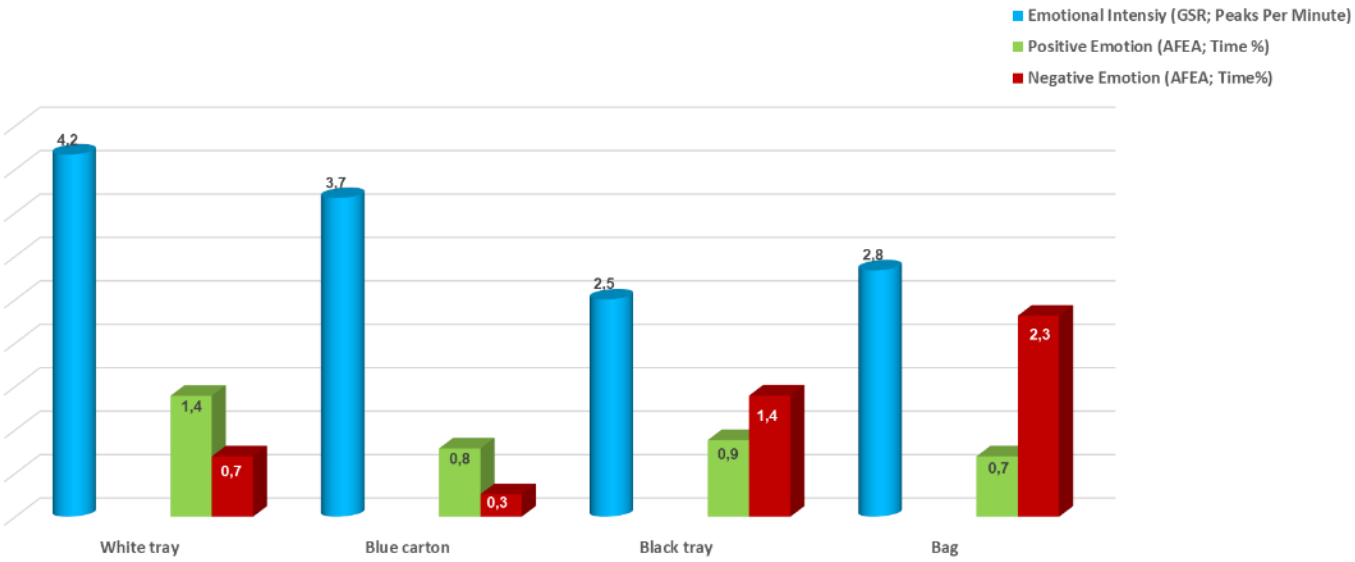


Figure 6. Intensity and valence (+/-) of the emotions elicited by the packaging (individual presentation).

It can be inferred from the individual interview with participants the positive and negative aspects connecting the implicit and explicit results, the most recurrent are listed in Table 6.

Table 6. Positive and negative opinions about the packaging gathered through individual interview.

Packaging	Positive opinion	Negative opinion
White tray	'80 % recyclable packaging' claim 'Guaranteed animal welfare' claim Ready-to-eat picture	Valuable information is missing Uncertainty packed per serving or no division
Blue carton	Individually packed 'Protects your heart' claim Fish picture	Too much plastic Mistrust due to 'Now 5 % cheaper' claim Valuable information is missing
Black tray	Packed per serving Lot of information at first sight Full vision of the product	Black colour of the tray Small letter size Too much plastic
Bag	Ready-to-eat picture 'Tapeo' as product's description Blue colour	Not able to see the product Bag format container Information is missing

5.2.4 Self-reported measures

The results of the self-reported measures of ranking, acceptability, and purchase probability (Table 7) confirm the preference of the participants for the options designed by consumers in the former experiment. In particular, the white tray had the better results in all three measures: ranking, acceptability, and purchase probability.

Table 7. Self-reported explicit measures results.

Packaging	Ranking	Mean score ranking	Acceptability	Purchase probability
White tray	1	1.88^{a}	6.55^{a}	6.65^{a}
Blue carton	2	2.45^{ab}	5.85^{ab}	5.00^{b}
Black tray	3	2.75^{b}	5.38^{b}	5.25^{b}
Bag	4	2.93^{b}	4.71^{b}	5.13^{b}

Superscript a–b: different letters in the same column indicate statistically significant differences ($p < 0.05$).

5.3 Relevance of sustainability dimensions

5.3.1 Choices to the product profiles

Regarding the choices made by participants that ranked the fish burger, the most relevant factor was animal welfare, both in control and experimental conditions, while the other factors had variable relative importance between both groups (Figures 7 and 8).

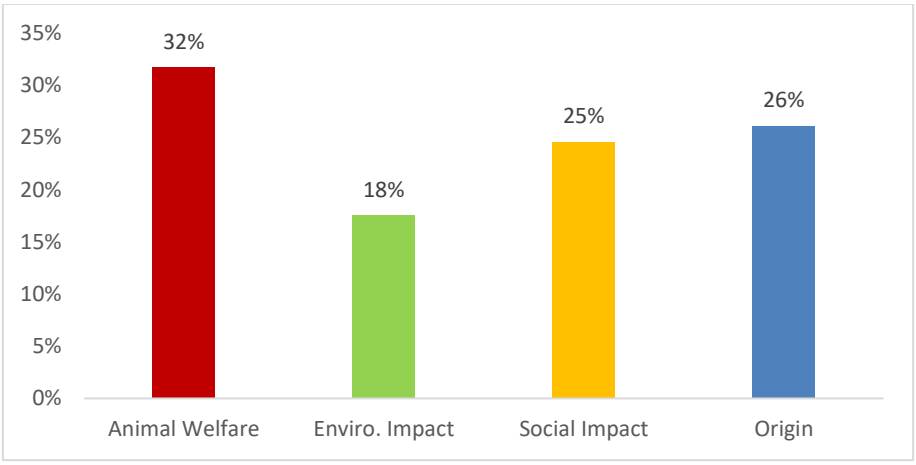


Figure 7. Relative importance of attributes for fish burgers in control conditions.

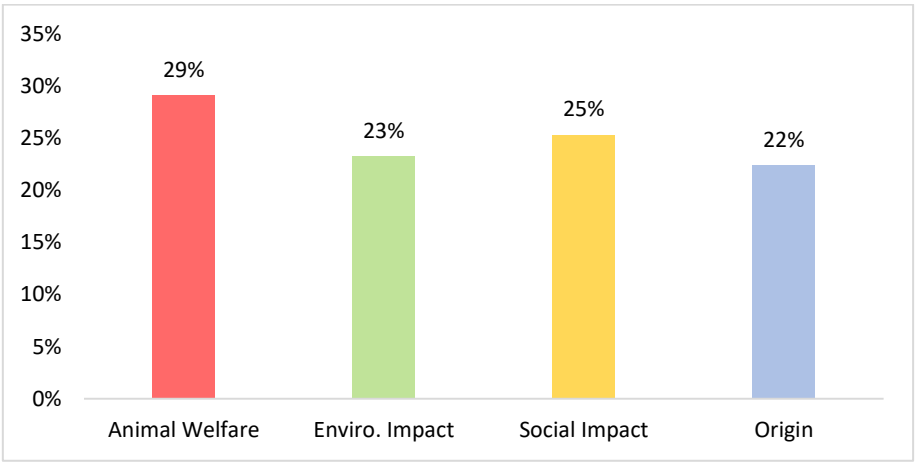


Figure 8. Relative importance of factors for fish burgers in experimental conditions.

In all cases, respondents preferred to have information about positive outcomes on the different sustainability dimensions (environmental and social), animal welfare and Spanish origin was chosen over EU and non-EU origin (Figure 9). Differences between control and experimental group were not significant either for factors' importance or levels.

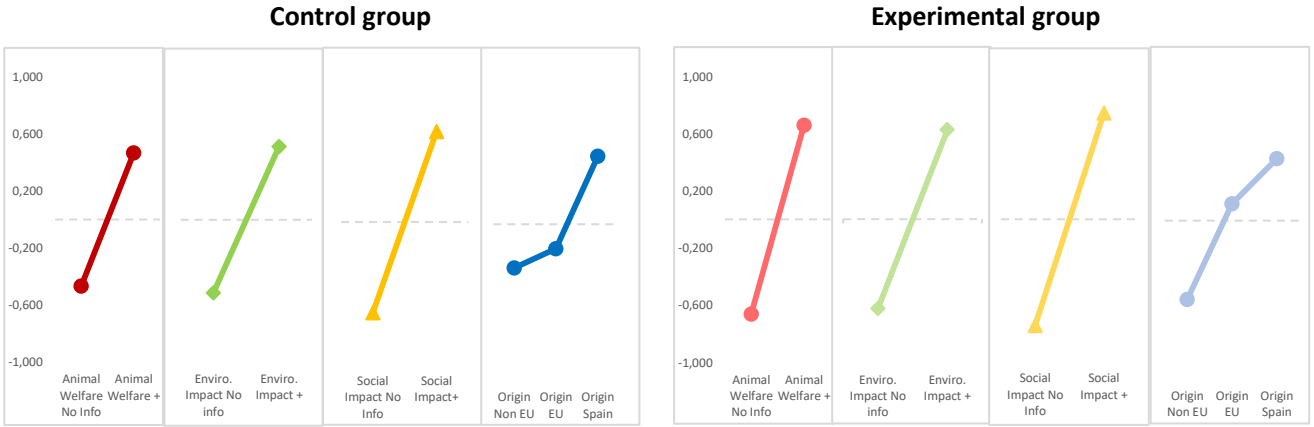


Figure 9. Utility values associated with specific factor levels for fish burgers. a) Left graphic: control group, b) Right graphic: experimental group.

In the case of the participants that ranked the fish sticks, the importance of the factors differed between groups, origin being the most relevant for control group and social impact for experimental group (Figures 10 and 11).

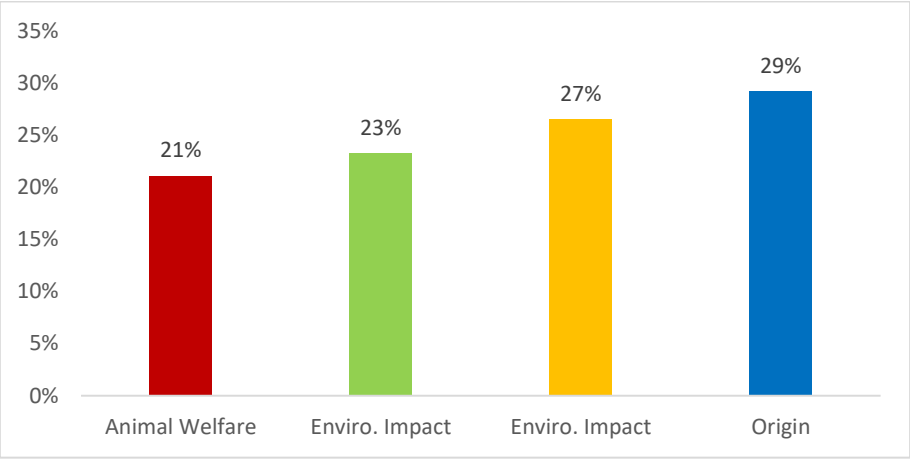


Figure 10. Relative importance of factors for fish sticks in control conditions.

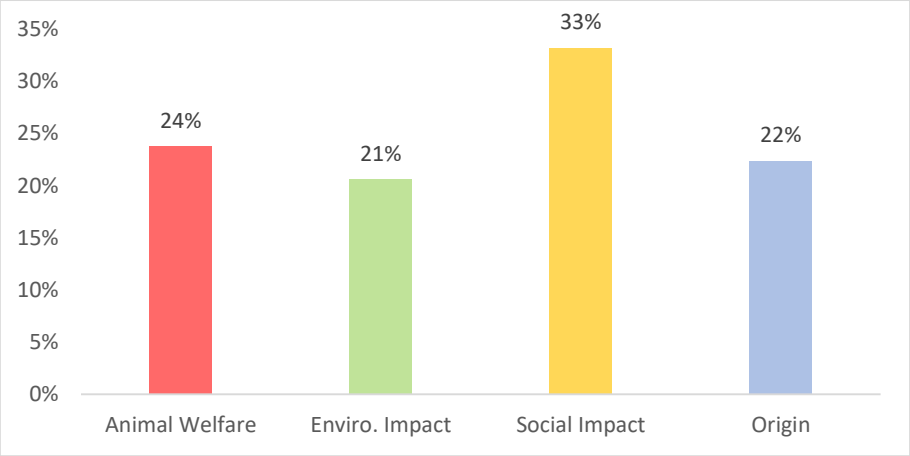


Figure 11. Relative importance of factors for fish sticks in experimental conditions.

For all factors, having information about positive impact on the different sustainability dimensions (environmental and social), animal welfare and origin were preferred, Spanish origin being more appreciated over EU OR non-EU (Figure 12). Differences between the control and the experimental group were not significant either for factors' importance or levels.

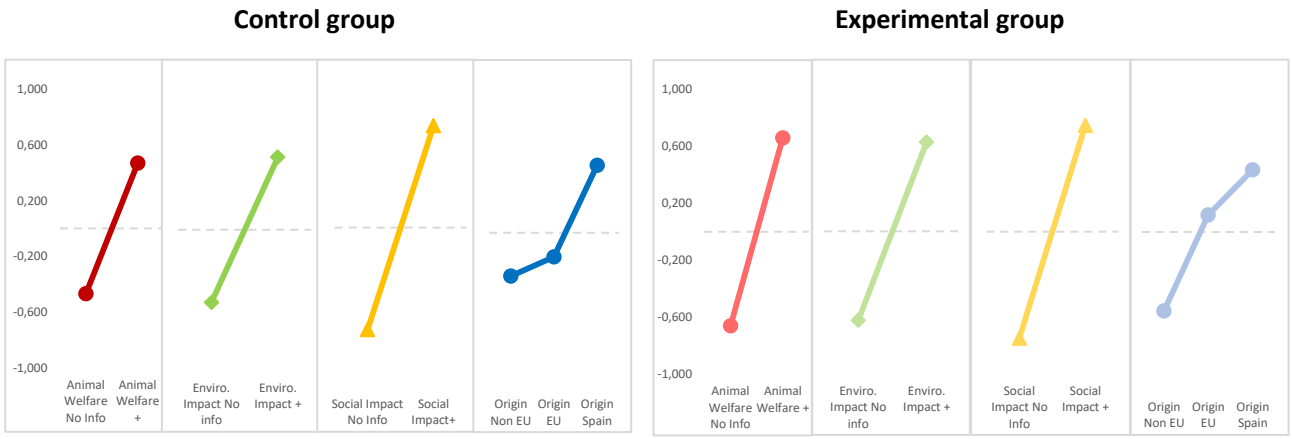
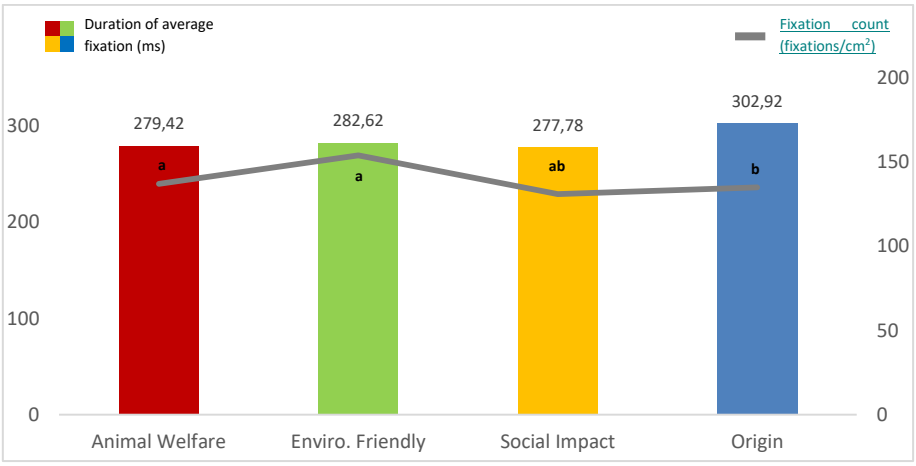


Figure 12. Utility values associated with specific attribute levels for fish sticks in control conditions. a) Left graphic: control group, b) Right graphic: experimental group.

5.3.2 Visual attention to the product profiles

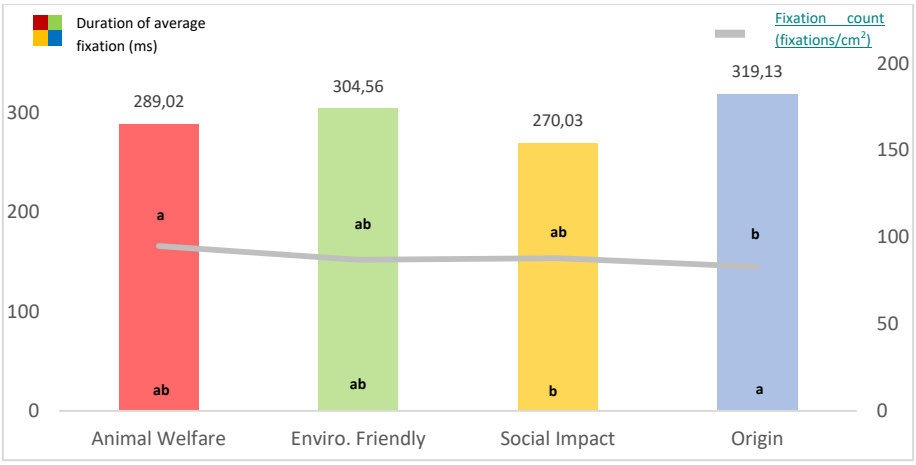
To evaluate the attention paid to the different levels, the areas of interest (AOI) of all statements presented to participants in the ranking task slide were identified (Appendix 2). The fixation count in each AOI was used to identify the areas which were more noticeable or relevant to viewers, and the duration of fixations to assess the difficulty to extract the information and the degree of involvement with the information provided (Van Loo et al., 2015). To correct the differences in the AOI areas (i.e. statements displayed had different lengths), fixation count was standardized dividing by the AOI area (cm^2). Drawing from the data of the different levels, the visual attention results were grouped by categories according to the factor they referred to (i.e. environmental impact, animal welfare, social impact, origin).



Superscript a–b: different letters indicate statistically significant differences ($p < 0.05$).

Figure 13. Visual attention to factors for fish burger in control conditions.

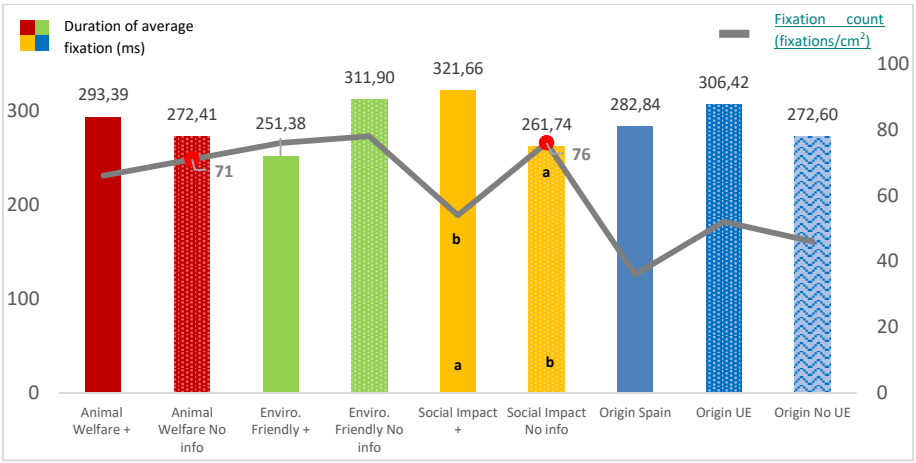
Regarding the fish burger, when comparing visual attention between factors inside the same group, fixation count had significant differences both in control (Figure 13) and experimental conditions (Figure 14). Fixation count was higher for statements about environmental impact for the control group and animal welfare for the experimental group. In relation to fixation duration, although for all groups origin was the factor with the longer fixation duration, it was only significant in the experimental condition. Differences between the control and experimental group were not significant.



Superscript a–b: different letters indicate statistically significant differences ($p < 0.05$).

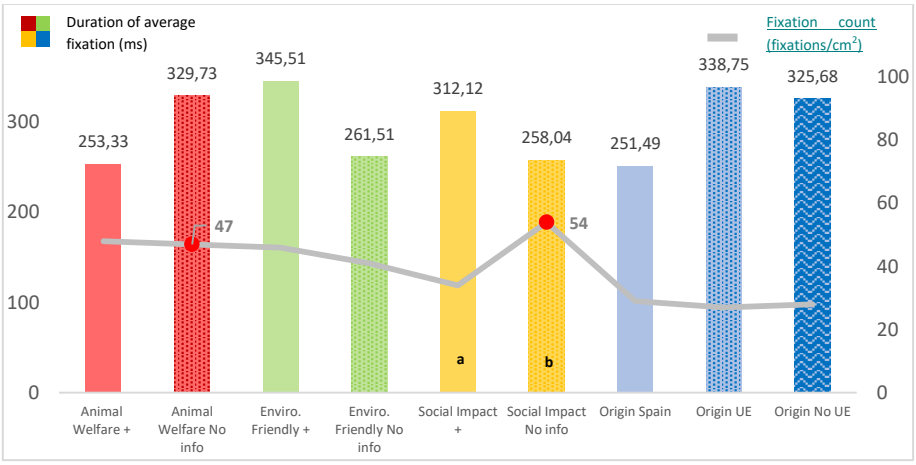
Figure 14. Visual attention to factors for fish burger in experimental conditions.

In relation to the factor level attention within the same group, social impact presented higher differences between the information displayed, both in the control and experimental conditions. In the control group (Figure 15), fixation count was significantly higher when the referred statement had no information about social impact, whereas fixation duration was higher for the statement with information about positive outcomes. In the experimental group, fixation duration was higher for the statement with information about positive impact (Figure 16). In addition, significant differences were found in the fixation count between groups for those statements that had no information about social impact or animal welfare.



Superscript a–b: different letters indicate statistically significant differences between levels ($p < 0.05$). Red dots indicate statistically significant differences between control and experimental group for that level ($p < 0.05$).

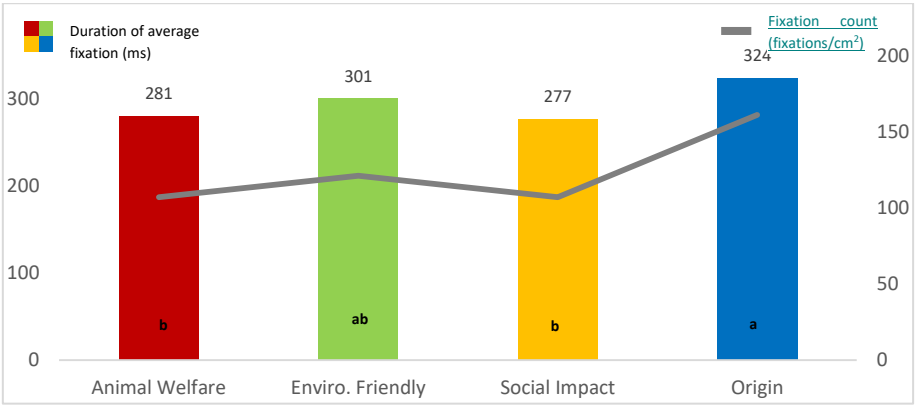
Figure 15. Visual attention to factor levels for fish burgers in control conditions.



Superscript a–b: different letters indicate statistically significant differences between levels ($p < 0.05$). Red dots indicate statistically significant differences between control and experimental group for that level ($p < 0.05$).

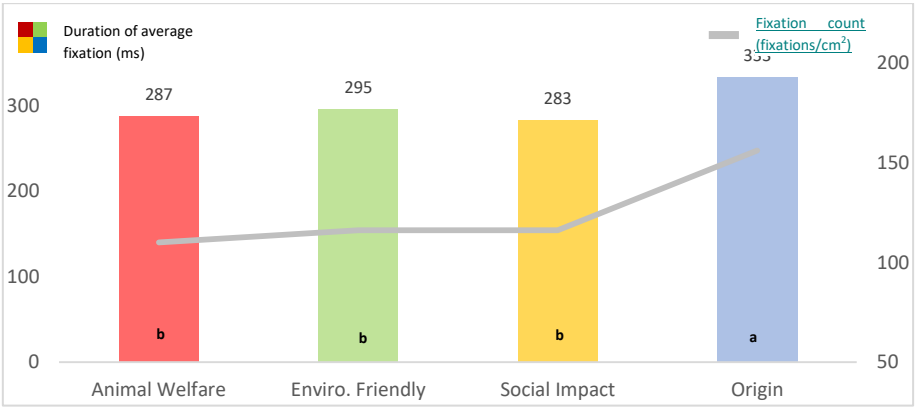
Figure 16. Visual attention to factor levels for fish burgers in experimental conditions.

In relation to the fish sticks, when comparing visual attention between factors, duration of fixations had significant differences both in control and experimental conditions. Fixation duration and fixation count were higher for origin in both groups (Figures 17 and 18). Differences between control and experimental group were not significant.



Superscript a–b: different letters indicate statistically significant differences ($p < 0.05$).

Figure 17. Visual attention to factors for fish sticks in control conditions.



Superscript a–b: different letters indicate statistically significant differences ($p < 0.05$).

Figure 18. Visual attention to factors for fish sticks in experimental conditions.

In relation to the factor level attention within the same group, social impact was also the factor which presented higher differences in the information displayed, although in the case of fish sticks, only in experimental conditions. In the experimental group, fixation count was higher for the statement with no information about social impact (Figure 20). Even not being significant, the fixation count of the control group was also higher when the participant had no social impact information (Figure 19). Differences between control and experimental group were not significant.

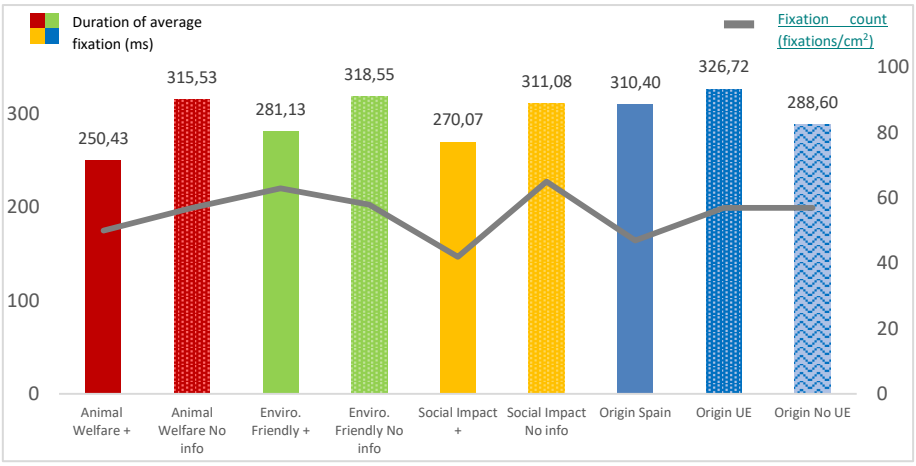
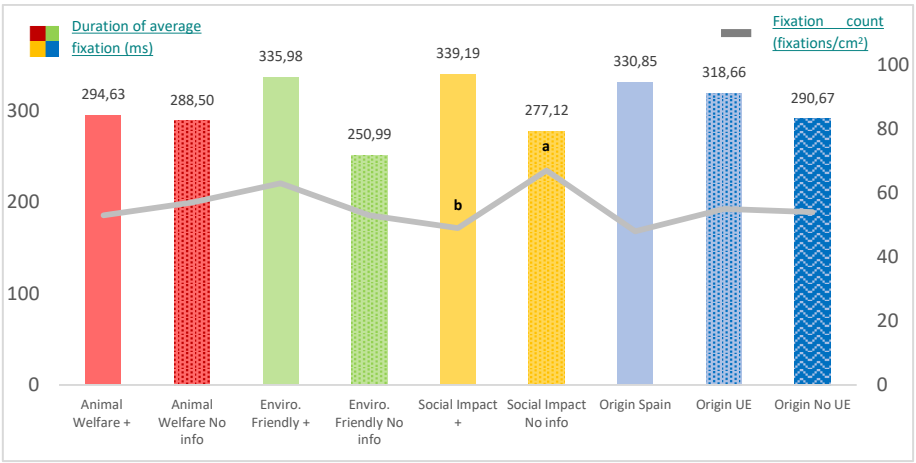


Figure 19. Visual attention to factor level for fish sticks in control conditions.



Superscript a–b: different letters indicate statistically significant differences between levels ($p < 0.05$).

Figure 20. Visual attention to factor levels for fish sticks in experimental conditions.

5.3.3 Self-reported measures

After the ranking task, participants were asked some self-reported final questions. The fish burger received higher scores than fish sticks for willingness to try, willingness to buy, and healthiness. Familiarity and convenience were higher for the fish sticks (Table 8). Between groups, only statistically significant differences were found in the construct for fish sticks, the control group being more familiar.

Table 8. Self-reported measures scored by product.

	Fish burger		Fish stick	
	Control	Experimental	Control	Experimental
Willingness to try	6.2	6.2	5.8	5.7
Familiarity	3.6	4.2	6.0[a]	5.4[b]
Healthiness	5.5	5.5	4.6	4.9
Convenience	6.1	6.1	6.2	6.1
Willingness s to buy	5.8	5.8	5.5	5.3

Superscript a–b: different letters in the same column indicate statistically significant differences ($p < 0.05$).

Participants were also asked about the importance attributed to different factors in relation to their choice for fish products using the single item FCQ. Healthy, sensory, and natural were the items with higher rates, followed by items connected to sustainability such as as environment, animal welfare, and social justice over price, convenience, familiarity, mood, or weight control (Table 9). Only significant differences were found in the price factor for control and experimental groups, price having more importance for the control.

Table 9. Factors affecting choice for fish products.

Items	Control	Experimental
Health	6.6	6.5
Sensory	6.6	6.6
Natural	6.4	6.4
Environment	6.5	6.1
Animal welfare	6.2	6.3
Social justice	6.2	6.0
Price	6.0[a]	5.5[b]
Convenience	5.7	5.6
Familiarity	4.9	5.4
Mood	4.9	5.0
Weight control	4.5	5.2

Superscript a–b: different letters in the same column indicate statistically significant differences ($p < 0.05$).

No significant differences in environmental orientation (Table 10) and prosocialness (Table 11) were found, both scoring on 7-point scales, between the control and experimental group. Higher scores revealed ecocentrism orientation in comparison to anthropocentrism, and a medium to high prosocial tendency.

Table 10. Environmental orientation.

	Control	Experimental
Ecocentrism	6.03	5.83
Anthropocentrism	3.40	3.10

Table 11. Prosocial tendency.

	Control	Experimental
Prosocial tendency index	5.82	5.71

6. Conclusions

Conclusions derived from the former two activities: 1) Packaging designed by consumers, and 2) Validation of the packaging through neuroscience) were grouped to allow a better understanding. They are presented below.

The combinations of visual and textual attributes that were preferred by consumers for two fish products were identified. Consumers have clear preferences for specific package designs, both in terms of visual and textual attributes. Nevertheless, small differences were found between consumers' preferences when fish burger and fish sticks attributes were compared. Those differences were particularly small for textual claims. Therefore, it may be unnecessary to make special efforts in designing different packaging for different categories of fish products, as consumers seem to have similar preferences for all of them.

Consumers showed their preference for informative claims over interpretative ones when it comes to the packaging of a fish product. Therefore, when selecting textual claims during packaging design, informative claims should be prioritized.

The information gathered could be useful to guide the packaging design for aquaculture fish products in the Spanish market. Caution is required if results obtained within this study are extrapolated to other countries, as there may be significant differences among consumers' preferences between countries.

The validation carried out with implicit methods showed that the packaging designed by consumers were preferred over the competitors. In particular, the white tray (the packaging designed with the preferred combination of visual and textual attributes) was the one with higher acceptability and purchasing probability. Therefore, the results obtained confirm the usefulness of incorporating consumers' opinions during packaging design.

As a final conclusion, it is highly encouraged to involve consumers in all stages of the New Product Development, but especially in packaging design, as it proved to be an easy and effective way to design the fish product's packaging according to consumers' demands and has been confirmed through neuroscience.

On the other hand, conclusions derived from the third activity; 3) Relevance of sustainability dimensions were presented below.

Sustainability concerns, as well as animal welfare, are gaining consumers' attention over the last decades. Deeper understanding of the importance of sustainability dimensions, both environmental and social, and animal welfare, indicates that it is primordial to recognize the optimal products' configuration.

For fish products perceived as innovative, such as the fish burger, animal welfare seemed to have greater importance in consumers' choices than origin, which traditionally has been one of the most important attributes for fish. When relevant information about positive outcomes of aquaculture (i.e. sustainability and animal welfare) was given, as is the case of the experimental manipulation video displayed, origin importance decreased.

In line with respondents' choices, visual fixation to animal welfare attributes was higher than the fixation for origin, highlighting the greater importance that participants attributed to fish welfare. On the other hand, the higher fixation duration for the experimental group could indicate that participants took more time in the deliberation process about the importance of origin, once informed, to finally giving less importance to it.

Considering visual attention between factor levels about social impact, it is worth mentioning the higher fixation count in the statements without information about social impact, indicating noticeable information, in relation with the statements about the positive outcomes. On the contrary, fixation duration was higher for the positive social impact. It could be inferred that social impact can be perceived as a more complex attribute when thinking about the consequences of aquaculture on the community. Both fixation counts and fixation duration decreased when relevant information about the positive outcomes was given.

For fish products perceived as more familiar, such as the fish sticks, origin remained the most important attribute when no specific positive outcomes of aquaculture were given (i.e. sustainability and animal welfare), social impact being the most relevant attribute for the experimental group, which were provided with this information. Regarding visual fixation, origin stood out over the other attributes and received higher attention, with similar results for the control and experimental group, confirming its relevance for the control group and its attendance in the deliberation process about the importance of origin for the experimental group.

When focusing on visual attention between factor levels, again, social impact stood out with significant differences between statements with and without information about social impact in the experimental group that positioned social impact as the most important factor. Higher fixation count and lower fixation duration was observed in the statements without social impact information in relation with the statements about the positive outcomes. This reveals the first to be more noticeable and the second easier to extract the information. Once again, this could be indicative of the complexity of the deliberation process, weighing the pros and cons. Fixation count showed similar results for control and experimental groups. Although the fixation duration and, thus, difficulty to extract information from the statements, increased for positive social impact it decreased when no information was given in line with the involvement to the positive social impact of the choice result.

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Appendix 1 – Edited photos of the four packagings used as stimuli

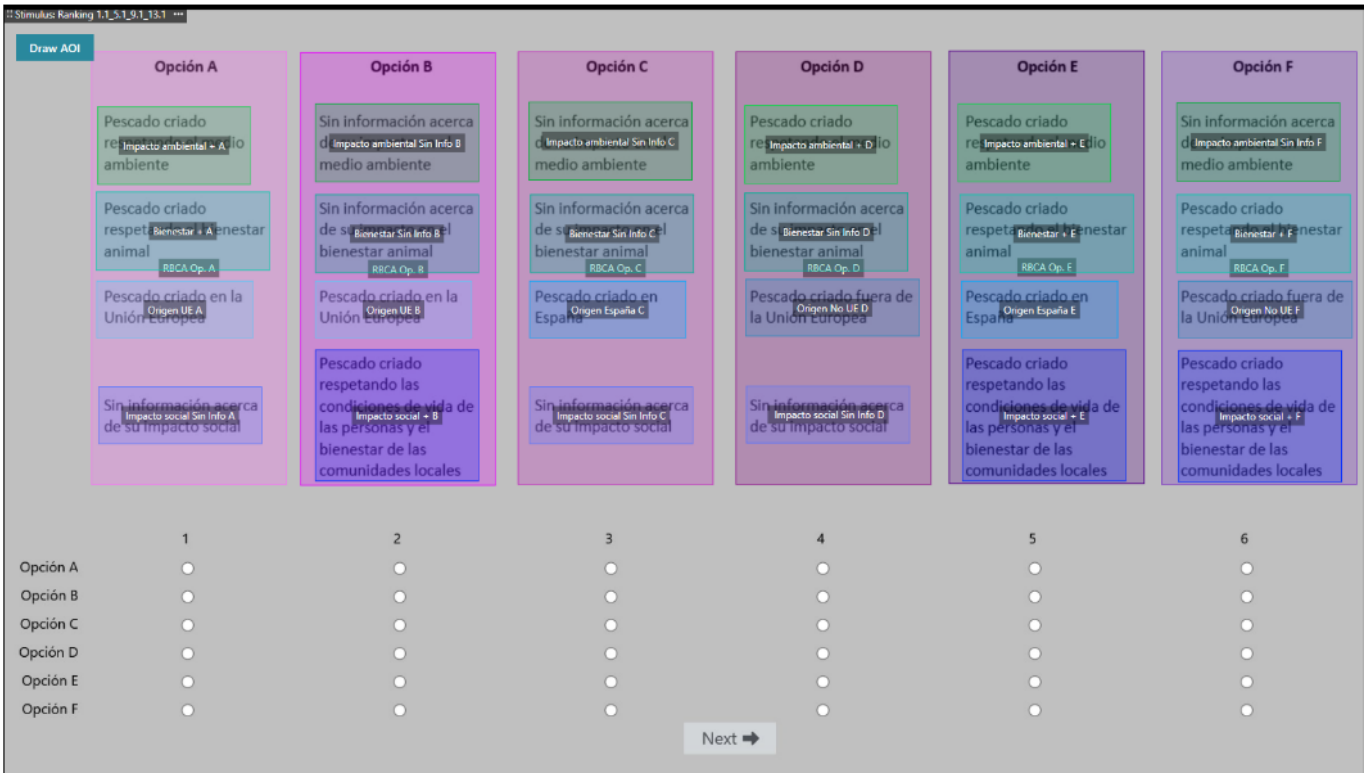
Figure 21. Packaging designed by consumers: the preferred combination of visual and textual attributes (White tray).

Figure 22. Packaging designed by consumers: the second preferred combination of visual and textual attributes (Blue carton).

Figure 23. Photo-edited packaging from an own brand of the Spanish supermarket with higher sales share (Black tray).

Figure 24. Photo-edited packaging from the most known and well-established brand of fish products in Spain (Bag).

Appendix 2 – Areas of interest (AOI) of all statements presented to participants in the ranking task slide



Technical and economic feasibility analysis of new aquaculture seafood products

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Table of contents

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1. Introduction

WP5 (Product development, market and consumer assessment) explored and validated the technical and market feasibility of different product alternatives from specific Mediterranean aquaculture fish species for commercial exploitation, analysing the potential of different market opportunities, and taking into account socio-economic aspects and consumer requirements.

Considering the current consumer demand and the lack of aquaculture seafood products in the market, the development of new fish products based on aquaculture species (seabass, gilthead seabream and meagre), could be an opportunity to increase the commercial value and profitability of the Mediterranean aquaculture value chain.

For this purpose, eight (8) new food products from Mediterranean aquaculture species were designed, formulated, and developed at pilot-scale in AZTI's facilities (Spain) considering the consumers´ needs identified and ideas generated in MedAID project (Tasks 5.1, 5.2 and 5.3). Finally, a selection of four products were elaborated through short production batches for a market validation step with consumers to study the sensory acceptability, consumer preferences, food packaging and purchase intention among other parameters in Spain, France, and Germany.

In the four selected products (grilled seabass with lemon, organic seabream fillet with couscous, sea & mountain meagre burger and seabream breaded bites), the three main Mediterranean aquaculture fish species were included as raw materials and different levels of processing (from minimally to medium) and market (retail, food industry, Horeca) and consumer niches (schools, canteens) were considered. A technical dossier for each product was generated including ingredients, nutrition facts, allergen list, storage conditions, shelf-life, packaging, process flow chart and work instructions to assure product technical quality and safety.

Task 5.5, "Technical and economic feasibility analysis of products", estimated the technical and economic feasibility of producing the four new food products developed in the framework of MedAID, in order to facilitate the possible implementation of these developments at industrial processing level by the food industry. For that purpose, costs for formulating and producing the products were estimated considering raw materials, ingredients, packaging costs, processing yield, labour and operation costs and infrastructures (equipment). For the economic analysis, a common scenario to calculate productivity, costs, expenses, and incomes was drawn up for the 4 products "case studies".

Economic indicators calculated were: Total Net Revenue, Gross Margin, Earnings Before Interest and Taxes (EBIT), Earnings Before Taxes (EBT), Net Income and Cash Flow for the first three years after launching the product on the market.

Finally, the work reported in this deliverable, is expected to contribute to product and process development as it is considered a key part of smart business strategy to compete with other players in the food value chain. The results can lead to work on a new range of healthy and convenient aquaculture seafood products developed according to the specific demands and needs of each commercial niche (school canteens, food industry, food service and/or retail channels) and suitable for new consumer lifestyles.

2. Objective

The main objective of Task 5.5. "Technical and economic feasibility analysis of products" was the development of new aquaculture fish products' technical and economic specification documents, needed to evaluate their industrial feasibility for the fish processing food industry.

The analysis performed, included basic costs for formulating and producing the product, raw materials, ingredients, processing yields, materials, packaging and production costs but also the definition of a full flow diagram for the process and the analysis of necessary infrastructures (equipment lines) to execute each of the potential products at an industrial scale-up level. For the economic analysis, a common scenario to calculate productivity, costs, expenses and incomes was drawn up for the 4 product "case studies"; grilled seabass with lemon, organic seabream fillet with couscous, sea & mountain meagre burger and seabream breaded bites.

3. EU fish market prices

The consumer prices of fishery and aquaculture products have been growing significantly since 2014 and by 2019, they were 14 % higher than eight years before. As the EU demand is primarily met through imports, the increases were in line with the increased prices of imported products. Moreover from 2018 to 2019, the household expenditure for fishery and aquaculture products increased in all Member States. (EUMOFA, 2020)

The value increase in aquaculture in the EU during the 2009-2018 decade (3 %), was due to increased production of high value species, such as salmon, seabass and bluefin tuna, combined with the strong price increase of some major species, such as salmon, seabass, gilthead seabream, oyster and clam. This slight volume increase combined with increased demand contributed to a price increase, (EUMOFA, 2020).

In Task 5.5, in order to analyse the updated market price of the three species considered in this study (seabass, gilthead seabream and meagre), prices from market reports (The European Fish Price Report. May 2020) and real prices purchased from aquaculture fish suppliers (2020) were compiled.

The tables below (Table 1, 2 and 3) show prices in aquaculture species. Raw farmed fish have a European origin and the prices are based on information supplied by industry correspondents to provide guidance on broad price trends. Price information is indicative.

Table 1. Meagre prices. The European Fish Price Report. May 2020

Fish Specie	Product Form	Price per kg (€)		Origin
Meagre *Argyrosomus regius*	Fresh – whole farmed	Max	6.33	Greece
		Min	4.99	
		Average	5.46	

Table 2. Seabass prices. The European Fish Price Report. May 2020

Fish Specie	Product Form	Price per kg (€)		Origin
Seabass *Dicentrarchus labrax*	Fresh – whole farmed	Max	13.52	Greece
		min	3.10	
		Average	5.74	
	Fresh – whole farmed	Max	12.50	Spain (Canary Islands)
		min	4.00	
		Average	6.35	
	Fresh – whole farmed	Max	10.70	Italy
		min	7.60	
		Average	9.33	

Table 3. Gilthead seabream prices. The European Fish Price Report. May 2020

Fish Specie	Product Form	Price per kg (€)		Origin
Seabream *Sparus aurata*	Fresh – whole farmed	Max	9.70	Greece
		min	12.40	
		Average	10.93	
	Farmed	Max	8.93	Greece
		min	4.20	
		Average	5.83	
	Farmed	Max	4.26	Italy
		min	4.10	
		Average	4.19	

Meagre purchase prices

Meagre is used in the ”sea and mountain burger” product. For ”sea and mountain burger”, fresh meagre fillets PBO (Pin Bones Out) are used as the initial fish product**.**

In Table 4, purchase prices for different meagre presentations (PBO fillets and whole fish) are shown. Meagre Real Market Price (Meagre RMP) is the price that suppliers provided for the pilot production in July 2020 at AZTI´s facilities for 600 – 1000 g weight fresh fillets.

Meagre RMP has a reasonable purchase price, but food companies could buy raw meagre industrially from supplier at a negotiated cheaper price. Meagre Industrial Market Price (Meagre IMP) is a better fitted price (around 35 % lower), estimated for large scale production.

Table 4. Prices for meagre. Market prices. July 2020

	PBO Fillet		Whole Fresh Meagre
	Meagre IMP	**Meagre RMP**	
Price (€/kg)	9.90	15.40	5.80

Seabass purchase prices

Seabass is used in ”grilled seabass with lemon”. For ” grilled seabass with lemon”, fresh or frozen seabass fillets PBO (Pin Bones Out) are used as the initial fish product.

In Table 5, maximum, minimum and average purchase prices for different seabass conservation conditions (fresh, frozen and whole fish) are shown.

Table 5. Max, min and average prices for seabass. Market prices. July 2020

	Fresh - PBO Fillet	Frozen - PBO Fillet	Whole Fresh Seabass
Max price (€/kg)	14.50	10.35	6.60
min price (€/kg)	10.85	9.20	3.90
Average price (€/kg)	**12.85**	**9.78**	**5.25**

Seabream purchase prices

Seabream is used in organic sea bream with couscous and seabream breaded bites products. For "organic seabream with couscous", fresh or frozen seabream fillets PBO (Pin Bones Out) are used as initial fish product. For "seabream breaded bites", frozen seabream mince blocks are used as initial fish product.

In Table 6, maximum, minimum and average purchase prices for different seabream conservation conditions (fresh, frozen and whole fish) are shown.

Table 6. Max, min and average prices for seabream. Market prices. July 2020

	Fresh PBO Fillet	Frozen PBO Fillet	Frozen Mince Blocks	Whole Fresh Seabream
Max price (€/kg)	14.60	10.35	23.47	5.90
min price (€/kg)	10.80	8.50	4.40	4.50
Average price (€/kg)	**12.70**	**9.43**	**8.90**	**5.20**

4. Common scenario

For the economic analysis and product industrialization, a common scenario to calculate productivity, costs, expenses and incomes was drawn up for the 4 product "case studies".

The implementation of a new production line in a food industry would enable a new range of products to be created for the market portfolio and could result in a increase of sales of the company and competitivity.

Common statements of these case studies:

- All facilities/buildings needed for the implementation of the new production line are already built.
- In the same building, other production lines are fully operational.
- Refrigeration & freezing chambers are in place and working (in use for other production lines) – No need for a new chamber, but since some space is needed, 25 % of a chamber cost will be charged to the new production line.
- Administration & sales work force already working in the company. New product will share these workers (25 % of 1 administration worker & 25 % of 1 sales worker).
- Investment is needed: additional furniture, office supplies, IT equipment, production line tools, PPEs.
- Marketing & sales budget: additional expenses considered (advertising & marketing, travel expenses, allowances, etc.) for every year of the technical and economic feasibility analysis.
- Target products are value-added products with a high nutritional and sensory profile. Product with high quality in raw materials (fish and others) and high quality in the final product.
- Line production characteristics:
    - Start-up during first year (increase in the production curve during the first 12 months). From second year, 20 % annual increase over the previous year.
    - 1 shift of production/day.

Product price:

The product price will depend on the final channel to which the product will be sold. There are two options: Retail Sector and HoReCa sector. In the HoReCa sector there is less packaging material per kg of product.

Retail products - Product Formula Price:

- Raw materials → Price/kg
- Packaging Additional 15 % of the raw material cost
- Shipment Additional 10 % of the raw material cost

HoReCa products - Product Formula Price:

- Raw materials → Price/kg
- Packaging Additional 5 % of the raw materials cost
- Shipment Additional 10 % of the raw materials cost

Wholesale price:

Wholesale price will be the price to sell the products to Retail/HoReCa customers. This price will be calculated multiplying the product price by 1.65, although it will depend on the competitive landscape. This wholesale price is used as reference to encompass all product expenses (labour, sales & marketing, amortization, processing-energy, etc).

In Table 7 below, some examples of wholesale prices appear in relation to product prices.

Table 7. Product Prices and related Wholesale Prices

Product Price	Wholesale Price
1.00 €	1.65 €
2.00 €	3.30 €
3.00 €	4.95 €
X.XX €	(X.XX x 1.65) €

For the economic calculations of Task 5.5, it was decided to work with these standard sales and profit margins, but considering that if wholesale price increased, so would the profit per unit of final product.

Sales:

Start-up of the new line during first year. An increase is assumed in the percentage of the production sold during the first 12 months (from 70 % in the first month to 90 % in the twelfth month). From the second year on, 95 % of the production is sold.

5. Technical and economic feasibility analysis. Case studies

The four new food products from Mediterranean aquaculture species designed, formulated and developed at pilot-scale in AZTI´s facilities (Spain) through short production runs and selected for technical and economic feasibility analysis were:

- Sea and mountain burger
- Grilled seabass with lemon
- Organic seabream with couscous
- Seabream breaded bites

5.1 Sea and mountain burger

Formulation

Table 8 shows the ingredients and formulation used to produce sea and mountain burger. It also shows the price/kg (in euros-€) of each ingredient and the total price.

Table 8. Sea and mountain burger formulation and cost/kg

Ingredients	%	Price €/Kg	
		Meagre RMP	Meagre IMP
Meagre	96.41	18.56*	11.93**
Black trumpet mushrooms (dehydrated)	0.50	53.57	53.57
Fried onion	3.09	1.45	1.45
TOTAL	**100.00**	**18.07**	**11.81**

*Note// Meagre RMP Fillet Price is 15.40 €/kg. Adjustment needed in order to adjust waste in skinning & mincing steps (17.02 % waste). Final price after these process steps: 18.56 €/kg.
**Note// Meagre IMP Fillet Price is 9.90 €/kg. Adjustment needed in order to adjust waste in skinning & mincing steps (17.02 % waste). Final price after these process steps: 11.93 €/kg.

Process flow

Process flow (Figure 1) to produce ”sea and mountain burgers” is detailed below. This production line has a productivity of 2.333 bags/hour, which is equivalent to 420.0 kg/hour, with a team of 4 people working on the production line. The ratio of production per person is 105 kg/person & hour.

Initial equipment investment is 648,523.00 €.

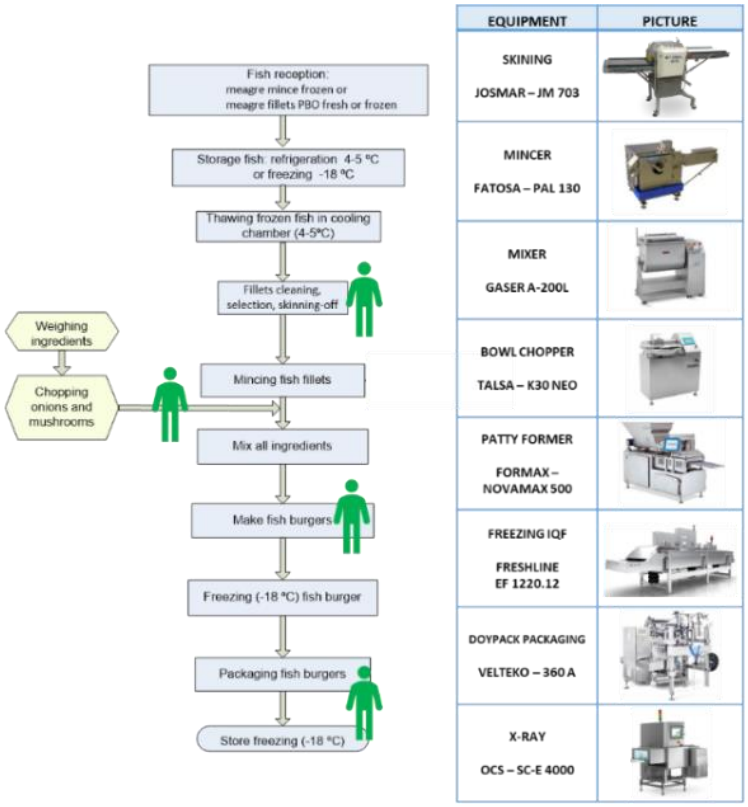

Figure 1. Process flow for ”sea and mountain burger” product

The first step of the process is the ingredient reception. All ingredients must arrive with their Certificate of Analysis (CoA) in order to enter the production process. Ingredients are later stored in their corresponding storage chambers. Meagre fillets arrive fresh and are stored in a refrigeration chamber until they are used in the production line.

Fresh fillets are transported to the beggining of the line, for fillet quality inspection and selection and removal of the remaining fishbones. A skinning machine removes the skin and the skinned fillets are minced in a mincing machine.

The rest of the ingredients are weighed and chopped (onions and mushrooms) and together with the minced fillets are placed in a mixer and mixed. This mixture is transported to a burger former machine, where burgers of 30 g are produced and transported to a freezing tunnel to be frozen.

Frozen burgers are packed in modified atmosphere (MAP) in a Doypack packing machine in bags of 180 g of weight (6 burgers). The final product passes through an X-Ray machine in order to detect any foreign objects and is finally stored in the freezing chamber to be later distributed to the market.

Product price

For a 180 g stand-up silver coloured bag of sea and mountain burgers (6 units/bag), the wholesale price proposed is 6.76 €/bag if meagre is meagre RMP, and 4.39 €/bag if meagre is Meagre IMP (Price to sell to the retailers). The estimated final product retail price (Table 9) is 10.41 €/bag if meagre is meagre RMP, and 6.75 €/bag if meagre is Meagre IMP (Assumption that retailers increase price 40 % of the wholesale price).

Table 9. Meagre wholesale & final product retail prices

	Wholesale Price - €/unit	Final Product Retail Price €/unit
Meagre IMP	4.39 €	6.75 €
Meagre RMP	6.76 €	10.41 €

Profit & loss analysis

In this section, the following economic indicators have been calculated for the profit & loss table: Total Net Revenue, Gross Margin, Earnings Before Interest and Taxes (EBIT), Earnings Before Taxes (EBT), Net Income and Cash Flow.

- **TOTAL NET REVENUE**: Net Revenue is the total amount of the money the company earns from the product sales minus the direct expenses.
- **GROSS MARGIN**: Gross Margin is the company´s net sales revenue minus its cost of goods sold (COGS).
- **EARNINGS BEFORE INTEREST AND TAXES (EBIT)**: Net profit measures how much net income or profit is generated as a percentage of revenue. It is the radio of net profits to revenues for the company. The net profit margin illustrates how much of each Euro in revenue collected by the company translates into profit.
- **EARNINGS BEFORE TAX (EBT)**: Earnings before tax (EBT) measures the company´s financial performance. It is a calculation of a firm´s earnings before taxes are taken out. The calculation is revenue minus expenses, excluding taxes.
- **NET INCOME (NI)**: Net Income (NI), also called net earnings, is calculated as sales minus cost of goods sold (COGS), selling, general and administrative expenses, operating expenses, depreciation, interest, taxes and other expenses. It is a useful number for investors to assess how much revenue exceeds the

expenses of an organization. This number appears on a company´s income statement and is also an indicator of a company´s profitability.

- **ACCUMULATED NET INCOME**: Accumulated Net Income are the net earnings generated over the years.
- **CASH FLOW**: Cash Flow is the net amount of cash and cash equivalents being transferred into and out of a business. Cash received represents inflows, while money spent represents outflows.

With all the requirements detailed above, a production and sales simulation has been conducted during the first 3 years of operation. Each of the indicators has been calculated to check if the estimated ”case studies”, with the defined considerations, are profitable products/line production from an economic point of view.

Meagre Real Market Price (RMP)

In the case of using meagre RMP, from the first year of production when the start-up of the line takes place, 547.911 bags of products are sold. These sales, minus all expenses, generate a positive EBT of 322.685 €.

During the second and third years, with a production and sales increase of 20 %/year, the EBT keeps growing achieving 1.650.286 € in the third year of production. Table 10 shows the indicator values for the first three years of production.

Table 10. Profit & loss analysis. Meagre RMP

PROFIT & LOSS						
	Year 1	**% of sales**	**Year 2**	**% of sales**	**Year 3**	**% of sales**
Kg of products sold	98.624		136.314		190.840	
Number of units sold (bags)	547.911		757.302		1.060.223	
SALES (income from sales)	3.703.390 €		5.118.686 €		7.166.160 €	
TOTAL NET REVENUE	**3.703.390 €**		**5.118.686 €**		**7.166.160 €**	
Raw materials	2.721.258 €	73%	3.265.509 €	64%	4.571.713 €	64%
Processign (energy)	380.976 €	10%	457.171 €	9%	640.040 €	9%
Staff (direct labour)	112.000 €	3%	115.360 €	2%	118.821 €	2%
COST OF GOODS SOLD	**3.214.234 €**	**87%**	**3.838.041 €**	**75%**	**5.330.574 €**	**74%**
GROSS MARGIN	**489.156 €**	**13%**	**1.280.645 €**	**25%**	**1.835.587 €**	**26%**
Amortization	84.090 €	2%	84.090 €	2%	84.090 €	1%
Sales & marketing	54.450 €	1%	64.913 €	1%	71.943 €	1%
General and administrative	21.950 €	1%	22.609 €	0%	23.287 €	0%
NET PROFIT (EBIT)	**328.665 €**	**9%**	**1.109.034 €**	**22%**	**1.656.267 €**	**23%**
Financial expenses	5.981 €		5.981 €		5.981 €	
EBT	**322.685 €**	**9%**	**1.103.053 €**	**22%**	**1.650.286 €**	**23%**
Taxes on profit (24%)	77.444 €		264.733 €		396.069 €	
NET INCOME	**245.240 €**	7%	**838.320 €**	16%	**1.254.217 €**	18%
Accumulated net income	245.240 €		1.083.561 €		2.337.778 €	
Cash flow	**329.331 €**	9%	**922.411 €**	18%	**1.338.308 €**	19%
Accumulated cash flow	329.331 €		1.251.741 €		2.590.049 €	

Figure 2 shows Total Net Revenue, Gross Margin and EBT values for the first three years of simulation for Meagre RMP.

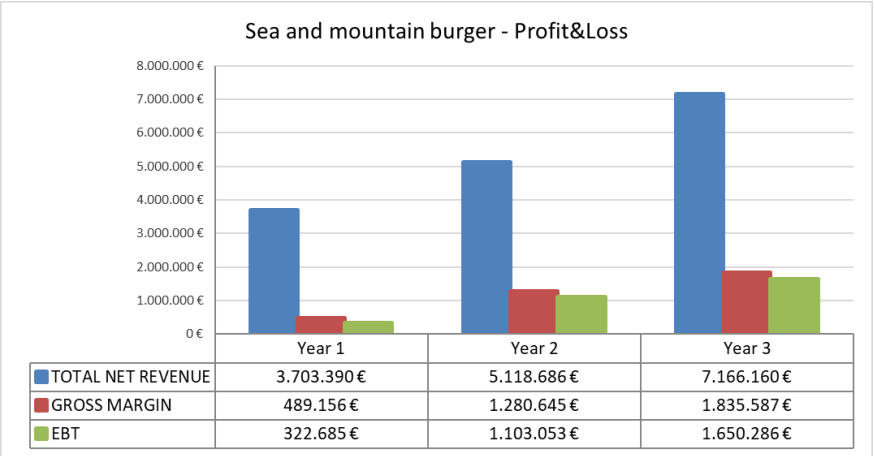

Figure 2. Profit & loss diagram. Meagre RMP

MEAGRE IMP

In the case of using meagre IMP as ingredient, Table 11 shows that the trend is the same as the previous case. From the first year of production, when the start-up of the line takes place, 547.911 bags of products are sold. These sales, minus all expenses, generate a positive EBT of 123.608 €. EBT is lower than the previous case because the wholesale price & the final product retail price are also lower.

During the second and third years, with a production & sales increase of 20 %/year, the EBT keeps growing, achieving 976.144 € in the third year of production. This study could be more realistic due to the fact that it uses the industrial meagre price of July 2020 (pilot scale production at AZTI).

Table 11. Profit & loss analysis. Meagre IMP

PROFIT & LOSS						
	Year 1	**% of sales**	**Year 2**	**% of sales**	**Year 3**	**% of sales**
Kg of products sold	98.624		136.314		190.840	
Number of units sold (bags)	547.911		757.302		1.060.223	
SALES (income from sales)	2.403.299 €		3.321.749 €		4.650.449 €	
TOTAL NET REVENUE	**2.403.299 €**		**3.321.749 €**		**4.650.449 €**	
Raw materials	1.765.948 €	73%	2.119.138 €	64%	2.966.793 €	64%
Processign (energy)	247.233 €	10%	296.679 €	9%	415.351 €	9%
Staff (direct labour)	112.000 €	5%	115.360 €	3%	118.821 €	3%
COST OF GOODS SOLD	**2.125.181 €**	**88%**	**2.531.177 €**	**76%**	**3.500.965 €**	**75%**
GROSS MARGIN	**278.117 €**	**12%**	**790.572 €**	**24%**	**1.149.483 €**	**25%**
Amortization	84.090 €	3%	84.090 €	3%	84.090 €	2%
Sales & marketing	54.450 €	2%	64.913 €	2%	71.943 €	2%
General and administrative	21.950 €	1%	22.609 €	1%	23.287 €	1%
NET PROFIT (EBIT)	**117.627 €**	**5%**	**618.960 €**	**19%**	**970.163 €**	**21%**
Financial expenses	5.981 €		5.981 €		5.981 €	
EBT	**111.646 €**	**5%**	**612.979 €**	**18%**	**964.183 €**	**21%**
Taxes on profit (24%)	26.795 €		147.115 €		231.404 €	
NET INCOME	**84.851 €**	4%	**465.864 €**	14%	**732.779 €**	16%
Accumulated net income	84.851 €		550.716 €		1.283.494 €	
Cash flow	**168.942 €**	7%	**549.955 €**	17%	**816.869 €**	18%
Accumulated cash flow	168.942 €		718.896 €		1.535.766 €	

Figure 3 shows Total Net Revenue, Gross Margin and EBT values for the first three years of simulation for meagre IMP.

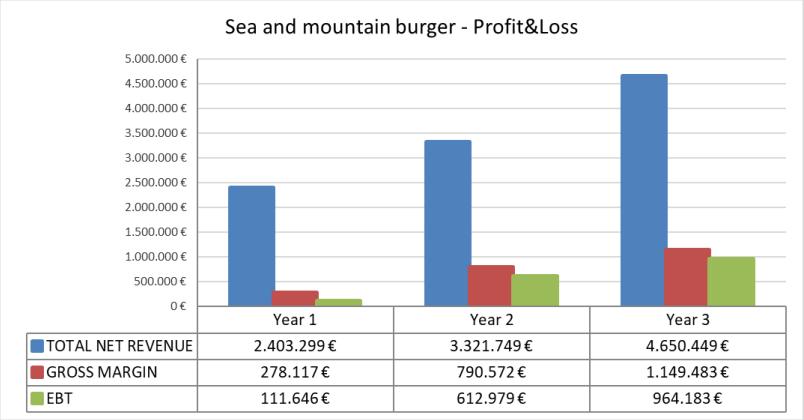

Figure 3. Profit & loss diagram. Meagre IMP

5.2 Grilled seabass with lemon

Formulation

Table 12 shows the ingredients and formulation used to produce grilled seabass with lemon. It also contains the price/kg (in euros-€) of each ingredient and the total formula price.

Table 12. Grilled seabass with lemon formulation and cost/kg

INGREDIENTS	%	Price €/Kg	
		Fresh PBO Fillet	Frozen PBO Fillet
Seabass	66.80	16.40*	12.48**
Water	14.10	0.01	0.01
Oil	5.00	1.44	1.44
Salt	1.50	0.20	0.20
Potato starch	4.50	3.10	3.10
Lemon juice prepared	4.00	0.62	0.62
Fish gelatin	2.00	18.10	18.10
Thermflo (Corn starch)	1.00	1.98	1.98
Carrageenan	0.20	12.59	12.59
Sodium tripolyphosphate	0.25	2.20	2.20
Tetrasodium pyrophosphate	0.25	2.00	2.00
Dry parsley	0.20	6.67	6.67
Granulated garlic	0.20	3.99	3.99
TOTAL	**100.00**	**11.64**	**9.01**

*Note// Fresh seabass PBI fillet price is 12.85 €/kg. Yield needs to be adjusted in skinning & mincing-deboning steps (21.65 % waste). Final price after these process steps: 16.40 €/kg

** Note// Frozen seabass PBI fillet price is 9.78 €/kg. Yield needs to be adjusted in skinning & mincing-deboning steps (21.65 % waste). Final price after these process steps: 12.48 €/kg

Process flow

Process flow (Figure 4) to produce ”grilled seabass with lemon” is detailed below. This production line has a productivity of 300 packs/hour, which is equivalent to 300.0 kg/hour, with a team of 5 people working on the production line. The ratio of production per person is 60 kg/person & hour.

Initial equipment investment is 862,625.00 €.

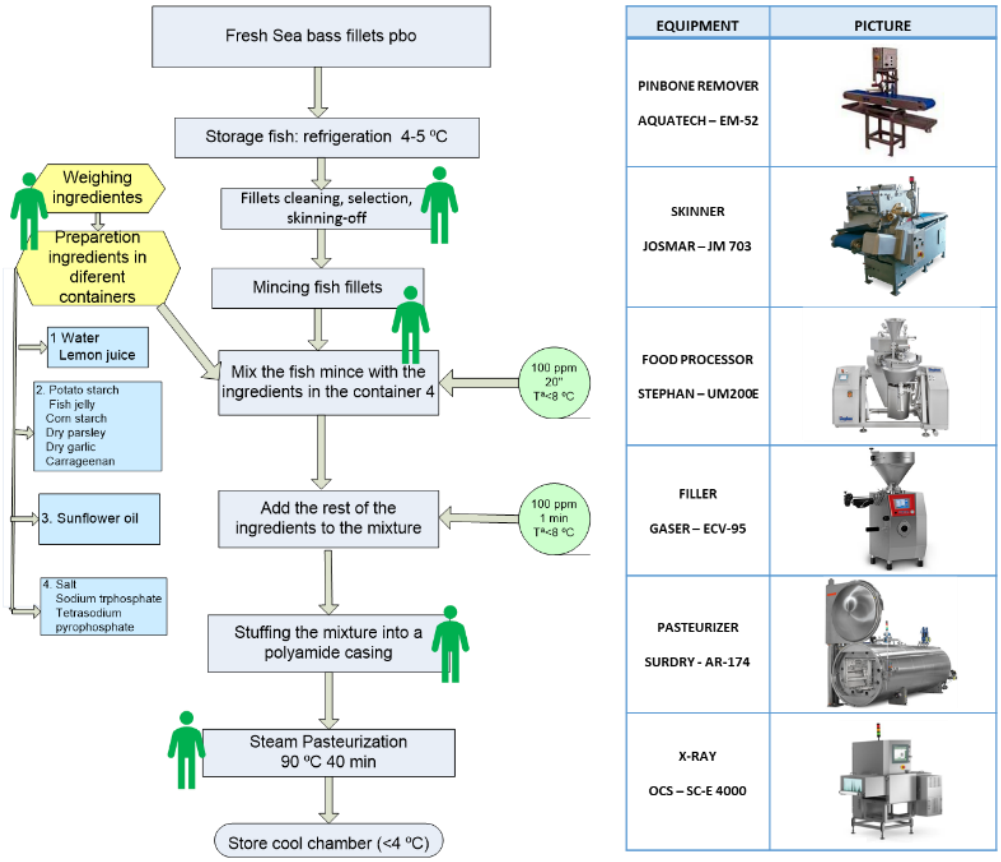

Figure 4. Process flow for ”grilled seabass with lemon” product

The first step of the process is the ingredient reception. All ingredients must arrive with their Certificate of Analysis (CoA) in order to enter the production process. Ingredients are later stored in their corresponding storage chambers. Seabass fillets arrive fresh or frozen (depending on the scenario selected) and are stored in a refrigeration or freezing chamber until being used in the production line.

Fillets are transported to the beginning of the line for quality inspection and selection. A pinbone remover machine removes the fishbones and a skinning machine removes the skin. The rest of the ingredients are weighed and placed together with the fillets in a processor machine.

This mixture is transported to a Casing vacuum filler where it is stuffed into a polyamide case. This filler produces units of 1000 g/each. The product is pasteurized in a retort and passes through X-Ray machine in order to detect any foreign objects. Finally it is stored in a refrigeration chamber to be distributed later to the market.

Product price

For a 1000 g round polyamide casing of grilled seabass with lemon, the product price proposed is 22.08 € if seabass PBO is fresh, and 17.10 € if seabass PBO is frozen (Table 13). Prices to sell to the HoReCa sector.

Table 13. Seabass final product retail prices (fresh & frozen)

	Wholesale Price - €/unit
Fresh seabass	22.08 €
Frozen seabass	17.10 €

Profit & loss analysis

In ”grilled seabass with lemon” product, the two scenarios selected to conduct the production & sales simulation during the first 3 years of operation are: using fresh seabass fish and frozen seabass fish as raw material.

Fresh

During first year of production EBT and Net Income are negative for a production of about 70 tonnes, which means that the company has to foresee an additional budget to support this year.

In the second year, with almost 100,000 units sold, EBT is positive and compensates the negative incomes from the first year. The third year of production follows the same trend as the second year and the EBT of this year grows to 458.263 €. Table 14 shows the indicator values of this scenario.

Table 14. Profit & loss. Fresh seabass

PROFIT & LOSS						
	Year 1	% of sales	Year 2	% of sales	Year 3	% of sales
Kg of products sold	70.446		97.367		136.314	
Number of units sold (bags)	70.446		97.367		136.314	
SALES (income from sales)	1.555.288 €		2.149.661 €		3.009.526 €	
TOTAL NET REVENUE	**1.555.288 €**		**2.149.661 €**		**3.009.526 €**	
Raw materials	1.142.829 €	73%	1.371.395 €	64%	1.919.953 €	64%
Processign (energy)	159.996 €	10%	191.995 €	9%	268.793 €	9%
Staff (direct labour)	140.000 €	9%	144.200 €	7%	148.526 €	5%
COST OF GOODS SOLD	**1.442.825 €**	**93%**	**1.707.590 €**	**79%**	**2.337.272 €**	**78%**
GROSS MARGIN	**112.463 €**	**7%**	**442.071 €**	**21%**	**672.254 €**	**22%**
Amortization	110.853 €	7%	110.853 €	5%	110.853 €	4%
Sales & marketing	54.450 €	4%	64.913 €	3%	71.943 €	2%
General and administrative	21.950 €	1%	22.609 €	1%	23.287 €	1%
NET PROFIT (EBIT)	**- 74.790 €**	**-5%**	**243.697 €**	**11%**	**466.171 €**	**15%**
Financial expenses	7.908 €		7.908 €		7.908 €	
EBT	**- 82.697 €**	**-5%**	**235.789 €**	**11%**	**458.263 €**	**15%**
Taxes on profit (24%)	- 19.847 €		56.589 €		109.983 €	
NET INCOME	**- 62.850 €**	-4%	**179.200 €**	8%	**348.280 €**	12%
Accumulated net income	- 62.850 €		116.350 €		464.630 €	
Cash flow	**48.003 €**	3%	**290.053 €**	13%	**459.133 €**	15%
Accumulated cash flow	48.003 €		338.056 €		797.190 €	

Figure 5 shows Total Net Revenue, Gross Margin and EBT values for the first three years of simulation.

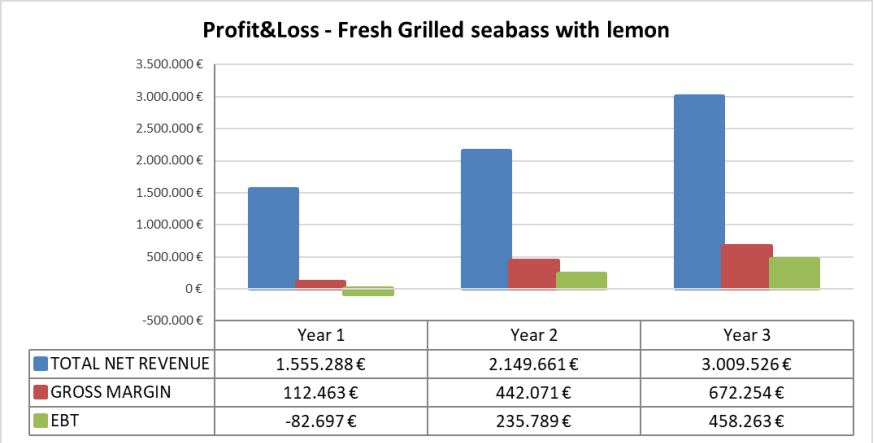

Figure 5. Profit & loss diagram. Fresh seabass

Fresh

Similar to the fresh seabass scenario, during the first year of production EBT and Net Income with frozen seabass are negative (Table 15).

In the second year, with almost 100.000 units sold, EBT is positive and almost equals the negative incomes from the first year. For that reason, the company has to foresee an additional budget to wthstand these two years. The third year of production follows the same trend as the second year and the EBT of this year grows to 273.322 €.

Table 15. Profit & loss. Frozen seabass

PROFIT & LOSS						
	Year 1	**% of sales**	**Year 2**	**% of sales**	**Year 3**	**% of sales**
Kg of products sold	70.446		97.367		136.314	
Number of units sold (bags)	70.446		97.367		136.314	
SALES (income from sales)	1.204.844 €		1.665.290 €		2.331.407 €	
TOTAL NET REVENUE	**1.204.844 €**		**1.665.290 €**		**2.331.407 €**	
Raw materials	885.322 €	73%	1.062.386 €	64%	1.487.341 €	64%
Processign (energy)	123.945 €	10%	148.734 €	9%	208.228 €	9%
Staff (direct labour)	140.000 €	12%	144.200 €	9%	148.526 €	6%
COST OF GOODS SOLD	**1.149.267 €**	**95%**	**1.355.320 €**	**81%**	**1.844.094 €**	**79%**
GROSS MARGIN	**55.577 €**	**5%**	**309.970 €**	**19%**	**487.312 €**	**21%**
Amortization	110.853 €	9%	110.853 €	7%	110.853 €	5%
Sales & marketing	54.450 €	5%	64.913 €	4%	71.943 €	3%
General and administrative	21.950 €	2%	22.609 €	1%	23.287 €	1%
NET PROFIT (EBIT)	**- 131.676 €**	**-11%**	**111.596 €**	**7%**	**281.229 €**	**12%**
Financial expenses	7.908 €		7.908 €		7.908 €	
EBT	**- 139.583 €**	**-12%**	**103.688 €**	**6%**	**273.322 €**	**12%**
Taxes on profit (24%)	- 33.500 €		24.885 €		65.597 €	
NET INCOME	**- 106.083 €**	-9%	**78.803 €**	5%	**207.725 €**	9%
Accumulated net income	- 106.083 €		- 27.280 €		180.444 €	
Cash flow	**4.770 €**	0%	**189.656 €**	11%	**318.578 €**	14%
Accumulated cash flow	4.770 €		194.426 €		513.004 €	

Figure 6 shows Total Net Revenue, Gross Margin and EBT values for the first three years of simulation.

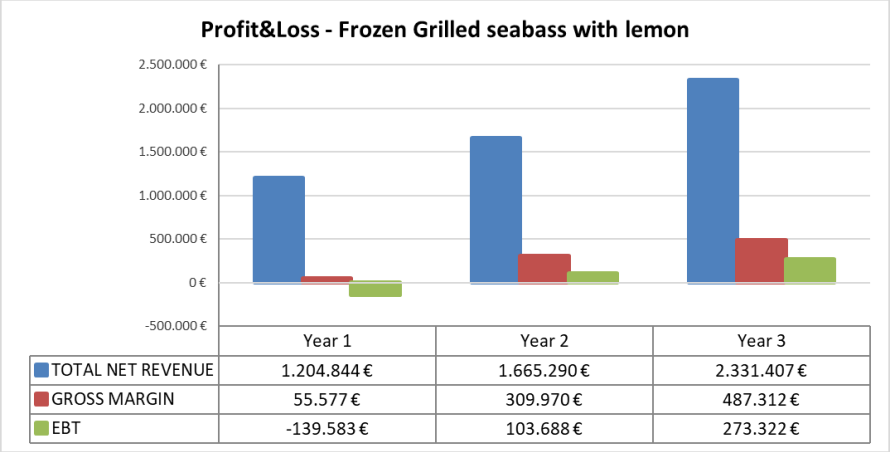

Figure 6. Profit & loss diagram. Frozen seabass

5.3 Organic seabream with couscous

Formulation

Table 16 shows the ingredients and formulation used to produce organic seabream with couscous. It also contains the price/kg (in euros-€) of each ingredient and the total price.

Table 16. Organic seabream with couscous formulation and cost/kg

INGREDIENTS	%	Price €/kg	
		Fresh PBO Fillet	Frozen PBO Fillet
Seabream	63.71	12.70	9.43
Cooked couscous	29.49	0.79	0.79
Green Pepper - Raw	2.06	7.00	7.00
Chopped Carrot - Raw	2.06	3.50	3.50
Dehydrated Tomato	0.29	6.88	6.88
Raisins	0.71	2.95	2.95
High Oleic Olive Oil	1.18	4.01	4.01
Dill	0.01	5.30	5.30
Salt	0.47	0.20	0.20
TOTAL	100.00	8.36	6.55

Process flow

Process flow (Figure 7) to produce ”organic seabream with couscous” is detailed below. This production line has a productivity of 1300 trays/hour, which is equivalent to 221.0 kg/hour, with a team of 4 people working on the production line. The ratio of production per person is 55.3 kg/person & hour.

Initial equipment´s investment is 797,623.00 €.

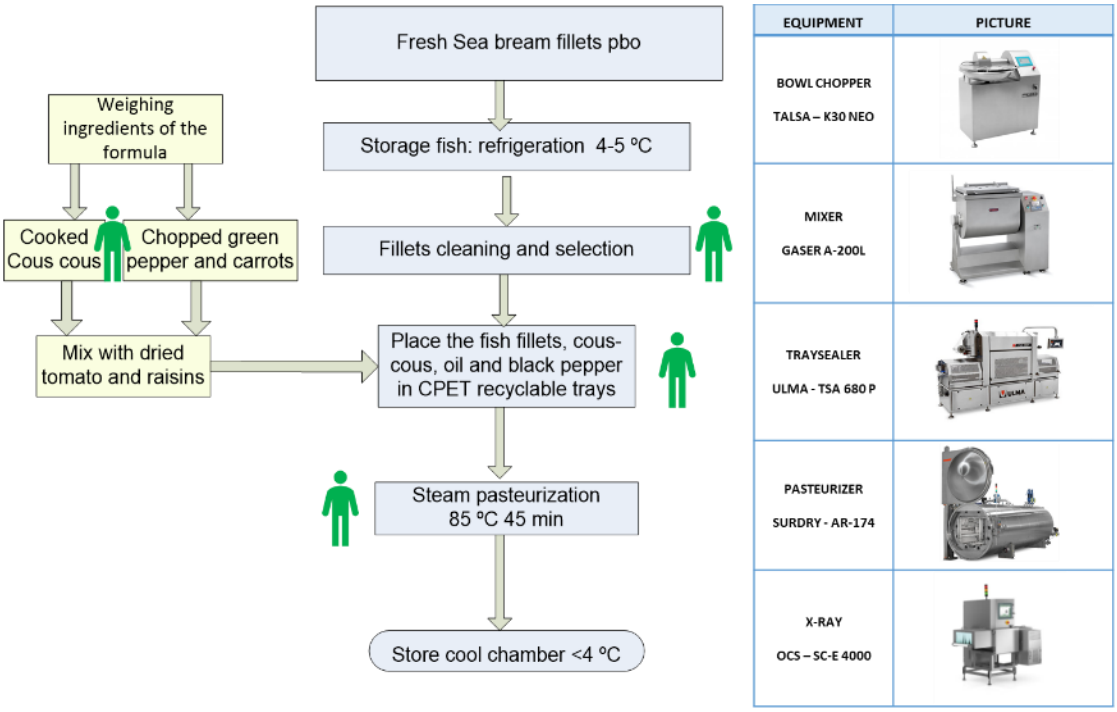

Figure 7. Process flow for "seabream fillet with couscous"

The first step of the process is the ingredient reception. All ingredients must arrive with their Certificate of Analysis (CoA) in order to enter the production process. Ingredients are later stored in their corresponding storage chambers. Seabream fillets arrive fresh or frozen (depending on the scenario selected) and are stored in a refrigeration or freezing chamber until they are used in the production line.

The rest of the ingredients are weighed, chopped (green peppers and carrots) and cooked (couscous) and are mixed in a mixer. This mixture is transported to the packing area and together with the fillets (previously inspected and selected), is placed automatically in trays. Trays are sealed in modified atmosphere (MAP) conditions in a tray sealing machine.

The product is pasteurized in a retort and passed through an X-Ray machine in order to detect any foreign objects. Finally it is stored in a refrigeration chamber to be later distributed to the market.

Product price

Due to the caracteristics of the product (amount of labour in the production line, low ratio of production per person and high quality of raw materials & product) the final product price will be calculated multiplying the Product Formula Price by 1.75 instead of by 1.65 as in the other products. It will increase the final product price, but it is recommended to include all product expenses explained previously.

Figure 8. Seabream fillet with couscous tray

For a 170 g ready-to-eat seabream fillet with couscous (in CPET recycled tray) (Figure 8), the wholesale price proposed is 3.21 € if seabream PBO is fresh, and 2.44 € if seabream PBO is frozen. Prices to sell to the retail sector.

The final product retail price estimated is 4.94 €/tray if seabream PBO is fresh, and 2.44 € if seabream PBO is frozen (assumption that retailers increase the price by 40 % of the product price) (Table 17).

Table 17. Seabream´s wholesale & final product retail prices (fresh & frozen)

	Wholesale Price - €/unit	Final Product Retail Price €/unit
Fresh seabream	3.21 €	4.94 €
Frozen seabream	2.44 €	3.75 €

Profit & loss analysis

The "seabream with couscous" production line is the most restrictive of the 4 production lines designed: productivity is the lowest with only 221 kg product/hour and there are 4 people working on the line, which generates a ratio of 55.25 kg/person & hour.

For that reason, and although the line is profitable on a steady basis, the first years of production are very challenging because the company does not have positive Accumulated Net Income until year 2 (fresh fillet scenario) or until year 3 of production (frozen fillet scenario).

Fresh

In the first year of production, when the start-up of the line takes place, 303,458 trays are sold and in the second year the sales increase up to 419,429 trays. In the first year EBT is negative, but in the second year EBT is positive and enough to compensate the negative values of first year. The company has to foresee a way to withstand this first year of production.

In the third year, with almost 600,000 trays sold, a positive EBT of 317.632 € is generated.

Table 18. Profit & loss. Fresh seabream

PROFIT & LOSS						
	Year 1	% of sales	Year 2	% of sales	Year 3	% of sales
Kg of products sold	55.887		77.245		108.143	
Number of units sold (bags)	328.747		454.381		636.134	
SALES (income from sales)	1.055.219 €		1.458.485 €		2.041.879 €	
TOTAL NET REVENUE	**1.055.219 €**		**1.458.485 €**		**2.041.879 €**	
Raw materials	731.070 €	69%	877.284 €	60%	1.228.198 €	60%
Processign (energy)	102.350 €	10%	122.820 €	8%	171.948 €	8%
Staff (direct labour)	112.000 €	11%	115.360 €	8%	118.821 €	6%
COST OF GOODS SOLD	**945.420 €**	**90%**	**1.115.464 €**	**76%**	**1.518.966 €**	**74%**
GROSS MARGIN	**109.800 €**	**10%**	**343.021 €**	**24%**	**522.912 €**	**26%**
Amortization	102.728 €	10%	102.728 €	7%	102.728 €	5%
Sales & marketing	54.450 €	5%	64.913 €	4%	71.943 €	4%
General and administrative	21.950 €	2%	22.609 €	2%	23.287 €	1%
NET PROFIT (EBIT)	**- 69.328 €**	**-7%**	**152.772 €**	**10%**	**324.955 €**	**16%**
Financial expenses	7.323 €		7.323 €		7.323 €	
EBT	**- 76.651 €**	**-7%**	**145.449 €**	**10%**	**317.632 €**	**16%**
Taxes on profit (24%)	- 18.396 €		34.908 €		76.232 €	
NET INCOME	**- 58.255 €**	-6%	**110.542 €**	8%	**241.401 €**	12%
Accumulated net income	- 58.255 €		52.287 €		293.687 €	
Cash flow	**44.473 €**	4%	**213.269 €**	15%	**344.128 €**	17%
Accumulated cash flow	44.473 €		257.743 €		601.871 €	

Figure 8 shows Total Net Revenue, Gross Margin and EBT values for the first three years of simulation.

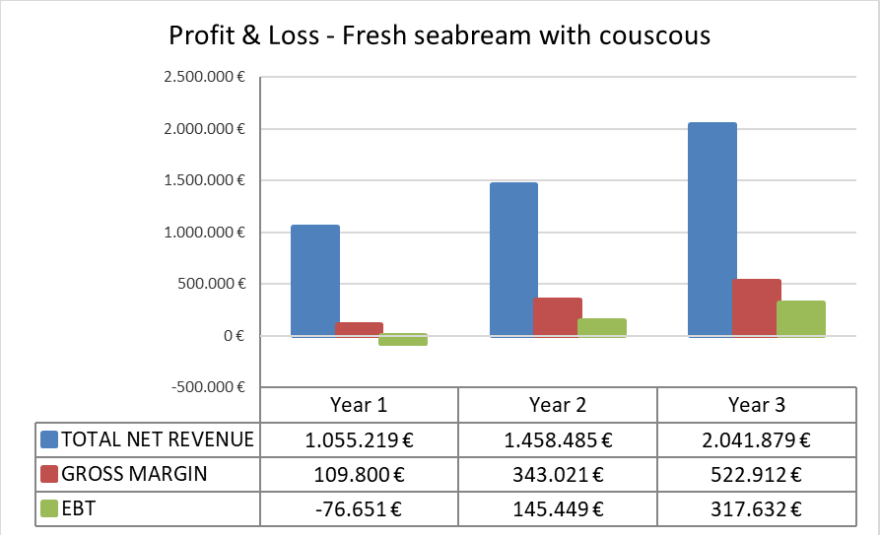

Figure 8. Profit & Loss diagram. Fresh seabream

Frozen

Table 19 shows the frozen seabream scenario, which is the most restrictive of all the cases. In the first year the EBT is negative and in the second year the EBT is positive (not enough to compensate the negative values of the first year). The company has to foresee a budget to support these two years of production before having positive accumulated net incomes.

Table 19. Profit & loss. Frozen seabream

PROFIT & LOSS						
	Year 1	**% of sales**	**Year 2**	**% of sales**	**Year 3**	**% of sales**
Kg of products sold	55.887		77.245		108.143	
Number of units sold (bags)	328.747		454.381		636.134	
SALES (income from sales)	800.536 €		1.106.470 €		1.549.059 €	
TOTAL NET REVENUE	**800.536 €**		**1.106.470 €**		**1.549.059 €**	
Raw materials	554.622 €	69%	665.546 €	60%	931.765 €	60%
Processign (energy)	77.647 €	10%	93.176 €	8%	130.447 €	8%
Staff (direct labour)	140.000 €	17%	144.200 €	13%	148.526 €	10%
COST OF GOODS SOLD	**772.269 €**	**96%**	**902.923 €**	**82%**	**1.210.738 €**	**78%**
GROSS MARGIN	**28.267 €**	**4%**	**203.548 €**	**18%**	**338.321 €**	**22%**
Amortization	102.728 €	13%	102.728 €	9%	102.728 €	7%
Sales & marketing	54.450 €	7%	64.913 €	6%	71.943 €	5%
General and administrative	21.950 €	3%	22.609 €	2%	23.287 €	2%
NET PROFIT (EBIT)	**- 150.861 €**	**-19%**	**13.299 €**	**1%**	**140.363 €**	**9%**
Financial expenses	7.323 €		7.323 €		7.323 €	
EBT	**- 158.184 €**	**-20%**	**5.976 €**	**1%**	**133.041 €**	**9%**
Taxes on profit (24%)	- 37.964 €		1.434 €		31.930 €	
NET INCOME	**- 120.220 €**	-15%	**4.542 €**	0%	**101.111 €**	7%
Accumulated net income	- 120.220 €		- 115.677 €		- 14.566 €	
Cash flow	**- 17.492 €**	-2%	**107.270 €**	10%	**203.839 €**	13%
Accumulated cash flow	- 17.492 €		89.778 €		293.617 €	

Figure 9 shows Total Net Revenue, Gross Margin and EBT values for the first three years of simulation.

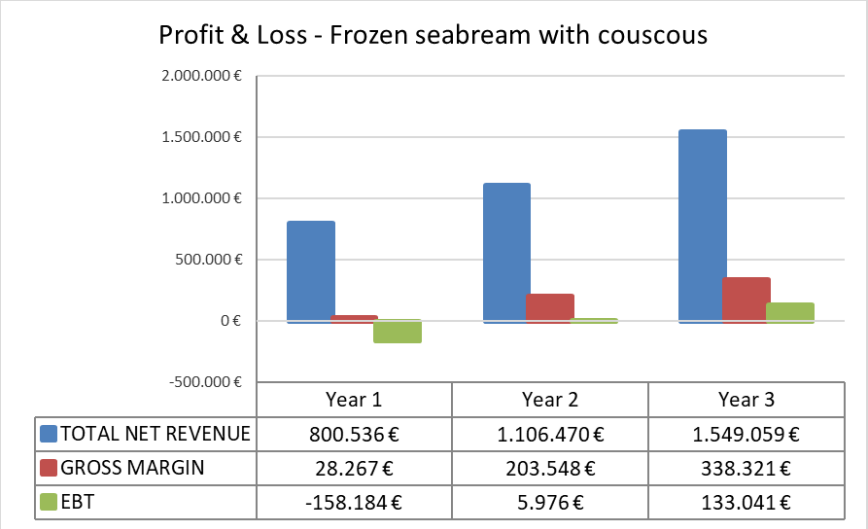

Figure 9. Profit & loss diagram. Frozen seabream

5.4 Seabream breaded bites

Formulation

Table 20 shows the ingredients and formulation used to produce seabream breaded bites. It also contains the price/kg (in euros-€) of each ingredient and the total price.

Table 20. Seabream breaded bites formulation and cost/kg

Ingredients	%	Price €/kg
Frozen Mince Blocks	73.37	8.90
Breadcrumb - Texta-Pois 24/15	14.82	1.45
Water	5.94	0.01
NP6515	3.01	1.36
Predust FF550	2.86	0.80
TOTAL	**100.00**	**6.81**

Process flow

The process flow (Figure 10) to produce ”seabream breaded bites” is detailed below. This production line has a productivity of 2,250 bags/hour, which is equivalent to 270.0 kg/hour, with a team of 3 people working on the production line. The ratio of production per person is 90 kg/person & hour.

Initial equipment´s investment is 334,600.00 €.

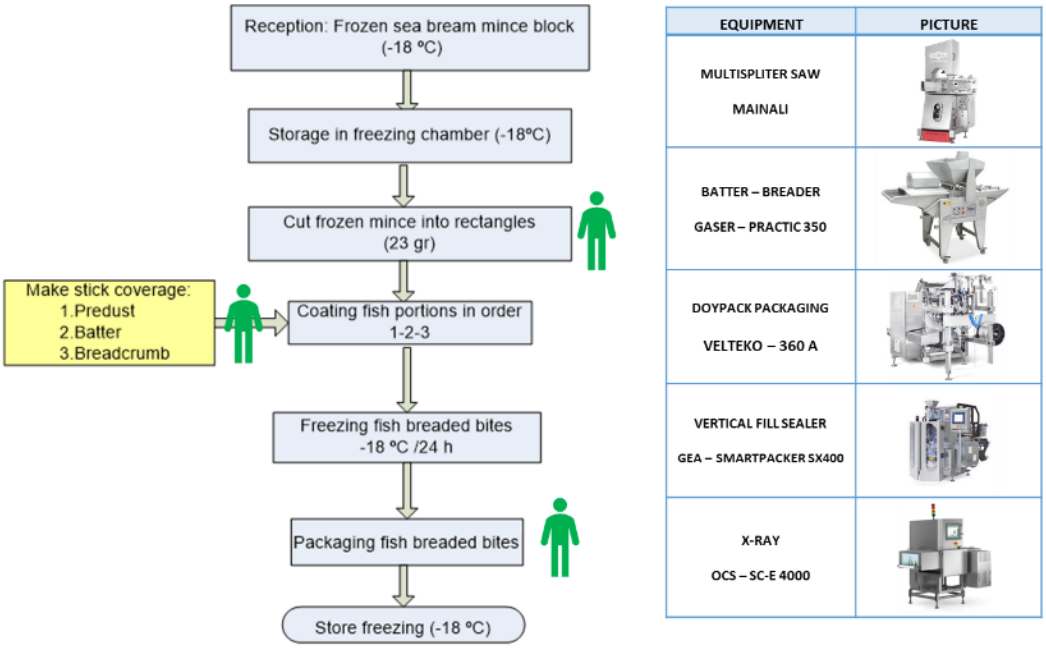

Figure 10. Process flow for "seabream breaded bites"

The first step of the process is ingredient reception. All ingredients must arrive with their Certificate of Analysis (CoA) in order to enter the production process. Ingredients are later stored in their corresponding storage chambers. Seabream blocks arrive frozen and are stored in a freezing chamber until they are used in the production line.

Blocks are cut into rectangles (23 g/unit) in a splitter saw and transported to the batter-breading step. Fish portions are coated with the predust, batter and breadcrumbs and stored in a freezing chamber for 24 hours. After that time, the product is packed depending on the final distribution channel: HoReCa or Retail.

For the HoReCa channel, the product is packed in a GEA SmartPacker SX400 machine in bags of 1200 g of weight (40 breaded bites) and for the retail channel, the product is packed in a Doypack packing machine in bags of 120 g of weight (4 breaded bites). Both packs are sealed in a modified atmosphere (MAP). Later, bags pass through an X-Ray machine in order to detect any foreign objects. The final product is stored in a freezing chamber to be later distributed to the market.

Product price

The wholesale price proposed is 15.50 € if breaded bites are sold in the HoReCa channel, and 1.69 € if breaded bites are sold in the retail channel. The final product retail price estimated is 2.60 €/bag. Table 21 show these retail and HoReCa prices.

Table 21. Wholesale prices & final product retail price. HoReCa and Retail

	Wholesale Price - €/unit	Final Product Retail Price €/unit
Breaded Bites – HoReCa	15.50 €	Not Applicable
Breaded Bites - Retail	1.69 €	2.60 €

Profit & loss analysis

In the last product analysed, "Seabream breaded bites" products, the two scenarios selected to conduct the production & sales simulation during the first 3 years of operation are: product distributed in the HorReCa channel and product distributed in the retail channel.

HoReCa Channel

In the first year of production, with the start-up of the line, EBT of the line is negative. In the second year the production line is profitable, with the EBT positive and the Accumulated Net Income is also positive. The third year follows the same trend achieving an EBT of 199,942 € (Table 22).

Table 22. Profit & loss. HoReCa channel

PROFIT & LOSS						
	Year 1	% of sales	Year 2	% of sales	Year 3	% of sales
Kg of products sold	63.401		87.631		122.683	
Number of units sold (bags)	52.834		73.026		102.236	
SALES (income from sales)	819.148 €		1.132.195 €		1.585.073 €	
TOTAL NET REVENUE	**819.148 €**		**1.132.195 €**		**1.585.073 €**	
Raw materials	601.911 €	73%	722.294 €	64%	1.011.211 €	64%
Processign (energy)	84.268 €	10%	101.121 €	9%	141.570 €	9%
Staff (direct labour)	84.000 €	10%	86.520 €	8%	89.116 €	6%
COST OF GOODS SOLD	**770.179 €**	**94%**	**909.935 €**	**80%**	**1.241.896 €**	**78%**
GROSS MARGIN	**48.969 €**	**6%**	**222.261 €**	**20%**	**343.177 €**	**22%**
Amortization	44.850 €	5%	44.850 €	4%	44.850 €	3%
Sales & marketing	54.450 €	7%	64.913 €	6%	71.943 €	5%
General and administrative	21.950 €	3%	22.609 €	2%	23.287 €	1%
NET PROFIT (EBIT)	**- 72.281 €**	**-9%**	**89.890 €**	**8%**	**203.098 €**	**13%**
Financial expenses	3.155 €		3.155 €		3.155 €	
EBT	**- 75.437 €**	**-9%**	**86.734 €**	**8%**	**199.942 €**	**13%**
Taxes on profit (24%)	- 18.105 €		20.816 €		47.986 €	
NET INCOME	**- 57.332 €**	-7%	**65.918 €**	6%	**151.956 €**	10%
Accumulated net income	- 57.332 €		8.586 €		160.542 €	
Cash flow	**- 12.482 €**	-2%	**110.768 €**	10%	**196.806 €**	12%
Accumulated cash flow	- 12.482 €		98.286 €		295.092 €	

Figure 11 shows Total Net Revenue, Gross Margin and EBT values for the first three years of simulation.

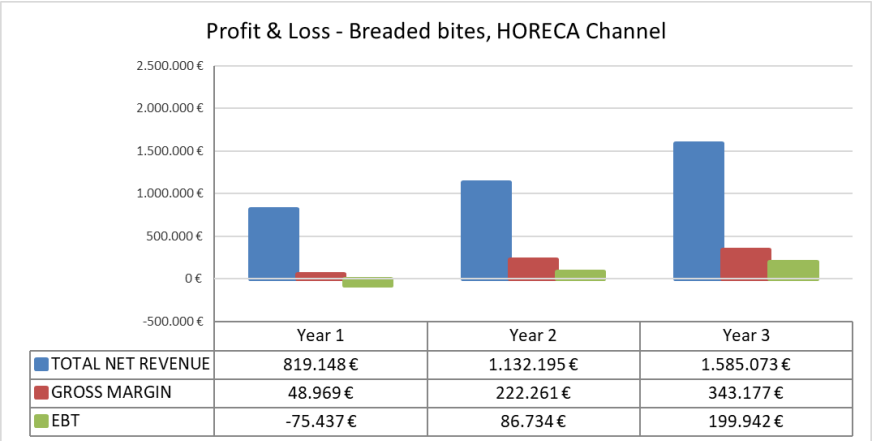

Figure 11. Profit & loss diagram. HoReCa channel

Retail channel

With the line production destined to the retail channel, the results are very similar to the HoReCa scenario, but with a smaller negative EBT during the first year of production.

In the second year the production line is profitable, with the EBT positive and the Accumulated Net Income also positive (27.260 €). The third year, with the sales increase of 20 %, follows the same trend achieving an EBT of 237.533 €. Table 23 shows these indicators for the first three years of production.

Table 23. Profit & loss. Retail Channel

PROFIT & LOSS						
	Year 1	% of sales	Year 2	% of sales	Year 3	% of sales
Kg of products sold	63.401		87.631		122.683	
Number of units sold (bags)	528.343		730.256		1.022.358	
SALES (income from sales)	890.378 €		1.230.647 €		1.722.906 €	
TOTAL NET REVENUE	**890.378 €**		**1.230.647 €**		**1.722.906 €**	
Raw materials	654.251 €	73%	785.102 €	64%	1.099.142 €	64%
Processign (energy)	91.595 €	10%	109.914 €	9%	153.880 €	9%
Staff (direct labour)	84.000 €	9%	86.520 €	7%	89.116 €	5%
COST OF GOODS SOLD	**829.847 €**	**93%**	**981.536 €**	**80%**	**1.342.138 €**	**78%**
GROSS MARGIN	**60.531 €**	**7%**	**249.111 €**	**20%**	**380.768 €**	**22%**
Amortization	44.850 €	5%	44.850 €	4%	44.850 €	3%
Sales & marketing	54.450 €	6%	64.913 €	5%	71.943 €	4%
General and administrative	21.950 €	2%	22.609 €	2%	23.287 €	1%
NET PROFIT (EBIT)	**- 60.719 €**	**-7%**	**116.740 €**	**9%**	**240.688 €**	**14%**
Financial expenses	3.155 €		3.155 €		3.155 €	
EBT	**- 63.874 €**	**-7%**	**113.585 €**	**9%**	**237.533 €**	**14%**
Taxes on profit (24%)	- 15.330 €		27.260 €		57.008 €	
NET INCOME	**- 48.544 €**	-5%	**86.324 €**	7%	**180.525 €**	10%
Accumulated net income	- 48.544 €		37.780 €		218.305 €	
Cash flow	**- 3.694 €**	0%	**131.174 €**	11%	**225.375 €**	13%
Accumulated cash flow	- 3.694 €		127.480 €		352.855 €	

Figure 12 shows Total Net Revenue, Gross Margin and EBT values for the first three years of simulation.

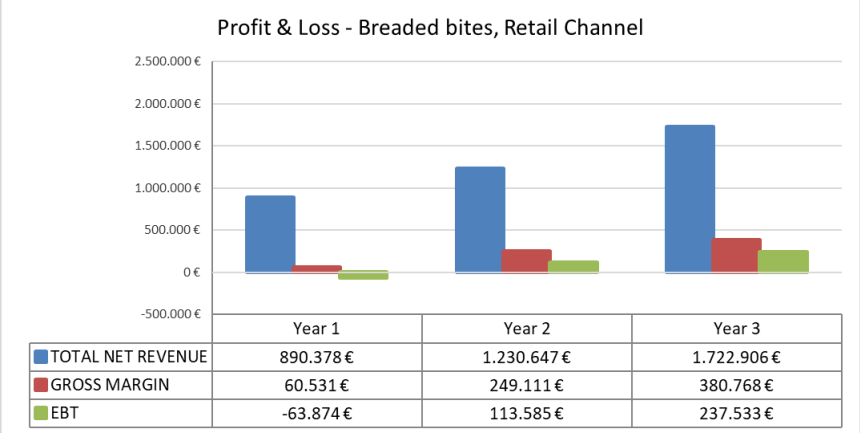

Figure 12. Profit & loss diagram. Retail Channel

6. Main findings/Conclusions

This task estimated the technical and economic feasibility of producing four new food products (grilled seabass with lemon, sea and mountain burger, seabream breaded bites and organic seabream with couscous) developed in the framework of MedAID at pilot scale and selected for the validation studies with consumers in Spain, France and Germany.

Considering the current consumer demand and the lack of aquaculture seafood products in the market, the development of new fish products based on aquaculture species (seabass, gilthead seabream and meagre) could be an opportunity to increase the commercial value and profitability of the Mediterranean aquaculture value chain.

As a result, to facilitate the possible implementation of these developments at industrial processing level, a detailed technical sheet for each product including ingredient listing, raw material grade, nutrition and health claims, allergen list, storage, packaging, food safety (shelf-life) was developed and provided for each of the concepts. Also, costs for formulating and producing the products were estimated considering raw materials, ingredients, packaging costs, processing yield, labour and operation costs and infrastructures (equipment).

For the economic analysis, a common scenario to calculate productivity, costs, expenses and incomes was drawn up for the 4 products "case studies" considering: the implementation of the processes in a food processing industry such as a new production line, no investments in facilities/buildings required, shared use of storage chambers, shared use of administration and sales work force (25 %), 1 shift of production per day and some statements for the products such as high quality standards in raw materials and final product (gourmet). Final product price estimation was based on raw materials, packaging (5 % of the raw materials cost for HoReCa channel and 15 % for retail) and shipment (10 % of the raw materials cost) and a selling price was calculated by multiplying the product by 1.65. Economic indicators calculated were: Total Net Revenue, Gross Margin, Earnings Before Interest and Taxes (EBIT), Earnings Before Taxes (EBT), Net Income and Cash Flow for the first three years.

Results showed that the estimated "case studies", with the defined considerations, are profitable products/line productions from an economic point of view. As is normal in any new production line, during the first year there is a start-up curve in which production and sales have not reached their stability and target values. But from the second year of production, when all the lines are working on a steady basis and the product is known in the market, all products have positive EBIT, EBT & NI indicators, which measure the company´s financial performance. Even in the case of the "sea and mountain burger" product, economic results are better. Positive EBIT, EBT & NI values are obtained from the first year of start-up.

The summarized conclusions are:

- This study enables the industrial viability of the 4 products developed by AZTI to be calculated and selected for market validation with consumers.
- All case studies have a common scenario with some statements determined, but could be updated depending on the characteristics of the companies in which these products are going to be implemented.
- The same happens for production, sales and sales prices used. Certain values are used to calculate the "case study", but any variation in these parameters can be applied depending on the characteristics of the market and country for commercializing.

- 4 different case studies (from 4 products developed in AZTI) have been evaluated to calculate the industrial viability for producing and marketing in the retail and HoReCa channels.
- The 4 cases analysed, when they have overcome the start-up and have steady productions, are profitable cases, which means that EBT (Earnings Before Taxes) and NI (Net Income) are positive and the incomes are higher than the expenses.
- Productivity and the ratio of production per person are very important to determine how productive a production line is. The greater the productivity and the higher the ratio of production per person, the more profitable the production line is.
- The best case is the “sea and mountain burger” with 420 kg/h of productivity and 105 kg/person hour ratio of production. And the more restrictive case is the “organic seabream with couscous” with 221 kg/h of productivity and 55.3 kg/person hour ratio of production.

General conclusions from all the studies and analysys

Innovation and development of new products for exisiting and new markets is clearly needed for a long-term competitive supply-demand equilibrium of Mediterranean marine aquaculture. As in the rest of the food industry, the improvement of the competitiveness and sustainability of the sector is governed by current consumer trends, which translates into the need to transform aquaculture species to offer consumers the safe, healthy, quality and convenience products they demand.

Considering the current consumer demand and the lack of aquaculture seafood products in the market, the development of new fish aquaculture products can be an opportunity to generate differentiation in the products' range and increase the commercial value and profitability of the Mediterranean aquaculture value chain.

Understanding consumer behaviour towards innovative aquaculture products can enable us to provide EU consumers and fish/food supply actors with high added-value, market-oriented fish products that deliver the value that contemporary EU fish/food consumers expect.

In this sense, studies performed in Market validation Task 5.4 can provide useful information to enhance the success in the market of the new products developed.

These studies covered the profiling of key EU consumer segments for new product adoption (through large-scale quantitative and qualitative surveys), the identification of the optimal product configuration (through choice experiments), the identification of the optimal combination of packaging attributes (validated through neuroscience)., the assessment of sustainability dimensions (choice experiment) and finally the validation tests (Home Use Tests and online questionnaires) of the new products in three European countries (Spain, France and Germany).

Moreover, the analysis (Task 5.5) of the technical and economic feasibility (case studies) of producing the four new food products (grilled seabass with lemon, sea and mountain burger, sea bream breaded bites and organic seabream with couscous) developed in the framework of MedAID can provide useful information to facilitate the implementation of these developments by the industry.

The following main conclusions from these studies are:

- Enhance knowledge of aquaculture by focusing the promotion of new aquaculture fish products on target consumer segments emphasizing the benefits of aquaculture fish, especially in terms of taste and quality, since a high percentage of EU consumers has still never consumed products from aquaculture.
- Develop strategies to be able to change general awareness and break down consumer preconceptions about Mediterranean aquaculture: feeding practices, sustainability, or products' conditions in terms of healthiness and safety, improving consumer confidence and trust.
- Incorporate the voice of consumers in all stages of the new product development process to increase the success rate when launching a new product to the market.
- Emphasize the combination in the packaging of visual and textual attributes that were mostly preferred by consumers.
- Consider consumption habits and preferences of a target group in the development of new fish products from aquaculture and follow a market-based segmentation.

- Work on a wider range of products to launch different concepts according to the specific demands and needs of each commercial niche (school canteens, food industry, food service and/or retail channels).
- Develop healthy and convenient products with high nutritional value, easy preparation, consumption and handling, longer shelf life and better organoleptic profile more suitable for new consumer lifestyle.
- Consider taste, texture, tasty appearance, healthiness, percentage of aquaculture fish in the final recipe and good nutritional value during the development of new fish products to increase new aquaculture product purchase intention. ASC label, Nutri-Score, domestic origin, a health claim and lower price would improve purchase intention as well.