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| <b>Deliverable title</b>                                                         | D7.4 Integrated Socio-Economic Insights from WP7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Deliverable Lead:</b>                                                         | UNIEGE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Related Work Package:</b>                                                     | WP7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Related Task:</b>                                                             | Task 7.1 Identification of drivers and lock-ins for the development of sea-fennel products<br>Task 7.2 Assessment of consumer attitudes and acceptance of sea fennel products<br>Task 7.3 Business model evaluation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
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| <b>Summary of Deliverable D7.4 – Integrated Socio-Economic Insights from WP7</b> | <p>Deliverable D7.4 brings together the findings of all socio-economic research carried out under WP7, offering a comprehensive picture of the opportunities and challenges for sea fennel as a new Mediterranean value chain. The report integrates three strands of work: lock-ins and drivers identified through expert Delphi surveys, consumer acceptance explored via large-scale questionnaires, and the evaluation of business models through participatory design.</p> <p>From the Delphi study, a clear consensus emerged that growing consumer demand for natural and local products is the strongest driver for sea fennel, while lack of awareness, limited processing capacity, and overreliance on wild collection remain critical barriers. Experts agreed that rural policies, training, and cooperation among stakeholders are essential to overcome these lock-ins.</p> <p>The consumer research confirmed this picture: awareness is still low, particularly outside Southern Mediterranean countries, yet perceptions turn highly positive once consumers are</p> |

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p>informed. Sea fennel was strongly associated with being healthy, safe, sustainable, and tasty, and purchase intention was especially high among younger, urban, and health-conscious groups. Importantly, social influence—family, friends, chefs—was found to play a decisive role in shaping consumer acceptance.</p> <p>Finally, the business model analysis showed that sea fennel holds real potential both in the food sector (as a gourmet, sustainable ingredient) and in the nutraceutical sector (leveraging its bioactive properties). Success will require tailored marketing strategies, partnerships with chefs and health professionals, innovation in packaging and product formats, and reliable supply chains based on cultivation rather than wild collection.</p> |
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## Versioning and Contribution History

| Version | Date       | Modified by         | Modification reason |
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# 1 Lock-ins and drivers for the development of sea-fennel products

## 1.1 Material and Methods

In this study, the Delphi method is used to achieve a broad understanding of the constraints and lock-ins for the development of the market of sea-fennel products, the factors enabling this development as well as the potential socio-economic impacts on the value chain.

The Delphi method, first used in "Project DELPHI" a study on the use of expert opinion intermittently conducted at the Rand Corporation, is a technique employed to obtain the most reliable consensus of a group of experts (Dalkey and Helmer, 1963). The name was proposed by the philosopher Abraham Kaplan (Dalkey, 1968). The derivation of the term 'Delphi' relates to the 'Delphic Oracle', an ancient Greek myth that held that a 'chosen one' on the island of Delphi was able to predict the future with infallible authority. Delphi technique was originally used to forecast technological developments; thus, like the oracle, it was used to look into the future. In subsequent research, the Delphi technique was used to generate ideas and forecast changes for a wide variety of educational purposes, such as curriculum development (Clayton, 1997). Since then, the Delphi technique is widely used in planning, policy analysis and long-range forecasting in both public and private sectors (Gupta and Clarke, 1996). In the literature, Delphi has been applied in various fields such as program planning, needs assessment, policy making, and resource utilization (Hsu and Standford, 2007; Diamond et al., 2014).

The Delphi method is a technique designed to elicit expert opinions systematically. The technique employed involves the repeated individual questioning of the experts (by interview or questionnaire) and avoids direct confrontation of the experts with one another (Dalkey and Helmer, 1963). The basic characteristics of the Delphi procedures are anonymity, iteration with controlled feedback and statistical group response. Anonymity is achieved by using questionnaires or other formal channels of communication, where specific responses are not associated with individual members of the group. This is a way of cutting down on the effects of dominant individuals and reducing group pressure (Dalkey, 1968). The anonymity of the participants guarantees that everyone can come up with new and different ideas without biases (Şahin, 2001).

The steps of the Delphi method in this study are shown in Figure 1. After identifying the problem, the first step is to define and select the experts. Experts are generally selected based on their knowledge and relevant experience. The interviews were conducted in three rounds to allow experts to react to each other's assessment. Detailed information on the identification of experts and the three rounds of surveys is given below.

### Selection of experts

In each partner country (Croatia, France, Italy, Tunisia, and Türkiye) an average of 15 experts were identified via the Stakeholder Platform (Task 2.2). The experts were contacted by telephone and informed about the study. Those who agreed to participate in the series of surveys were included in the list of participants (Table 1). The expert groups consisted of farmers, processors, representatives of farmer and processor organizations, retailers and their organizations, academicians, private and public sectors.

Table 1: Number of responses by countries

| Country | First Round |         | Second Round |         | Third Round |         |
|---------|-------------|---------|--------------|---------|-------------|---------|
|         | Frequency   | Percent | Frequency    | Percent | Frequency   | Percent |
| Croatia | 6           | 16.67   | 6            | 18.75   | 6           | 19.35   |
| France  | 2           | 5.56    | 2            | 6.25    | 2           | 6.45    |
| Italy   | 10          | 27.78   | 9            | 28.13   | 8           | 25.81   |
| Tunisia | 9           | 25.00   | 7            | 21.88   | 7           | 22.58   |

|        |    |        |    |        |    |        |
|--------|----|--------|----|--------|----|--------|
| Turkey | 9  | 25.00  | 8  | 25.00  | 8  | 25.81  |
| Total  | 36 | 100.00 | 32 | 100.00 | 31 | 100.00 |

## First round

The Delphi process traditionally begins with a questionnaire made up of open-ended questions that are given to a panel of selected experts to solicit specific information about a subject or content area (Custer et al., 1999). In the first round, an online questionnaire was sent to the experts, and they were asked to list their thoughts and responses to each open-ended question. After the first round of questionnaires has been completed, the answers given by the experts to the questions posed to them in the first round are brought together. Similar answers and expressions are kept unchanged. They are grouped and merged. Then, a second questionnaire is prepared, providing a Likert-type response for each answer.

In the first round, the experts were asked seven open-ended questions to brainstorm and discover as wide a range of perspectives as possible. Demographic data (age, gender, education, experience in the sector, etc.) was also collected. Seven open-ended questions posed to experts in the first round are given below.

1. What are the most important influences that have shaped the market development of sea fennel and sea fennel-based products in the past 5 years? (Please describe key events if appropriate.)
2. How would you describe the current state of the sea fennel and sea fennel-based products market (including regional variations, if any)?
3. How do you expect the sea fennel and sea fennel-based products market to develop over the next 10 years? (Please include important new influences not discussed in previous answers.)
4. In your opinion, what are the factors that may lead to the destruction of the natural environment of wild sea fennel plants?
5. In your opinion, what are the proportions of cultivation and wild collection in the total production of sea fennel in your home country (total must be 100)?
6. In your opinion, what should be done to ensure that sea fennel cultivation is an environmentally and economically sustainable production activity?
7. What characteristics make the sea fennel products successful? (Please give concrete examples, if appropriate)

The first round questionnaire was translated into local languages for implementation in different countries. The data was collected via Qualtrics software. The first round Delphi questionnaire was sent to 15 experts from Italy, 14 experts from France, 14 experts from Croatia, 15 experts from Turkey, and 16 experts from Tunisia. Due to the limited number of responses in the first round, several reminders were sent in June and July 2023. Finally, out of the total of 74 experts contacted, 48.65% returned the completed questionnaire. 9 experts from Turkey, 6 experts from Croatia, 10 experts from Italy, 9 experts from Tunisia, and 2 experts from France responded first round of the Delphi survey. In total 36 experts were surveyed.

## Second round

After the compilation of the first round, the study on the second round of the Delphi survey was initiated. The second round Delphi questionnaire was based on the analysis of the responses gathered in the first round. The purpose of the second round was to allow the experts to react to each other's assessments. To this end, the answers of all country experts to the questions posed to them in the first round were aggregated. The answers given by the experts to the questions in the first round are listed one after the other. Similar answers and expressions were grouped and combined. All statements were reviewed to be optimized and duplications were reduced to a single statement. Statements that were too specific were not

included. Each item was transformed into a structure that could be scored on a 5-point Likert scale. In this way, it would be possible to present the expert group with the answers given to the questions in the first round and to determine their level of agreement with these items.

Once the second round Delphi expert questionnaire was finalized, it was translated into the native language of each country. The second round Delphi questionnaire was sent on 24 January 2024 to the 36 experts who had responded to the first round. After several reminders, 8 experts from Turkey, 6 experts from Croatia, 9 experts from Italy, 7 experts from Tunisia, and 2 experts from France responded second round of the Delphi survey. In total 32 experts were surveyed.

The data from the second round of questionnaires were analysed using SPSS (Statistical Package for the Social Sciences) 25 program. For this purpose, the national and international literature on the Delphi method was reviewed (Dalkey and Helmer, 1963; Dalkey, 1968; Gupta and Clarke, 1996; Clayton, 1997; Custer et al., 1999; Şahin, 2001; Hsu and Standford, 2007; Ab Latif et al., 2017; Zartha Sossa et al., 2019; Beiderbeck et al., 2021). A frequency analysis was performed. For each statement in the questionnaire, first quarter (Q1), third quarter (Q3), mean, median (Md), and interquartile range (IQR) were calculated. Finally, the statements on which a consensus was reached on the relevant subject were determined. In Delphi studies, authors used a wide range of definitions for determining the consensus (Diamond et al., 2014). Following Zelif and Heldenbrand (1993), in this study, statements with an IQR (Q3-Q1) of less than 1.2 are considered consensus statements. Various authors used this criteria and threshold in Delphi studies (Custer et al, 1999; Şahin, 2001; Hussein, 2010; Peng et al, 2013; Acaroğlu et al, 2018; Kılıç and Saygılı, 2022).

### Third round

After the analysis of the second round, the third round was started in the first week of May 2024 to allow experts to react to each other's assessment. In the third round of the Delphi survey, the same statements, used in the second-round questionnaire were sent to the experts again. Unlike the second round, the question forms were personalized in this round. Next to each statement, the statistical results calculated at the end of the second round (mean values) and the expert's answers to each statement in the previous round were included. The experts were asked to compare their responses with the mean score and to indicate their current opinion.

After several reminders, 8 experts from Turkey, 6 experts from Croatia, 8 experts from Italy, 7 experts from Tunisia, and 2 experts from France responded third round of the Delphi survey. In total 31 experts were surveyed. In the third round, as in the second round, the first quarter (Q1), third quarter (Q3), mean, median (Md), and interquartile range (IQR) were calculated for each statement. It was checked whether there was a decrease in width between quarters. As in the second round, statements with an IQR (Q3-Q1) of less than 1.2 were considered consensus statements.

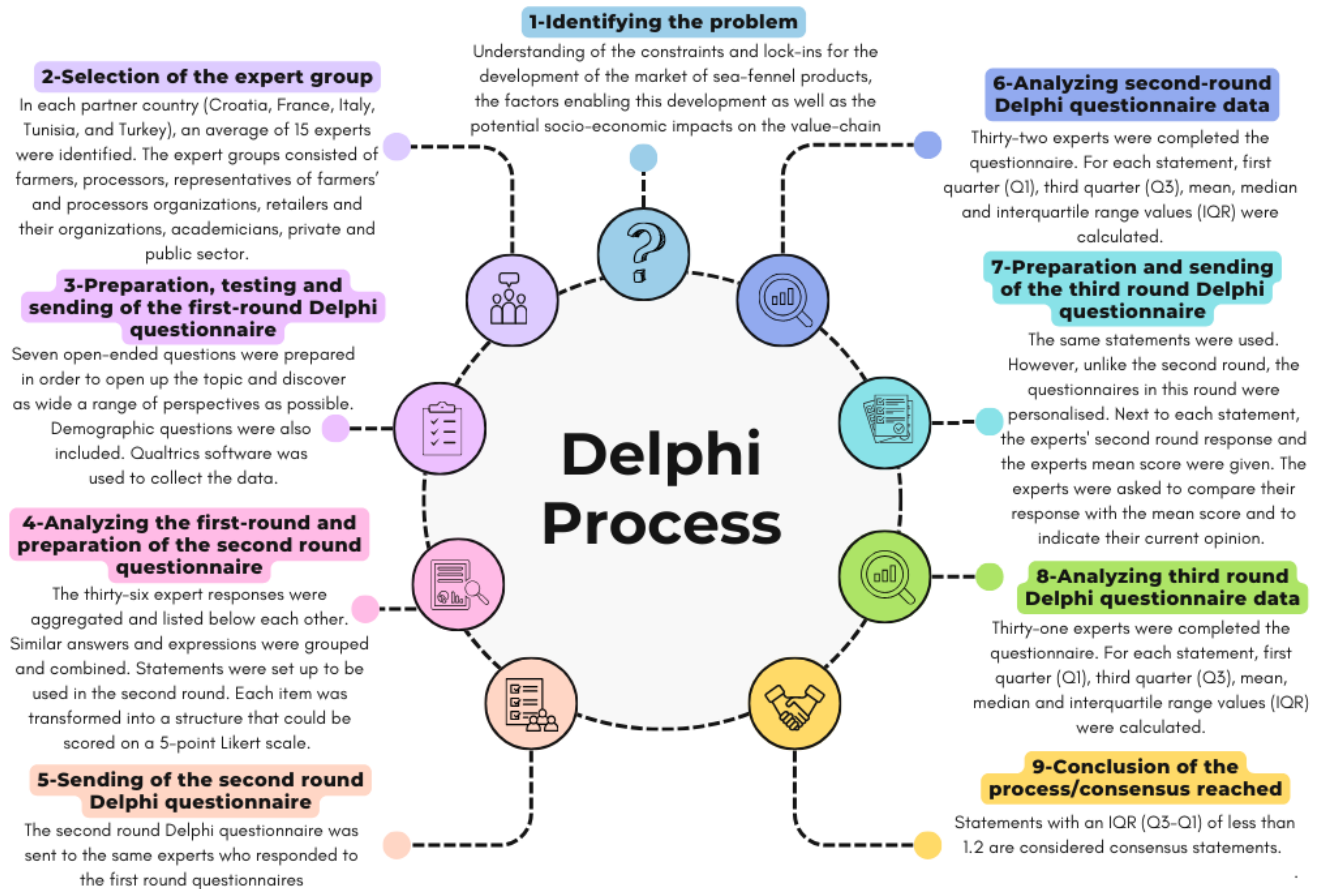


Figure 1: The steps of the Delphi method in this study (Source: Authors own elaboration)

## 1.2 Key Findings of the Delphi Surveys

### 1.2.1 Demographic Composition of the Expert Group

The demographic characteristics of the participants for the three rounds are shown in Table 2. The average age of the 31 experts who participated in the third round was approximately 47 years and 22 of them (approximately 71%) were male. Regarding the educational level of the experts, about 81% have a postgraduate degree and the rest have a bachelor's degree. About 26% of the experts are academic staff, about 23% are farmers and representatives of their organizations and about 16% are individuals or consultants and experts in control & certification bodies (Table 2).

Table 2: Demographic characteristics of the respondents

|                    |                                                                                   | First Round |         | Second Round |         | Third Round |         |
|--------------------|-----------------------------------------------------------------------------------|-------------|---------|--------------|---------|-------------|---------|
| Age (average)      |                                                                                   | 48,50       |         | 47,69        |         | 47.06       |         |
|                    |                                                                                   | Frequency   | Percent | Frequency    | Percent | Frequency   | Percent |
| Gender             | Female                                                                            | 10          | 27.78   | 9            | 28.13   | 9           | 29.03   |
|                    | Male                                                                              | 26          | 72.22   | 23           | 71.88   | 22          | 70.97   |
|                    | Total                                                                             | 36          | 100.00  | 32           | 100.00  | 31          | 100.00  |
| Level of Education | Upper secondary and equivalents                                                   | 1           | 2.78    | 1            | 3.13    | -           | -       |
|                    | Bachelor's degree or equivalent level                                             | 6           | 16.67   | 6            | 18.75   | 6           | 19.35   |
|                    | Postgraduate with master's or doctoral degree                                     | 29          | 80.56   | 25           | 78.13   | 25          | 80.65   |
|                    | Total                                                                             | 36          | 100.00  | 32           | 100.00  | 31          | 100.00  |
| Sector             | Farmers and their organizations                                                   | 9           | 25.00   | 8            | 25.00   | 7           | 22.58   |
|                    | Processors and their organizations                                                | 5           | 13.89   | 4            | 12.50   | 4           | 12.90   |
|                    | Retailers & their organizations (Super/Hypermarket Chains-Restaurants included)   | 1           | 2.78    | 1            | 3.13    | 1           | 3.23    |
|                    | Private sector: Individual or Co. on Consulting / Control / Certification Academy | 5           | 13.89   | 5            | 15.63   | 5           | 16.13   |
|                    | Academy                                                                           | 9           | 25.00   | 8            | 25.00   | 8           | 25.81   |
|                    | Public sector: Researcher                                                         | 3           | 8.33    | 3            | 9.38    | 3           | 9.68    |
|                    | Public sector: Administration                                                     | 3           | 8.33    | 2            | 6.25    | 2           | 6.45    |
|                    | Other (please indicate)                                                           | 1           | 2.78    | 1            | 3.13    | 1           | 3.23    |
|                    | Total                                                                             | 36          | 100.00  | 32           | 100.00  | 31          | 100.00  |

### 1.2.2 Results of the first round

Responses to the seven open-ended questions asked to experts in the first round are given below in Table 3. Based on the expert opinions stated in the first round, the questionnaire to be used in the second round of the survey was set up, which consisted of six 5-point Likert-type questions. The results obtained in the second round are given in the next section.

Question number 5 of the first round, which had a numerical content was not used for the following rounds. In this question, the respective shares of cultivation and wild collection of sea fennel in each expert's country were questioned. According to experts' opinions, most of the production (80,5%) in the research countries is based on wild collection (Table 3).

Table 3: Experts' opinions on the sea fennel and sea fennel-based products market

**Q1. What are the most important influences that have shaped the market development of sea fennel and sea-fennel-based products in the past 5 years? (Please describe key events if appropriate.)**

- Consumers' demand for natural products is increasing.
- Consumers' demand for sustainable local products is increasing.
- Consumers' demand for sea fennel is increasing.
- Marketing and trade activities of the companies have positively affected the sea fennel market.
- Research and development of new products for niche markets is increasing.
- Research and development of new products for niche markets is increasing.
- There is no market of sea fennel.
- Inadequacies in market organization negatively affect the development of the market.
- The promotion of sea fennel was insufficient.
- Ease of preparation of sea fennel enables the development of the sea fennel market.
- Recognition of products made from sea fennel is increasing.
- Sea fennel contains a lot of vitamin C, iodine and essential oils, making it a very nutritive food.
- The essential oils in sea fennel have curative properties.
- Social media posts about sea fennel increase curiosity about this product.
- Cost of sea fennel is more affordable than other similar plants.
- The different flavour of sea fennel products may be a barrier to consumer liking.
- Consumers find sea fennel products delicious.
- Consumers are gaining healthy eating habits.
- More information is available on sea fennel cultivation.
- Tourism activities promoting local products (food/wine etc.) have positively influenced the development of sea fennel market.
- Local companies have rediscovered sea fennel and invested in its cultivation.

**Q2. How would you describe the current state of the sea fennel and sea-fennel-based products market (including regional variations, if any)?**

- The sea fennel market is limited to a regional level where it is known by the local population as a typical product.
- Sea fennel-based products are intended for haute cuisine.
- There are limited number of sea fennel products in the market.
- Sea fennel is mostly sold in the specialised shops.
- Sea fennel is rarely available in the retail chains.
- Sea fennel market is niche.

- Sea fennel and its products are not known by consumers.
- The market for sea fennel and sea-fennel-based products is undeveloped.
- The increase in demand for sea fennel products increases the danger of extinction of sea fennel populations that grow spontaneously in nature.
- Domestic sale of sea fennel products through e-commerce increases the recognition of these products.
- The sale of sea fennel products in delicatessens increases the recognition of these products.
- The sea fennel market is not stable since many growers don't have sufficient knowledge about how to grow and preserve the product.
- Consumer demand for sea fennel is limited.
- There are only a few processors producing sea fennel and its products.
- Seasonally grown sea fennel is usually offered to the market as pickles.
- Sea fennel and sea fennel-based products are known by a limited part of consumers since it is grown on a local basis.
- Sea fennel is usually available in restaurants.
- The promotion of sea fennel is insufficient.
- Sea fennel and sea-fennel-based products market is in its infancy phase.
- The market for sea fennel products is limited to coastal areas.

**Q3. How do you expect the sea fennel and sea-fennel-based products market to develop over the next 10 years? (Please include important new influences not discussed in previous answers.)**

- The market growth will depend on consumer awareness of sea fennel and sea fennel-based products.
- The sea fennel market will continuously grow in the next 10 years.
- I expect that the market growth will be very slow.
- I expect that the increase in consumer knowledge will be very slow.
- I believe that more companies interested in the transformation of sea fennel-based products are needed for a quick diffusion on the market.
- The use of sea fennel as an ingredient in the food industry will increase due to its nutritional characteristics.
- There is a potential for market development by increasing consumer awareness through chefs and experts.
- I think that sea fennel market will not change as it is a typical niche product limited to local markets.
- Since it is a product that grows spontaneously in nature and has a limited growing area, I do not think that its market will develop much.
- The market will develop if sea fennel is cultivated in suitable growing areas.
- Developing different recipes using sea fennel will help the market growth.
- I think that the foreign markets will grow more than the domestic market.
- The sea fennel market can develop with the support of territorial policies.

- The sea fennel market can grow if the natural environment and characteristics of the products are respected.
- Application of flavour enhancing processing techniques will enable the market development.
- Juicy leaves and stems will attract the consumer liking.

**Q4. In your opinion, what are the factors that may lead to the destruction of the natural environment of wild sea fennel plants? -**

- Harvest of sea fennel without respecting the production cycles of the plant may lead to destruction of wild sea fennel populations.
- There will be no problem if sea fennel is collected without damaging the roots.
- Wild animals destroy natural sea fennel populations.
- The natural environment of the sea fennel plant is damaged by livestock breeding activities (overgrazing, herd trampling).
- Pollution may lead to the destruction of the natural environment of wild sea fennel plants.
- Destruction of natural stone coastlines to make them more accessible to boats, creating of docks etc. may lead to loss of wild sea fennel populations.
- Uncontrolled exploitation of sea fennel may cause extinction of the plants in case demand increases significantly.
- Lack of awareness may lead to the destruction of the natural environment of wild sea fennel plants.
- Excessive tourism activities destroy natural environment of sea fennel.
- Climate change may lead to the destruction of the natural environment of wild sea fennel plants.
- Urbanisation may lead to the destruction of the natural environment of wild sea fennel plants.
- Excessive use of pesticides destroys natural environment of sea fennel.
- Unregulated collection may lead to the destruction of the natural environment of wild sea fennel plants.

**Q5. In your opinion, what are the proportions of cultivation and wild collection in the total production of sea fennel in your home country (total must be 100)?**

|                 | Average % |
|-----------------|-----------|
| Cultivation     | 19,5      |
| Wild collection | 80,5      |
| Total           | 100,0     |

**Q6. In your opinion, what should be done to ensure that sea fennel cultivation is an environmentally and economically sustainable production activity?**

- Improving the statistical data availability on sea fennel production and consumption.
- Decreasing production costs of sea fennel.
- Limiting the natural collection of sea fennel.
- Identifying coastal areas suitable for sea fennel cultivation.
- Demand-side policies (public procurement, public promotion, etc.).

- Establish a common policy for all Mediterranean countries on sustainable sea fennel cultivation.
- Limiting the use of fertilizers and pesticides.
- Selecting ecotypes of sea fennel that are well adapted to the Mediterranean climate.
- Introduction of sustainable agricultural systems to produce organic sea fennel in the Mediterranean.
- Development of new and/or alternative high value-added products from organic sea fennel crops.
- Adding value to sea fennel by-products by the production of alternative products (functional foods, soil conditioners, etc.)
- Demonstrating the socio-economic benefits, environmental impact, and overall sustainability of the proposed innovations.
- Disseminating sustainable cultivation of sea fennel in the Mediterranean.
- Developing training programs on sustainable cultivation techniques of sea fennel
- To encourage and subsidize cultivation.
- Setting up protection zones.
- Protecting the existing natural gene resources of the sea fennel plant.
- Implementation of an agricultural policy for a resilient / sustainable sea fennel cultivation.
- Cooperation among stakeholders to encourage farmers for the cultivation of sea fennel.
- Creation of some sea fennel growing fields for demonstration purposes.
- Investigating growing conditions, yields, production costs and quality of the final product of sea fennel.
- Promoting organic sea fennel cultivation.
- Legislation in sea fennel collecting.
- Creating products acceptable by consumers.

**Q7. What characteristics make the sea fennel products successful? (Please give concrete examples, if appropriate)**

- Being natural
- Nutraceutical characteristics
- Specific sensory characteristics
- Specific taste originating from the Mediterranean microclimate
- Distinctive flavour
- Possibility to be used for various purposes
- Possibility to be combined with different products
- Vitamin C content
- Originality
- Medicinal properties
- Nutritional value
- Being locally produced

- Iodine content
- Easy to collect
- Being an opportunity for small local producers
- Having strong territorial connection

### 1.2.3 Results of the second and the third rounds of the Delphi survey

The first question in the second and the third rounds was about the factors influencing the development of the sea fennel and sea fennel products market in the last 5 years (Table 4). Among the 12 factors originally mentioned in the first round by the experts, those which were found to be the most influential were consumer demand for “natural” and “local” products respectively. These factors were followed by “different flavour of sea fennel products”. This factor may also be translated into the recent trend in terms of search for different flavours by the consumers. Also, consensus is achieved for these factors in both rounds, implying that experts agree with each other on the dominant impact of these factors, with ratings between “moderate” and “a lot” impact. These findings are in line with those mentioned in many recent studies (Renna and Gonella, 2013; Łuczaj et al, 2013; Renna, 2018)

On the other hand, the experts do not think that there is a meaningful improvement or significant effort on the production and marketing side for a substantial development of the sea fennel market. While experts' views on these elements were rather varied in the second round; they reached a consensus in the third round. In both rounds, these factors were found to be either “a little” or “moderately” influential.

Table 4: Experts' views on influential factors on the development of sea fennel and sea-fennel-based products market in the last 5 years

| Q1. Please indicate, in your opinion, to what extent each of the following factors had impact on the development of the sea fennel and sea fennel products market in the last 5 years. |                                                                   |         |           |        |      |              |             |           |        |      |              |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|---------|-----------|--------|------|--------------|-------------|-----------|--------|------|--------------|
| S#                                                                                                                                                                                     | Factors                                                           | Round 2 |           |        |      |              | Round 3     |           |        |      |              |
|                                                                                                                                                                                        |                                                                   | Mean    | Std. Dev. | Median | IQR* | Consensus ** | Mean        | Std. Dev. | Median | IQR* | Consensus ** |
| 1                                                                                                                                                                                      | Consumer demand for natural products                              | 3.59    | 0,875     | 4.00   | 1.00 | Yes          | <b>3.58</b> | 0.620     | 4.00   | 1.00 | Yes          |
| 2                                                                                                                                                                                      | Consumer demand for local products                                | 3.56    | 0,914     | 4.00   | 1.00 | Yes          | <b>3.55</b> | 0.675     | 4.00   | 1.00 | Yes          |
| 9                                                                                                                                                                                      | Different flavour of sea fennel products                          | 3.44    | 0,878     | 4.00   | 1.00 | Yes          | <b>3.48</b> | 0.626     | 4.00   | 1.00 | Yes          |
| 11                                                                                                                                                                                     | Local tourism                                                     | 3.19    | 0,875     | 3.00   | 2.00 | No           | <b>3.19</b> | 0.833     | 3.00   | 1.00 | Yes          |
| 4                                                                                                                                                                                      | Research and development on sea fennel products                   | 3.13    | 1,212     | 3.00   | 2.00 | No           | <b>3.19</b> | 0.749     | 3.00   | 1.00 | Yes          |
| 3                                                                                                                                                                                      | Marketing and trade activities of the sea fennel producers        | 3.13    | 1,185     | 3.00   | 2.00 | No           | <b>3.10</b> | 0.831     | 3.00   | 1.00 | Yes          |
| 5                                                                                                                                                                                      | Development of processing and distribution of sea fennel products | 3.00    | 0,950     | 3.00   | 2.00 | No           | <b>3.10</b> | 0.746     | 3.00   | 1.00 | Yes          |
| 6                                                                                                                                                                                      | Consumer awareness of sea fennel products                         | 3.09    | 1,027     | 3.00   | 1.75 | No           | <b>3.06</b> | 0.574     | 3.00   | 0.00 | Yes          |
| 7                                                                                                                                                                                      | Social media                                                      | 2.97    | 1,121     | 3.00   | 2.00 | No           | <b>3.03</b> | 0.912     | 3.00   | 0.00 | Yes          |
| 12                                                                                                                                                                                     | Interest by local SMEs                                            | 2.91    | 0,914     | 3.00   | 2.00 | No           | <b>2.97</b> | 0.912     | 3.00   | 1.00 | Yes          |
| 10                                                                                                                                                                                     | Agricultural extension and advisory                               | 2.69    | 1,203     | 3.00   | 1.75 | No           | <b>2.55</b> | 0.850     | 3.00   | 1.00 | Yes          |
| 8                                                                                                                                                                                      | Low consumer prices of sea fennel compared to similar products    | 2.47    | 0,803     | 3.00   | 1.00 | Yes          | <b>2.45</b> | 0.675     | 3.00   | 1.00 | Yes          |

1. Not at all      2. A little      3. Moderately      4. A lot      5. A great deal

\*IQR: Inter Quartile Range (Q3-Q1)

\*\*There is consensus when the IQR is less than or equal to 1.2.

The second question was about the current state of the sea fennel and sea fennel-based products market (Table 5). Twelve statements were set up upon the results of the first round. The experts generally agreed with the statements. They especially agreed that the promotion of sea fennel products was insufficient, sea fennel and its products were not known by consumers and mostly not available in the large retail chains, there were a limited number of sea fennel products and few processors in the market. They also agreed that consumer demand for sea fennel was limited. At the same time, they reached a consensus on these issues right from the second round of the survey. On some other statements, such as those on the growing conditions and environmental aspects, consensus could only be reached in the third round. This is most probably due to limited

experience in the country with respect to growing of sea fennel under farmer conditions. The experts were indifferent and almost did not agree with the statement that sea fennel was usually available in the restaurants. They were also indifferent towards the statement "Sea fennel-based products are intended for haute cuisine." Actually, the experts did not reach a consensus on the accuracy of this statement, in the third round either.

Table 5: Experts' views on the current state of the sea fennel market

| Q2. Please indicate your level of agreement with following statements on the current state of the sea fennel and sea fennel-based products market. |                                                                                                                                    |         |           |        |      |            |             |           |        |      |             |
|----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|---------|-----------|--------|------|------------|-------------|-----------|--------|------|-------------|
| S#                                                                                                                                                 | Statements                                                                                                                         | Round 2 |           |        |      |            | Round 3     |           |        |      |             |
|                                                                                                                                                    |                                                                                                                                    | Mean    | Std. Dev. | Median | IQR* | Consensus* | Mean        | Std. Dev. | Median | IQR* | Consensus** |
| 11                                                                                                                                                 | The promotion of sea fennel products is insufficient.                                                                              | 4.13    | 0,751     | 4.00   | 1.00 | Yes        | <b>4.29</b> | 0.588     | 4.00   | 1.00 | Yes         |
| 4                                                                                                                                                  | Sea fennel and its products are not known by consumers.                                                                            | 4.13    | 0,793     | 4.00   | 1.00 | Yes        | <b>4.19</b> | 0.792     | 4.00   | 1.00 | Yes         |
| 3                                                                                                                                                  | Sea fennel is rarely available in the large retail chains.                                                                         | 4.03    | 0,967     | 4.00   | 1.00 | Yes        | <b>4.10</b> | 0.870     | 4.00   | 1.00 | Yes         |
| 1                                                                                                                                                  | There are a limited number of sea fennel products in the market.                                                                   | 3.97    | 0,740     | 4.00   | 0.00 | Yes        | <b>4.06</b> | 0.680     | 4.00   | 0.00 | Yes         |
| 5                                                                                                                                                  | Consumer demand for sea fennel is limited.                                                                                         | 3.97    | 0,782     | 4.00   | 0.00 | Yes        | <b>4.00</b> | 0.516     | 4.00   | 0.00 | Yes         |
| 8                                                                                                                                                  | There are only a few processors of sea fennel and its products.                                                                    | 3.84    | 0,954     | 4.00   | 0.75 | Yes        | <b>3.97</b> | 0.706     | 4.00   | 0.00 | Yes         |
| 2                                                                                                                                                  | Sea fennel is mostly sold in specialised shops (e.g., natural/health food stores, delicatessen, etc.).                             | 3.66    | 1,004     | 4.00   | 1.00 | Yes        | <b>3.87</b> | 0.670     | 4.00   | 0.00 | Yes         |
| 12                                                                                                                                                 | The market for sea fennel products is limited to coastal areas.                                                                    | 3.56    | 0,948     | 4.00   | 1.00 | Yes        | <b>3.68</b> | 0.599     | 4.00   | 1.00 | Yes         |
| 7                                                                                                                                                  | The sea fennel market is not stable since many growers don't have sufficient knowledge about how to grow and preserve the product. | 3.66    | 1,004     | 3.50   | 1.75 | No         | <b>3.65</b> | 0.877     | 4.00   | 1.00 | Yes         |
| 6                                                                                                                                                  | The increase in demand for sea fennel products increases the danger of extinction of wild sea fennel populations.                  | 3.19    | 1,230     | 3.00   | 2.00 | No         | <b>3.42</b> | 0.958     | 3.00   | 1.00 | Yes         |
| 10                                                                                                                                                 | Sea fennel-based products are intended for haute cuisine.                                                                          | 3.09    | 1,118     | 3.00   | 2.00 | No         | <b>3.13</b> | 0.922     | 3.00   | 2.00 | No          |
| 9                                                                                                                                                  | Sea fennel is usually available in restaurants.                                                                                    | 2.59    | 1,292     | 2.50   | 3.00 | No         | <b>2.71</b> | 1.006     | 3.00   | 1.00 | Yes         |

1. Strongly disagree   2. Disagree   3. Neither Agree nor disagree   4. Agree   5. Strongly agree

\*IQR: Inter Quartile Range (Q3-Q1)

\*\*There is consensus when the IQR is less than or equal to 1.2.

Regarding the future (next 10 years) of the sea fennel and sea fennel-based products market, experts mostly agreed with the statements constructed based on the responses of the group in the first round (Table 6). Consensus was reached for all the statements in the second round. The highest level of agreement was on the statement "Developing different recipes using sea fennel will help the market growth."; "The sea fennel market will develop with the support of agro-food and rural policies." and "Chefs and restaurants will be influencing consumer awareness of sea fennel products" respectively. There was a consensus of being indifferent towards the idea that the market would grow only in specific local areas and that the limited growing area of sea fennel would limit the market development. Overall, the experts are optimistic about the future of the sea fennel market.

Table 6: Experts' views on the market outlook of sea fennel and sea fennel-based products in the next 10 years

| Q3. Please indicate your level of agreement with following statements on the market outlook of sea fennel and sea fennel-based products in the next 10 years. |                                                                                                                   |         |           |        |      |              |             |           |        |      |              |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|---------|-----------|--------|------|--------------|-------------|-----------|--------|------|--------------|
| S#                                                                                                                                                            | Statements                                                                                                        | Round 2 |           |        |      |              | Round 3     |           |        |      |              |
|                                                                                                                                                               |                                                                                                                   | Mean    | Std. Dev. | Median | IQR* | Consensus ** | Mean        | Std. Dev. | Median | IQR* | Consensus ** |
| 7                                                                                                                                                             | Developing different recipes using sea fennel will help the market growth.                                        | 4.28    | 0,457     | 4.00   | 1.00 | Yes          | <b>4.19</b> | 0.543     | 4.00   | 1.00 | Yes          |
| 9                                                                                                                                                             | The sea fennel market will develop with the support of agro-food and rural policies.                              | 4.13    | 0,942     | 4.00   | 1.00 | Yes          | <b>4.19</b> | 0.601     | 4.00   | 1.00 | Yes          |
| 4                                                                                                                                                             | Chefs and restaurants will be influencing consumer awareness of sea fennel products                               | 4.22    | 0,870     | 4.00   | 1.00 | Yes          | <b>4.13</b> | 0.619     | 4.00   | 0.00 | Yes          |
| 10                                                                                                                                                            | The sea fennel market will grow if the natural environment and characteristics of the products are respected.     | 4.03    | 0,897     | 4.00   | 1.00 | Yes          | <b>3.97</b> | 0.752     | 4.00   | 0.00 | Yes          |
| 1                                                                                                                                                             | Consumer awareness of sea fennel and sea fennel-based products will increase                                      | 3.84    | 0,628     | 4.00   | 0.00 | Yes          | <b>3.77</b> | 0.669     | 4.00   | 1.00 | Yes          |
| 2                                                                                                                                                             | The sea fennel market will continuously grow in the next 10 years.                                                | 3.69    | 0,644     | 4.00   | 1.00 | Yes          | <b>3.74</b> | 0.575     | 4.00   | 1.00 | Yes          |
| 8                                                                                                                                                             | I think that the export market will grow more than the domestic market.                                           | 3.66    | 0,902     | 4.00   | 1.00 | Yes          | <b>3.74</b> | 0.729     | 4.00   | 1.00 | Yes          |
| 3                                                                                                                                                             | The use of sea fennel as an ingredient in the food industry will increase due to its nutritional characteristics. | 3.66    | 0,787     | 4.00   | 1.00 | Yes          | <b>3.71</b> | 0.783     | 4.00   | 1.00 | Yes          |
| 5                                                                                                                                                             | The market will grow only in specific local areas (e.g., tourist and coastal areas where it grows)                | 3.47    | 0,879     | 4.00   | 1.00 | Yes          | <b>3.48</b> | 0.851     | 4.00   | 1.00 | Yes          |
| 6                                                                                                                                                             | The limited growing area of sea fennel will limit the market development                                          | 3.19    | 0,859     | 3.00   | 1.00 | Yes          | <b>3.45</b> | 0.568     | 3.00   | 1.00 | Yes          |

1. Strongly disagree 2. Disagree 3. Neither Agree nor disagree 4. Agree 5. Strongly agree

\*IQR: Inter Quartile Range (Q3-Q1)

\*\*There is consensus when the IQR is less than or equal to 1.2..

For acquiring experts' views on destructive factors in the natural environment of wild sea fennel plant populations, the level of the influence of ten options was questioned (Table 7). Among these, "urbanization", "excessive and unregulated collection" and "harvest without respecting the production cycles" were found to be the most influential ones according to experts. Also, a consensus was reached from the second round for these statements. The experts think the wild animals are "a little" dangerous for wild sea fennel populations. They also find "animal production" and "excessive pesticide use" to be only a "moderate" source of danger. In the third round, consensus on either "a little", "moderate" or "a lot" influence was reached for all the sources of danger included.

Table 7: Experts' views on influential factors in the destruction of the natural environment of wild sea fennel plant populations

*Q4. Please indicate to what extent each of the following factors may have an impact on the destruction of the natural environment of wild sea fennel plant populations.*

| S# | Factors                                                                          | Round 2 |           |        |      |              | Round 3     |           |        |      |              |
|----|----------------------------------------------------------------------------------|---------|-----------|--------|------|--------------|-------------|-----------|--------|------|--------------|
|    |                                                                                  | Mean    | Std. Dev. | Median | IQR* | Consensus ** | Mean        | Std. Dev. | Median | IQR* | Consensus ** |
| 9  | Urbanisation and destruction of stone coastlines                                 | 4.19    | 0,738     | 4.00   | 1.00 | Yes          | <b>4.26</b> | 0.575     | 4.00   | 1.00 | Yes          |
| 6  | Excessive exploitation and unregulated collection of wild sea fennel populations | 4.13    | 0,793     | 4.00   | 1.00 | Yes          | <b>4.19</b> | 0.654     | 4.00   | 1.00 | Yes          |
| 1  | Harvest of sea fennel without respecting the production cycles                   | 4.16    | 0,723     | 4.00   | 1.00 | Yes          | <b>4.13</b> | 0.846     | 4.00   | 1.00 | Yes          |
| 5  | Pollution                                                                        | 3.75    | 1,107     | 4.00   | 2.00 | No           | <b>3.77</b> | 0.717     | 4.00   | 1.00 | Yes          |
| 7  | Excessive tourism in coastal areas                                               | 3.69    | 1,030     | 4.00   | 1.00 | Yes          | <b>3.77</b> | 0.956     | 4.00   | 1.00 | Yes          |
| 2  | Damaging the roots of sea fennel during collection                               | 3.81    | 1,091     | 4.00   | 2.00 | No           | <b>3.68</b> | 1.045     | 4.00   | 1.00 | Yes          |
| 8  | Climate change                                                                   | 3.53    | 0,983     | 4.00   | 1.00 | Yes          | <b>3.58</b> | 0.720     | 4.00   | 1.00 | Yes          |
| 10 | Excessive use of pesticides                                                      | 3.47    | 1,295     | 4.00   | 2.75 | No           | <b>3.45</b> | 0.961     | 4.00   | 1.00 | Yes          |
| 4  | Livestock and animal production (e.g., overgrazing, herd trampling).             | 2.75    | 0,984     | 3.00   | 1.00 | Yes          | <b>2.65</b> | 0.798     | 3.00   | 1.00 | Yes          |
| 3  | Wild animals                                                                     | 2.06    | 0,982     | 2.00   | 2.00 | No           | <b>2.00</b> | 0.632     | 2.00   | 0.00 | Yes          |

1. Not at all      2. A little      3. Moderately      4. A lot      5. A great deal

\*IQR: Inter Quartile Range (Q3-Q1)

\*\*There is consensus when the IQR is less than or equal to 1.2.

Processing the experts' suggestions for an environmentally and economically sustainable cultivation system in the first round, 15 policy options were constructed to be scored in rounds 2 and 3 (Table 8). Concerning this section, all suggested options were found "effective" by the experts, and almost all of them with a consensus already in the second round. Experts especially believe in the potential effectiveness of R&D and new high-value-added product development activities and focused rural and agricultural policies and dissemination efforts on organic and sustainable sea fennel cultivation.

**Table 8: Experts' views on the effectiveness of various measures in ensuring sea-fennel cultivation to be an environmentally and economically sustainable production activity**

*Q5. In your opinion, to what extent can each of the following suggestions be effective in ensuring the sea fennel cultivation to be an environmentally and economically sustainable production activity?*

| S# | Suggestions                                                                                                                  | Round 2 |           |        |      |              | Round 3     |           |        |      |              |
|----|------------------------------------------------------------------------------------------------------------------------------|---------|-----------|--------|------|--------------|-------------|-----------|--------|------|--------------|
|    |                                                                                                                              | Mean    | Std. Dev. | Median | IQR* | Consensus ** | Mean        | Std. Dev. | Median | IQR* | Consensus ** |
| 15 | Research and development                                                                                                     | 4.44    | 0,504     | 4.00   | 1.00 | Yes          | <b>4.45</b> | 0.506     | 4.00   | 1.00 | Yes          |
| 9  | Development of new and/or alternative high value-added products from sea fennel                                              | 4.19    | 0,535     | 4.00   | 0.75 | Yes          | <b>4.32</b> | 0.475     | 4.00   | 1.00 | Yes          |
| 6  | Focused rural and agricultural policies on organic and sustainable sea fennel cultivation                                    | 4.34    | 0,701     | 4.00   | 1.00 | Yes          | <b>4.26</b> | 0.575     | 4.00   | 1.00 | Yes          |
| 8  | Dissemination of organic and sustainable agricultural systems for the production of sea fennel in the Mediterranean          | 4.22    | 0,491     | 4.00   | 0.75 | Yes          | <b>4.26</b> | 0.514     | 4.00   | 1.00 | Yes          |
| 14 | Cooperation among stakeholders to encourage farmers for the cultivation of sea fennel.                                       | 4.25    | 0,622     | 4.00   | 1.00 | Yes          | <b>4.23</b> | 0.669     | 4.00   | 1.00 | Yes          |
| 7  | Selecting ecotypes of sea fennel that are well adapted to the Mediterranean climate                                          | 4.16    | 0,767     | 4.00   | 1.00 | Yes          | <b>4.19</b> | 0.543     | 4.00   | 1.00 | Yes          |
| 13 | Protecting the existing natural gene resources of the sea fennel plant (e.g., by protected areas).                           | 4.13    | 0,793     | 4.00   | 1.00 | Yes          | <b>4.19</b> | 0.654     | 4.00   | 1.00 | Yes          |
| 12 | Developing training programs on organic and sustainable cultivation techniques of sea fennel                                 | 4.31    | 0,693     | 4.00   | 1.00 | Yes          | <b>4.16</b> | 0.688     | 4.00   | 1.00 | Yes          |
| 4  | Identifying coastal areas suitable for sea fennel cultivation.                                                               | 4.25    | 0,568     | 4.00   | 1.00 | Yes          | <b>4.16</b> | 0.454     | 4.00   | 0.00 | Yes          |
| 10 | Adding value to sea fennel by-products by the production of alternative products (functional foods, soil conditioners, etc.) | 4.16    | 0,628     | 4.00   | 1.00 | Yes          | <b>4.13</b> | 0.499     | 4.00   | 0.00 | Yes          |
| 11 | Demonstrating the socio-economic benefits, environmental impact and overall sustainability of the proposed innovations       | 4.00    | 0,803     | 4.00   | 0.75 | Yes          | <b>3.94</b> | 0.574     | 4.00   | 0.00 | Yes          |
| 3  | Regulating/limiting the collection of wild sea fennel                                                                        | 4.00    | 0,762     | 4.00   | 0.75 | Yes          | <b>3.94</b> | 0.854     | 4.00   | 0.00 | Yes          |
| 2  | Decreasing the production costs of sea fennel                                                                                | 3.84    | 0,987     | 4.00   | 1.75 | No           | <b>3.90</b> | 0.790     | 4.00   | 0.00 | Yes          |
| 5  | Demand-side policies (public procurement, public promotion, etc.).                                                           | 3.69    | 0,965     | 4.00   | 1.00 | Yes          | <b>3.68</b> | 0.599     | 4.00   | 1.00 | Yes          |
| 1  | Improving the statistical data availability on sea fennel production and consumption                                         | 3.47    | 0,915     | 4.00   | 1.00 | Yes          | <b>3.55</b> | 0.675     | 4.00   | 1.00 | Yes          |

1. Absolutely ineffective    2. Ineffective    3. Neither effective nor ineffective    4. Effective    5. Absolutely effective

\*IQR: Inter Quartile Range (Q3-Q1)

\*\*There is consensus when the IQR is less than or equal to 1.2..

The expert group with various backgrounds was expected to have different experiences and insights regarding the successful production of sea fennel products. In order to find out the experts' views on the contribution of various characteristics to the success of the sea fennel products, the level of importance of eight characteristics mentioned by them in the first round was scored in the 2nd and the 3rd rounds (Table 9). All the characteristics were rated as being quite important in both rounds. Among them, "authenticity", being "natural", "locally produced" and having a "distinctive flavour" were found to be the prominent features. On the other hand, nutraceutical/medicinal properties and nutritional value, such as vitamin C and iodine content were not among the outstanding ones among the eight characteristics elaborated. There was considerable consensus among

experts on the importance of all the characteristics presented to them, right from the second round. In the third round, the level of consensus has further increased.

Table 9: Experts' views on the contribution of various characteristics on the success of the sea-fennel-based products

| Q6. In your opinion, to what extent each of the following characteristics are important to contribute the success of the sea fennel products? |                                            |         |           |        |      |              |             |           |        |      |              |
|-----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|---------|-----------|--------|------|--------------|-------------|-----------|--------|------|--------------|
| S#                                                                                                                                            | Characteristics                            | Round 2 |           |        |      |              | Round 3     |           |        |      |              |
|                                                                                                                                               |                                            | Mean    | Std. Dev. | Median | IQR* | Consensus ** | Mean        | Std. Dev. | Median | IQR* | Consensus ** |
| 5                                                                                                                                             | Authenticity                               | 4.25    | 0,718     | 4.00   | 1.00 | Yes          | <b>4.23</b> | 0.669     | 4.00   | 1.00 | Yes          |
| 1                                                                                                                                             | Natural                                    | 4.22    | 0,659     | 4.00   | 1.00 | Yes          | <b>4.16</b> | 0.523     | 4.00   | 0.00 | Yes          |
| 7                                                                                                                                             | Locally produced                           | 4.13    | 0,707     | 4.00   | 1.00 | Yes          | <b>4.13</b> | 0.562     | 4.00   | 0.00 | Yes          |
| 3                                                                                                                                             | Distinctive flavour                        | 4.06    | 0,716     | 4.00   | 0.75 | Yes          | <b>4.13</b> | 0.499     | 4.00   | 0.00 | Yes          |
| 8                                                                                                                                             | Opportunity for small local producers      | 3.91    | 0,734     | 4.00   | 0.75 | Yes          | <b>4.06</b> | 0.574     | 4.00   | 0.00 | Yes          |
| 4                                                                                                                                             | Versatility as ingredient                  | 3.84    | 0,515     | 4.00   | 0.00 | Yes          | <b>3.94</b> | 0.442     | 4.00   | 0.00 | Yes          |
| 2                                                                                                                                             | Nutraceutical/medicinal properties         | 4.06    | 0,801     | 4.00   | 1.00 | Yes          | <b>3.87</b> | 0.670     | 4.00   | 0.00 | Yes          |
| 6                                                                                                                                             | Nutritional value (e.g. vitamin C, iodine) | 3.88    | 0,871     | 4.00   | 1.75 | No           | <b>3.84</b> | 0.779     | 4.00   | 1.00 | Yes          |

1. Not at all      2. A little      3. Moderately      4. A lot      5. A great deal

\*IQR: Inter Quartile Range (Q3-Q1)

\*\*There is consensus when the IQR is less than or equal to 1.2..

## 1.3 Conclusions

The main highlights of the Delphi survey can be listed as follows.

According to the experts:

- Consumers' tendency to consume natural and local products is an advantage for the development of the market.
- Though, sea fennel and its products are not known by consumers
- Consumer demand for sea fennel is limited.
- The market for sea fennel and sea fennel products is not yet developed.
- There are only a few processors of sea fennel and its products.

The market can be developed with:

- Sufficient promotion of sea-fennel-based products.
- Favourable agricultural and rural policies.
- Applications that respect the natural environment and characteristics of the products.
- Cooperation between the sector stakeholders.
- Research and development and related funding.

## 2 Report on consumer research on the attitudes and acceptance of sea-fennel product

### 2.1 Material and Methods

#### Theoretical framework

Considering that sea fennel food products are a fairly new concept in the food market, a behavioural model leveraging the Theory of Planned Behaviour (TPB) was developed to measure the attitude and acceptance of consumers regarding sea fennel-based food products. According to the TPB (Ajzen, 1991), people's intentions to perform or not perform a behaviour can be used to predict their behaviour. The intentions are determined by attitudes (positive or negative evaluation of the individual performing the behaviour), subjective norms (the view of others on the individual's choices), and perceived behavioural control (the extent to which the individual perceives that the behaviour is under their control) (Figure 1).

In the food sector, the model has been applied to numerous studies to investigate the innovative food-related behaviours of consumers such as purchasing functional foods, eating insect-based foods, supplement use, use of genetically modified foods, dairy product intake, and organic product consumption (e.g., Menozzi et al., 2017; Metcalf et al., 2021; Naspetti et al., 2021; Patch et al., 2005).

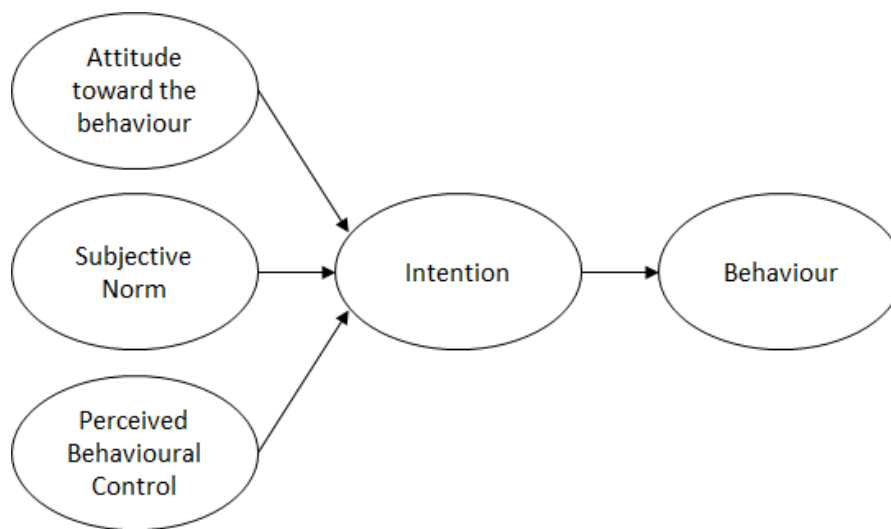
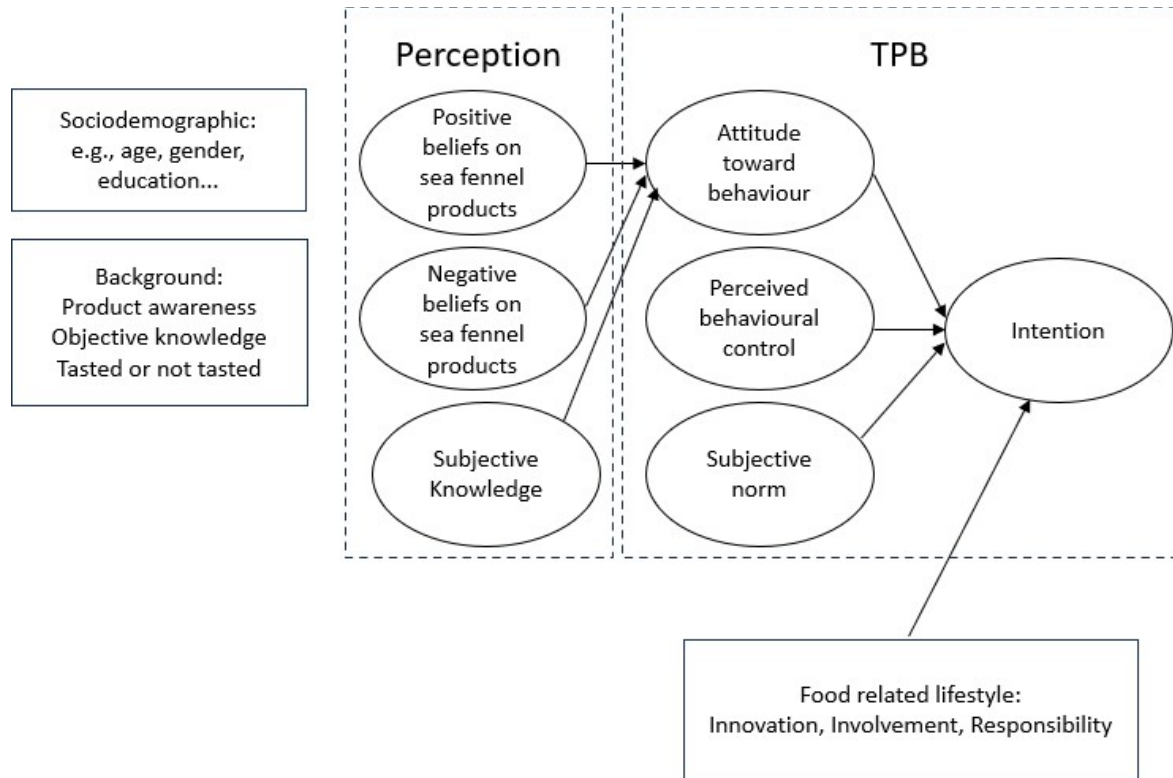


Figure 1 The original Theory of Planned Behaviour (TPB) model (Ajzen, 1991)

The core of the adapted model remains with the original constructs, attitude towards the behaviour, subjective norm, and perceived behaviour control (Figure 1). The theory was extended with additional constructs, positive and negative beliefs, background information related to sea fennel products (product awareness, objective and subjective product knowledge), and food-related lifestyle (FRL) including innovation, involvement, and responsibility (See Figure 2). Sociodemographic characteristics such as age, gender, employment status, family composition, and education were also considered to explore the variables' relationships.



*Figure 2 The behavioural intentions model used in the study*

Based on this theoretical framework, the following hypotheses of consumer acceptance of sea fennel food products were formulated.

H1: The (positive/negative) attitude of consumers toward sea fennel is directly related to their intention (not) to buy sea fennel.

H2: The more that consumers have positive (H2a) or negative (H2b) perceptions toward sea fennel food products, the more favourable or unfavourable, respectively, their attitude toward sea fennel

H3: The attitude towards purchasing sea fennel is higher for consumers with higher product knowledge (objective and subjective).

H4: The more consumers perceive the influence of social and peer pressure to be favourable to sea fennel, the higher the consumer intention towards buying sea fennel food products.

H5: The more consumers perceive that the decision to purchase sea fennel is under their control, the higher the consumer intention towards buying sea fennel food products.

H6: The more the consumer is innovative, involved and responsible, the higher the consumer intention towards buying sea fennel food products.

## 2.2 Data collection

The data for the evaluation of the theoretical model were gathered through an online questionnaire distributed to consumers via Qualtrics online survey platform. The sub-contracted agency CINT has recruited consumers across five

Mediterranean countries: Croatia (HR), France (FR), Italy (IT), Tunisia (TN), and Turkey (TR).

The questionnaire, reported in Annex 1, can be divided into five main sections considering the information collected:

The first section is a screening segment that aims to select eligible consumers. Accordingly, participants in the study were responsible for making household food purchases and, were not involved in any food-related professions, such as agriculture or food processing, nor did they work for a market research company. Additionally, questions regarding country of residence, age, and gender were included to ensure balanced representation from each country and guarantee that the age of all respondents was over 18 years.

The second section includes questions about consumer awareness of sea fennel. Participants were asked if they had ever heard about sea fennel, with dichotomous response options 'yes' or 'no'. Then, regardless of their previous knowledge, all the participants were provided a brief description of sea fennel to ensure a consistent information level among them. The information provided is given below:

*"Sea Fennel (Chritum maritimum L.) is a halophyte plant that grows spontaneously in rocky areas and salty soils along coastlines. In Mediterranean countries, sea fennel has several usage areas, such as culinary, medicine, and cosmetics, because of its nutrient and phytochemical contents, high nutritional value, and diuretic, digestive, and carminative properties. Traditionally, its leaves are consumed in salads, sauces, soups, and as fermented in vinegar or oil. The composition of sea fennel contains dietary fibre, protein, polyunsaturated fatty acids, minerals, vitamins (C, A, E), polyphenols, and essential oils. Bioactive compounds of sea fennel have functional properties such as antioxidant, antimicrobial, and anti-inflammatory activity.*

The third section focuses on consumer knowledge about sea fennel. Participants were presented with a multiple-choice question featuring images of fresh, pickled, and dry food images (see [Figure 3](#)) for the assessment of their objective knowledge. They were asked to identify the sea fennel among these options displayed in a randomized order.

Correct answers



Furthermore, the subjective knowledge question, which is important for understanding consumer preferences (Brucks, 1985; Park et al., 1994), was asked with a three-item construct. Participants rated their level of agreement on a five-point Likert scale verbally anchored from 'strongly disagree' to 'strongly agree' and at the mid-point with 'neither agree nor disagree' (See [Table 1](#) in D7.4).

The fifth section of the survey deals with socioeconomic information such as employment status, family composition, and education as well as age and gender, which were addressed in the screening section. Participants were requested to report their age as a continuous variable and to indicate the number of family members in each of the following categories: under 18 years old, between 18 and 64 years old, and over 64 years old. The categories for employment status included employed, unemployed, retired, and students or inactive population who are not currently looking for a job. The education levels were re-grouped into smaller categories following the International Standard Classification of Education (ISCED) (UNESCO, 2012) to facilitate a comparison between countries. In addition, participants were asked about their type of residence (urban, rural, semi- rural/semi-urban) and **whether they had ever tasted sea fennel**.

The questionnaire was initially developed in English and later translated into the relevant national languages with the help of project partners. Cross-checking, editing, and pre-testing were conducted before the survey was administered. The data was collected between August and September 2024. The questionnaire was sent to a panel of 3070 consumers, and after eligibility and consistency checks, 1031 consumer responses were retained.

## 2.2.1 Analysis

The Confirmatory Factor Analysis (CFA) and Structural Equation Modelling (SEM) were carried out using a robust maximum likelihood estimator (Hancock & Schoonen, 2015; Satorra & Bentler, 1994) via Mplus 8 (Muthén & Muthén, 2017). A post-hoc analysis was conducted to perform further model invariance tests finalised to latent means difference testing:

- across consumers with high or low knowledge of sea fennel
- across genders (male vs. female), age groups, and urban-rural residence
- across countries, and
- across the state of awareness and taste experience.

All descriptive analyses were carried out by using Stata version 18.

## 2.3 Results

### 2.3.1 Descriptive statistics

#### Socio-demographics

Socio-demographic data included information on gender, age, level of education, employment status, area of residence, and number of persons in the household.

As reported in [Table 3](#), we collected 1031 valid survey responses from five Mediterranean countries: CR (196), FR (225), IT (206), TN (204), and TR (200). Female respondents represent 53% of the sample. Among the age groups, the largest consumer segment was the '45-65' category (39%), followed by the '30-45' category (34%). The youngest group, aged '18-29', accounted for 16%, while the oldest group over '65' represented 12%.

Regarding the composition of family members, Tunisia has the highest average number of adults (mean 2.62  $\pm$  1.25). In contrast, France has the lowest average of adults in the family (mean 1.36  $\pm$  1.04; See

Most participants have a Bachelor's degree or higher, are employed, and live in urban areas (see [Table 3](#) for details).

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*Table 3 Sociodemographic characteristics of the sample*

| Sociodemographic variables    | CR  | FR  | Country<br>IT | TN  | TR  | Total       |
|-------------------------------|-----|-----|---------------|-----|-----|-------------|
| <b>Total sample</b>           | 196 | 225 | 206           | 204 | 200 | <b>1031</b> |
| <b>Gender in %</b>            |     |     |               |     |     |             |
| Female                        | 51  | 60  | 51            | 50  | 50  | <b>53</b>   |
| Male                          | 49  | 40  | 49            | 50  | 50  | <b>47</b>   |
| <b>Age group in %</b>         |     |     |               |     |     |             |
| 18-29 (%)                     | 19  | 3   | 10            | 17  | 30  | <b>16</b>   |
| 30-45 (%)                     | 28  | 22  | 27            | 55  | 40  | <b>34</b>   |
| 46-65 (%)                     | 41  | 50  | 46            | 28  | 29  | <b>39</b>   |
| over 65 (%)                   | 12  | 26  | 17            | 0   | 2   | <b>12</b>   |
| <b>Education in %</b>         |     |     |               |     |     |             |
| Lower secondary or below      | 1   | 6   | 4             | 7   | 3   | <b>4</b>    |
| Upper secondary               | 48  | 15  | 59            | 23  | 23  | <b>33</b>   |
| Bachelor's degree             | 31  | 38  | 18            | 42  | 64  | <b>38</b>   |
| Postgraduate                  | 18  | 38  | 17            | 26  | 11  | <b>23</b>   |
| Other                         | 2   | 4   | 2             | 1   | 0   | <b>2</b>    |
| <b>Employment status in %</b> |     |     |               |     |     |             |

|                                                   |                 |                 |                 |                 |                 |                 |
|---------------------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Employed                                          | 65              | 53              | 61              | 76              | 71              | <b>65</b>       |
| Unemployed                                        | 12              | 6               | 13              | 8               | 7               | <b>9</b>        |
| Retired                                           | 17              | 37              | 21              | 5               | 12              | <b>19</b>       |
| Student/not looking for a job                     | 6               | 4               | 4               | 12              | 11              | <b>7</b>        |
| <b>Geographical area in %</b>                     |                 |                 |                 |                 |                 |                 |
| Urban                                             | 47              | 32              | 50              | 70              | 93              | <b>58</b>       |
| Intermediate                                      | 34              | 34              | 34              | 25              | 6               | <b>27</b>       |
| Rural                                             | 36              | 34              | 16              | 4               | 2               | <b>15</b>       |
| <b>Household size in mean <math>\pm</math> sd</b> |                 |                 |                 |                 |                 |                 |
| < 18 years old                                    | 0.60 $\pm$ 0.90 | 0.45 $\pm$ 0.89 | 0.44 $\pm$ 0.90 | 1.16 $\pm$ 1.04 | 1.09 $\pm$ 1.01 | 0.74 $\pm$ 1.00 |
| 18-64 years old                                   | 1.98 $\pm$ 1.13 | 1.36 $\pm$ 1.04 | 1.71 $\pm$ 1.09 | 2.62 $\pm$ 1.25 | 2.21 $\pm$ 0.96 | 2.20 $\pm$ 7.81 |
| > 64 years old                                    | 0.45 $\pm$ 0.79 | 0.78 $\pm$ 4.62 | 0.46 $\pm$ 0.72 | 0.75 $\pm$ 0.86 | 0.21 $\pm$ 0.47 | 0.54 $\pm$ 2.26 |
| Overall                                           | 1.01 $\pm$ 0.45 | 0.86 $\pm$ 1.54 | 0.87 $\pm$ 0.41 | 1.51 $\pm$ 0.62 | 1.17 $\pm$ 0.43 | 1.15 $\pm$ 2.70 |

### Background about sea fennel

Concerning consumer awareness of sea fennel, 46% of the 1031 participants indicated that they had heard about sea fennel previously. The level of awareness varied on country bases as shown in [Figure 4](#). Particularly, Tunisian respondents demonstrated the highest awareness with 79%, while the French participants showed the lowest, with 23% admitting that they had heard about sea fennel.

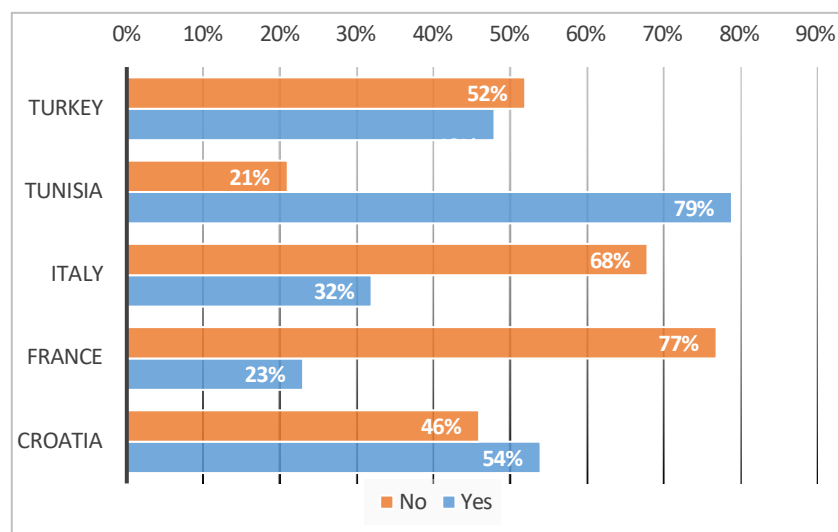


Figure 4 Distribution of respondents by country who are aware of sea fennel

The results of the awareness question are consistent with the results of the product-tasting question. As shown in Figure 5, Tunisian respondents have the highest score as 76% reported that they have tasted sea fennel before. They are followed by Turkish (37%), Croatian (28%), Italian (16%) and French (11%) participants.

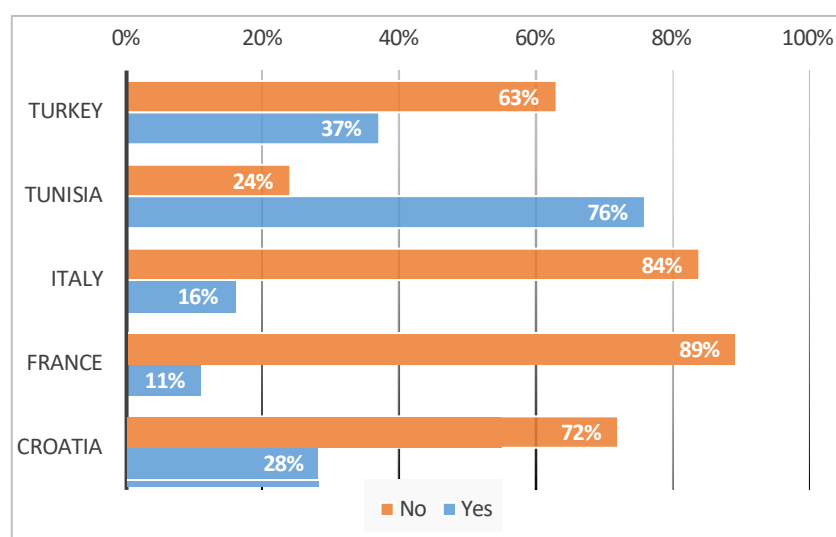


Figure 5 Distribution of respondents by country who tasted sea fennel

The objective and subjective knowledge questions were posed to all consumers, including those who said they had not heard of sea fennel considering that they had never heard the name but might have seen the plant with different names. According to the results, the fresh sea fennel image was the most recognized one among the respondents, 55% of 1031 participants selected the correct image. This was followed by the recognition of pickled sea fennel, with 35%, and sea fennel powder with 34%. The order of recognition of product images showed a similarity at the country level, as illustrated in Figure 6.

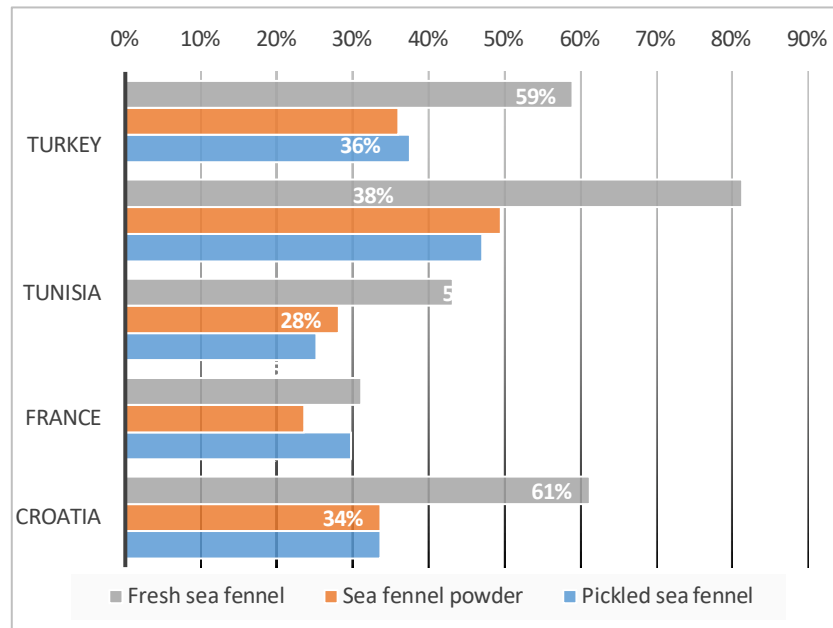


Figure 6 Distribution of respondents by country who recognized sea fennel product images

The distribution of ratings for the 'subjective knowledge' items in terms of level of agreement is shown in Figure 7. The figure presents the results of the entire sample of 1031 participants, for all three items of the construct. The option of 'strongly disagree' is the most selected category.

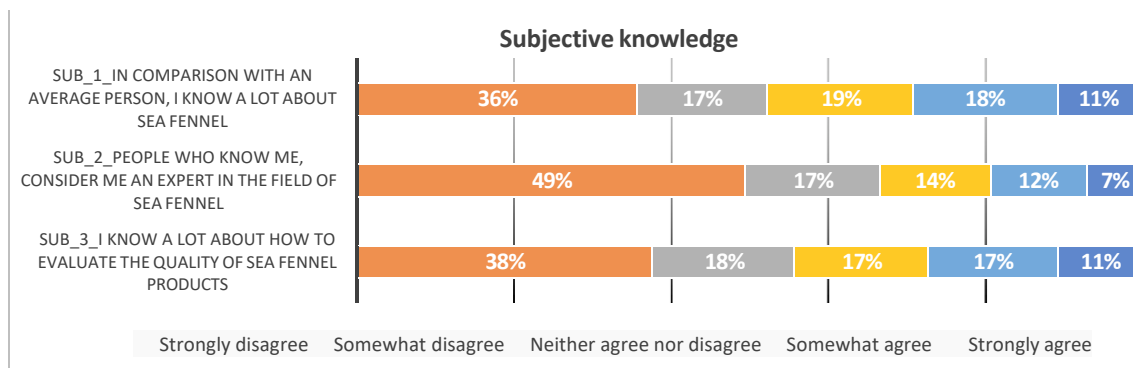


Figure 7 Distribution of subjective knowledge items ranking

The mean values of subjective knowledge responses are reported by country in Figure 8. Accordingly, all country scores are below the theoretical mean value (red line), except for Tunisia ( $3.75 \pm 1.05$ ).

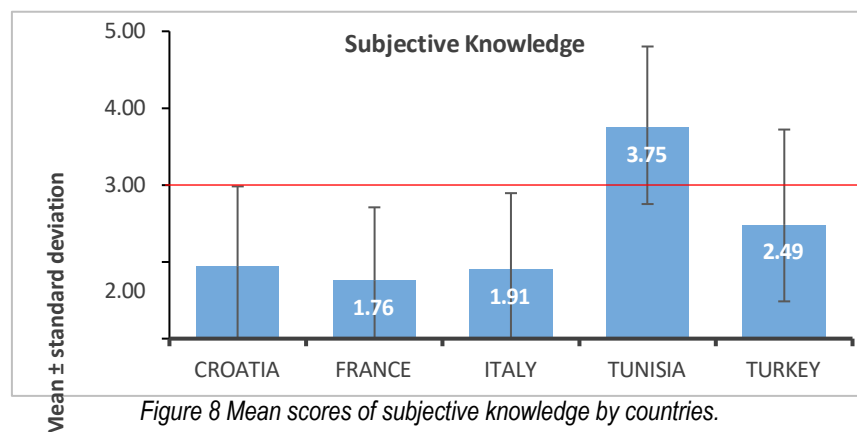


Figure 8 Mean scores of subjective knowledge by countries.

### Multi-item constructs

Respondents perceived sea fennel food products as being low-processed, pleasant, tasty, safe, natural, healthy, and sustainable (See Figure 9). For the other attributes, the answers were rather neutral, e.g. respondents did not perceive sea fennel food products as either modern or traditional, cheap or expensive, and either difficult to find or easy to find. Particularly, 61% of the 1031 participants strongly agreed with the statement that sea fennel food products are 'natural' and 52% strongly agreed that they are 'healthy'. In contrast, only 18% strongly perceived that sea fennel food products are 'easy to find'.

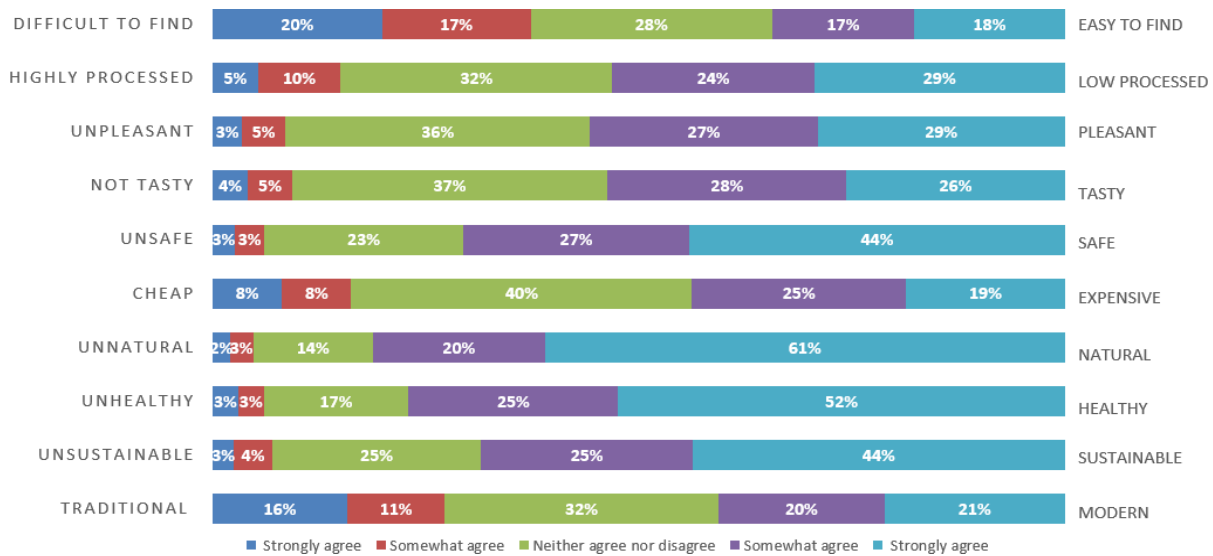


Figure 9 Distribution of respondents' attribute perception of sea fennel food products

Figure 10 illustrates the distribution of ratings for the FRL items. All items received a high level of agreement from respondents, with most ratings falling into 'somewhat agree' or 'strongly agree' categories. The mean values for each subconstruct of FRL were above the theoretical mean (Figure 11, red line). Particularly, the mean for participant's involvement is 4.11 ( $\pm 0.71$ ), which is higher than the mean for responsibility at 3.91 ( $\pm 0.68$ ) and innovation at 3.85 ( $\pm 0.81$ ) (see Figure 11).

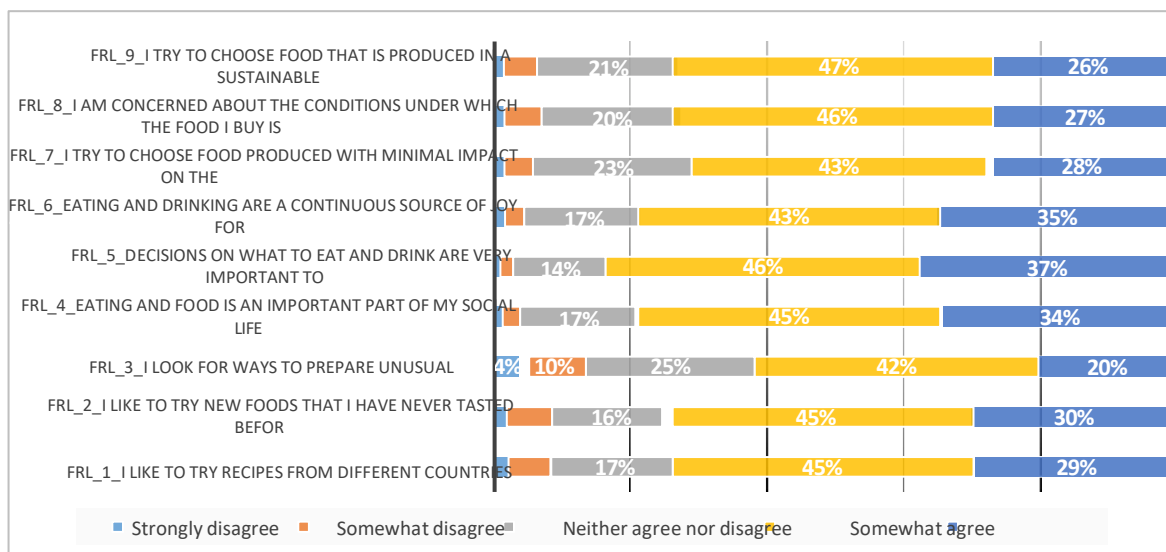


Figure 10 Distribution of Food-Related Lifestyle (FRL) items ranking

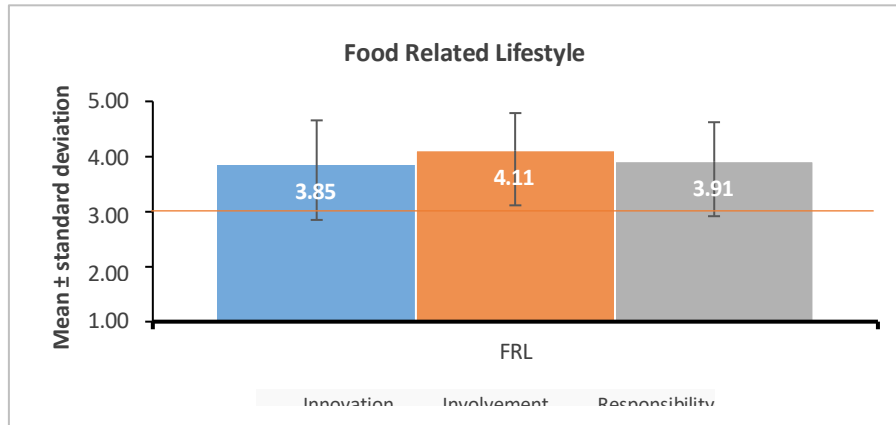


Figure 11 Mean scores of food-related lifestyle (innovation, involvement, and responsibility)

In country-based responses to FRL constructs, involvement received the highest rating score across all countries. While responsibility was ranked second in all countries, in Tunisia, innovation took second place instead (See Figure 12).

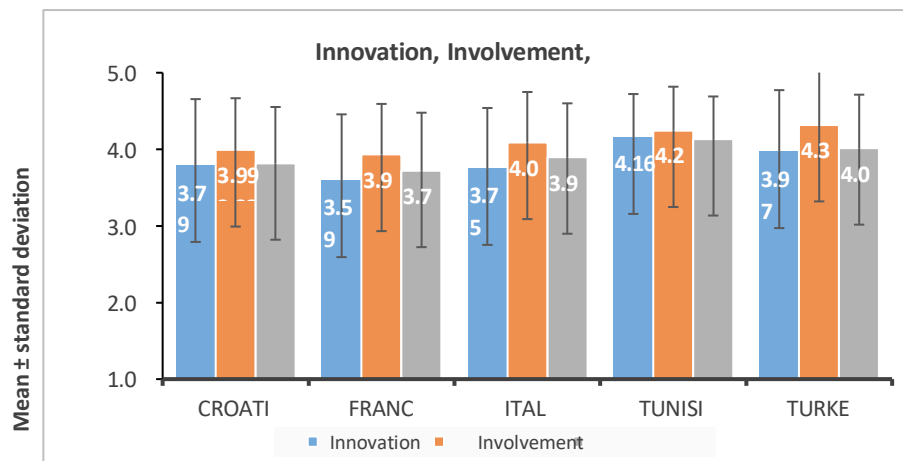


Figure 12 Mean scores of FRL constructs by countries

Descriptive statistics of the attitudes at the item level are given in Figure 13. Item ratings are mostly above the neutral response value of 'neither agree nor disagree'. Although the means vary by country, all ratings are above the theoretical mean (See Figure 14).

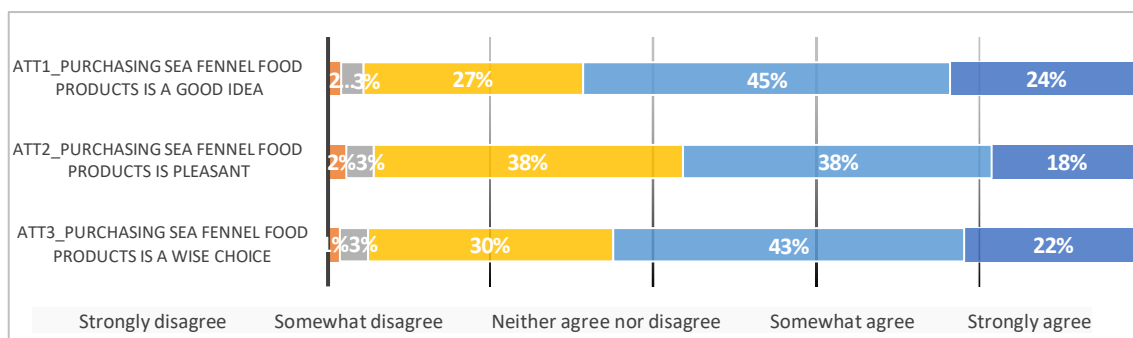


Figure 13 Distribution of attitude items ranking

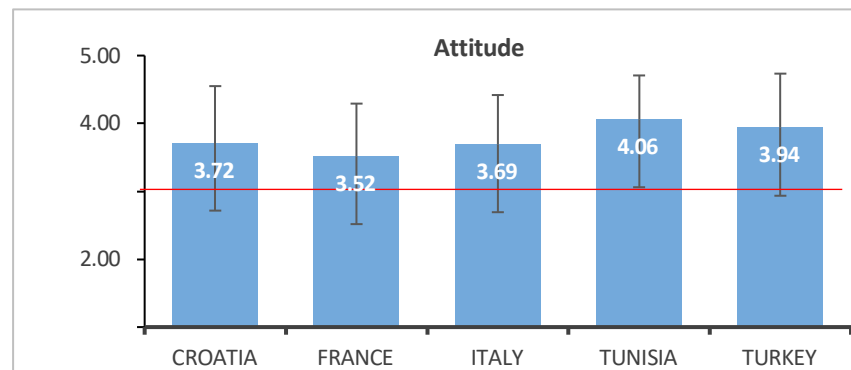


Figure 14 Mean scores of attitude by countries

Regarding the subjective norm, Figure 15 represents the distribution of the responses from all participants on an item base. The option of 'neither agree nor disagree' is the most frequently selected category. Notably, all countries, except France (mean  $2.79 \pm 1.03$ ), have a mean value above the theoretical average. Tunisia has the highest mean score at  $4.04 \pm 0.75$  (See Figure 16).

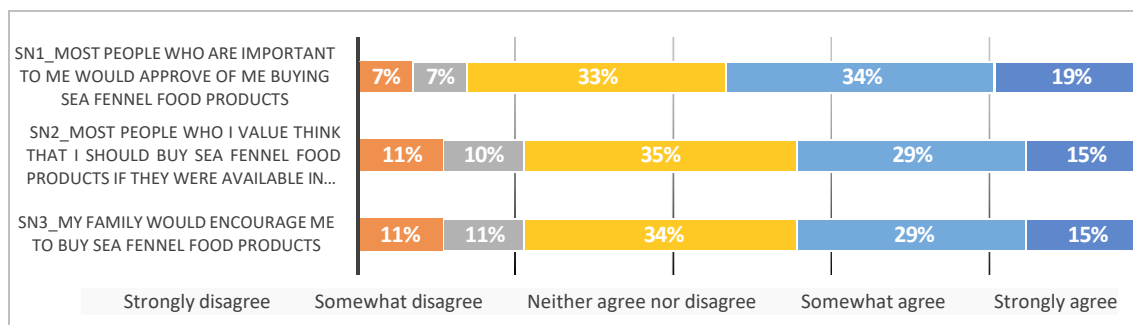


Figure 15 Distribution of subjective norm items ranking

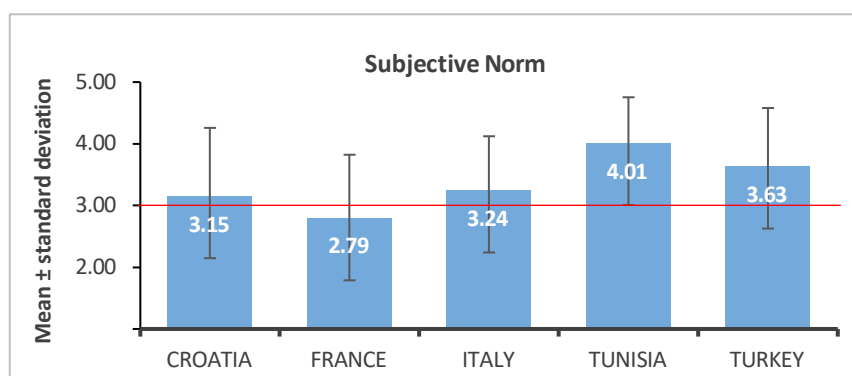


Figure 16 Mean scores of the subjective norm by countries

Respondents expressed a strong level of agreement with the behavioural items, as more than 75% of responses indicated 'somewhat agree' or 'strongly agree' as shown in Figure 17. Additionally, the mean values for all construct items are notably above the theoretical mean in all countries. Tunisia recorded the highest mean at  $4.27 (\pm 0.5)$ , followed by Croatia, Italy, Turkey, and France (See Figure 18).

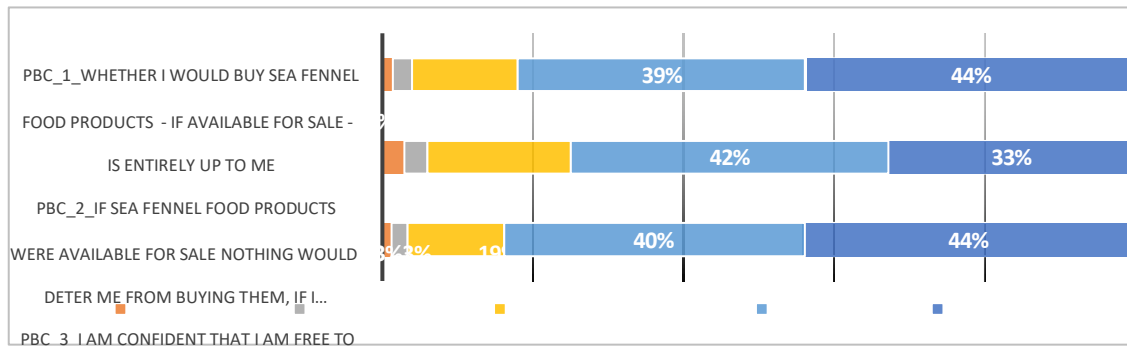


Figure 17 Distribution of perceived behavioural control items ranking

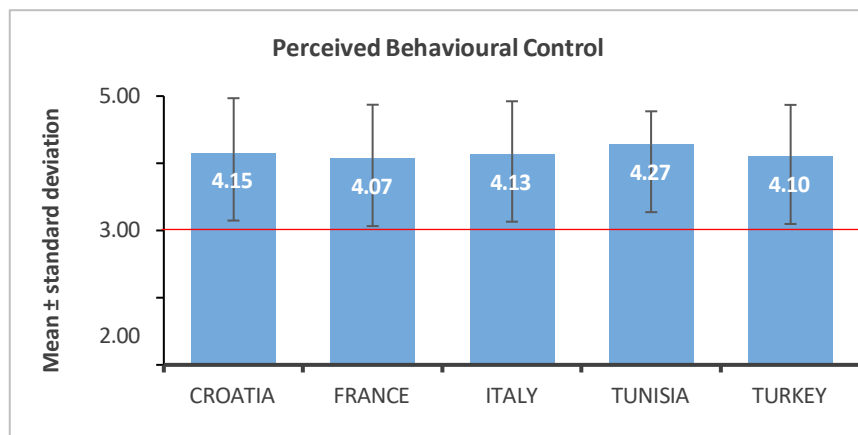


Figure 18 Mean scores of perceived behavioural control by countries

Figure 19 reports the respondent's intentions to buy sea fennel products. The category 'somewhat agree' is the most chosen, with 45 %, followed by 'strongly agree' with 24%.

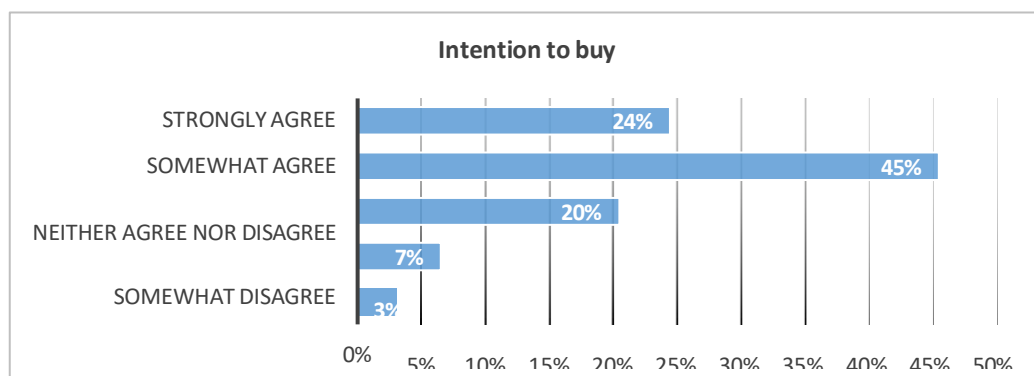


Figure 19 Distribution of intention to buy ratings of sea fennel food products

Regarding product base ratings, fresh sea fennel received the highest scores, with 40% of participants selecting 'somewhat agree' and 25% choosing 'strongly agree.' This was followed by pickled sea fennel, and finally, sea fennel powder (Figure 20).

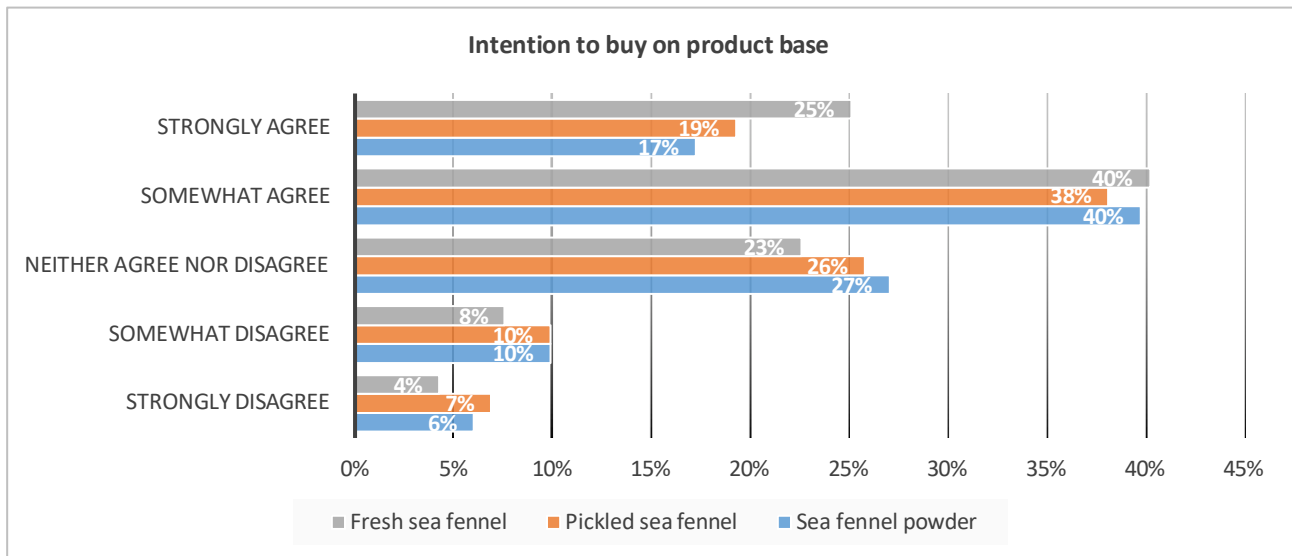


Figure 20 Distribution of intention to buy ratings on product base

In country-based responses for the intention to buy sea fennel food products, mean scores are above the theoretical value in all countries. While Tunisia recorded the highest intention to buy score with  $4.28 \pm 0.71$ , France recorded the lowest with  $3.79 \pm 1.06$  (Figure 21).

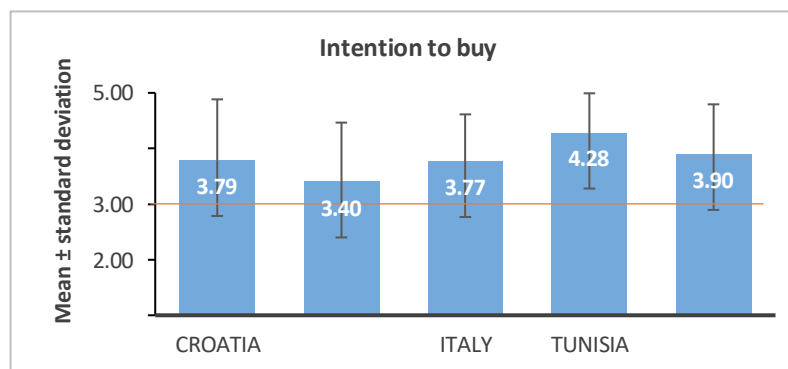


Figure 21 Mean scores of intention to buy by countries

Fresh sea fennel received the highest score in all countries except Turkey where pickled sea fennel had the highest mean value. See Figure 22 for details of the product-based intention to buy scores by country.

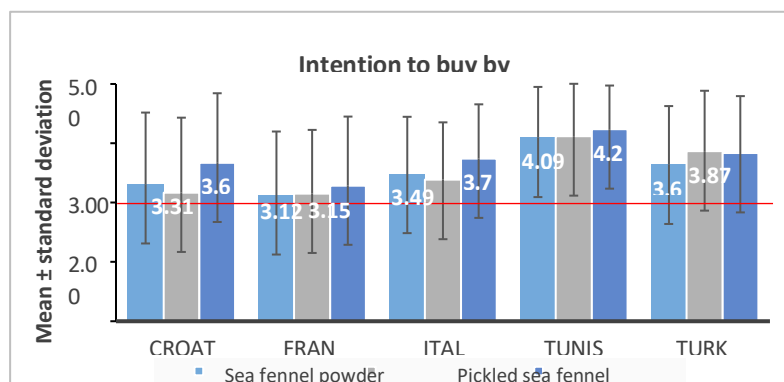


Figure 22 Mean scores of intention to buy by products and countries

### 2.3.2 Structural equation modelling (SEM) analysis

Confirmatory factor analysis was conducted to test the model validity on multi-item scales: Intention (measured on overall and product base intention); Attitude; Subjective Norm; Perceived Behavioural Control; Perception based on beliefs; and Food-Related Lifestyle. Descriptive statistics at the item level were reported in the previous chapter.

Robust maximum-likelihood estimation was used for the initial CFA models and the SEM model. The estimation of the SEM model resulted in confirming the theoretical model depicted in Figure 2.

All of the measurement statistics for the overall sample (pooled CFA model) are given in Table 4, while the statistics of the overall CFA and SEM models' fit are given in Table 5. All constructs exhibit high reliability<sup>1</sup>. All models were estimated using the algorithms implemented in Mplus version 8.11 (Muthén & Muthén, 2017).

*Table 4 Measurement properties for the multi-item constructs (overall sample)*

| Construct                           | Cronbach's alpha* | Composite reliability (rho)* | Average variance extracted (AVE)* |
|-------------------------------------|-------------------|------------------------------|-----------------------------------|
| Knowledge (KNOW)                    | 0.92              | 0.92                         | 0.80                              |
| Perception (beliefs) (PB)           | 0.83              | 0.83                         | (0.45)                            |
| Perceived behavioural control (PBC) | 0.80              | 0.76                         | 0.51                              |
| Subjective norm (SN)                | 0.90              | 0.90                         | 0.75                              |
| Attitude (Att)                      | 0.88              | 0.88                         | 0.70                              |
| Intention (Int)                     | 0.84              | 0.84                         | 0.57                              |
| Food-Related Lifestyle (FRL)        | 0.84              | 0.83                         | (0.36)                            |

\*Alpha should be above 0.70, Rho should be higher than 0.6, and AVE > 0.4. In brackets the values below the threshold

*Table 5 CFA and SEM models' fit statistics*

| Model | Chi-Square          | RMSEA                  | CFI   | SRMR  |
|-------|---------------------|------------------------|-------|-------|
|       |                     | (90% C.I.)             |       |       |
| CFA   | 913.73<br>(df 407)  | 0.035<br>(0.032-0.038) | 0.963 | 0.051 |
| SEM   | 1492.91<br>(df 538) | 0.042<br>(0.039-0.044) | 0.934 | 0.062 |

Legend: RMSEA= Root Mean Square Error of Approximation; CFI=Comparative Fit Index; SRMR = Standardized Root Mean Square Residual

All models exhibit close fit. In both the CFA and the SEM models, all loadings were significant and above the 0.50 threshold.

Using the alignment method factor means were compared for the groups based on gender, age group (below and above 45 years old), urban dwelling (0/1), living in a Southern Mediterranean country (IT/TR/TN), university or higher education (0/1), awareness of sea fennel (0/1), objective knowledge of at least 2 forms of sea fennel products (0/1), experience (whether they had tasted it before or not). At the same time, the measurement invariance of the CFA structure was tested.

Given the FREE alignment approach, as usually happens, was poorly identified, the FIXED approach was used with the group with the factor mean closest to zero as the reference group (factor mean = 0). As a rule of thumb, up to 20% of non-invariant parameters may be acceptable. For higher percentages, a Monte Carlo simulation is recommended to assess the validity of the results (Asparouhov & Muthén, 2014). In general, there was a small degree of (non-)invariance for most of the loadings and intercepts, showing that measurement invariance holds to a large extent. In all cases, only a few parameters were non-invariant, thus rejecting the hypothesis that the measurement model is non-invariant across groups (Coromina & Peral, 2020a).

Latent factor means are not estimated in absolute scores, but instead as an arbitrary adimensional factor mean, reflecting average differences in the level of attitude toward sea fennel products between groups. Since one group factor mean is set to zero, means values may also be interpreted as differences between any given group and the reference group.

In terms of gender differences, men exhibit a significantly more favourable attitude to sea fennel than women. However, this does not translate into higher purchase intentions by men. This is probably the result of men's less positive perception of the product and lower perceived behaviour control. Respondents younger than 45 years old exhibit significantly higher subjective knowledge, subjective norm, and food-related lifestyle scores than older respondents. Urban dwellers also exhibit significantly higher knowledge, better attitude, higher subjective norm, perceived behavioural control, and food-related lifestyle scores. However, perception and intention to buy are not significantly higher neither for the younger nor for the urban consumers. Respondents from Southern Mediterranean countries (IT, TR, TN) exhibit significantly higher latent means for all variables, except attitude, perception, and intention, meaning there are no big differences in the most relevant decision-making variables across the Mediterranean. Similarly, higher objective knowledge implies higher latent means for all variables except the two key ones: attitude and intention.

On the contrary, higher awareness, and – especially – previous experiences with the sea-fennel products (i.e., having tasted it), significantly increase all model constructs' scores: perception, knowledge, attitude, subjective norm, perceived behavioural control, food-related lifestyle and intention to buy.

The overall pooled SEM model is displayed in Figure 23. All coefficients are significant. Attitude depends largely on perception (beliefs) while itself is the second most relevant antecedent of behavioural intention together with the subjective norm. The difference is small, but it is interesting to note that – in the purchase of a complementary food such as sea fennel - for consumers the opinion of relevant others (SN) appears to be equally relevant than their own opinion (Attitude).

Perceived behavioural control as often in the SEM model related to food, appears to explain only a little above 20% of the final behavioural intention, followed by the food-related lifestyle that has a lower (but still significant) impact. Although purchasing sea fennel could be difficult if it is not usually available in local food stores, the evolving online marketplace renders almost any product at the willing consumer reach.

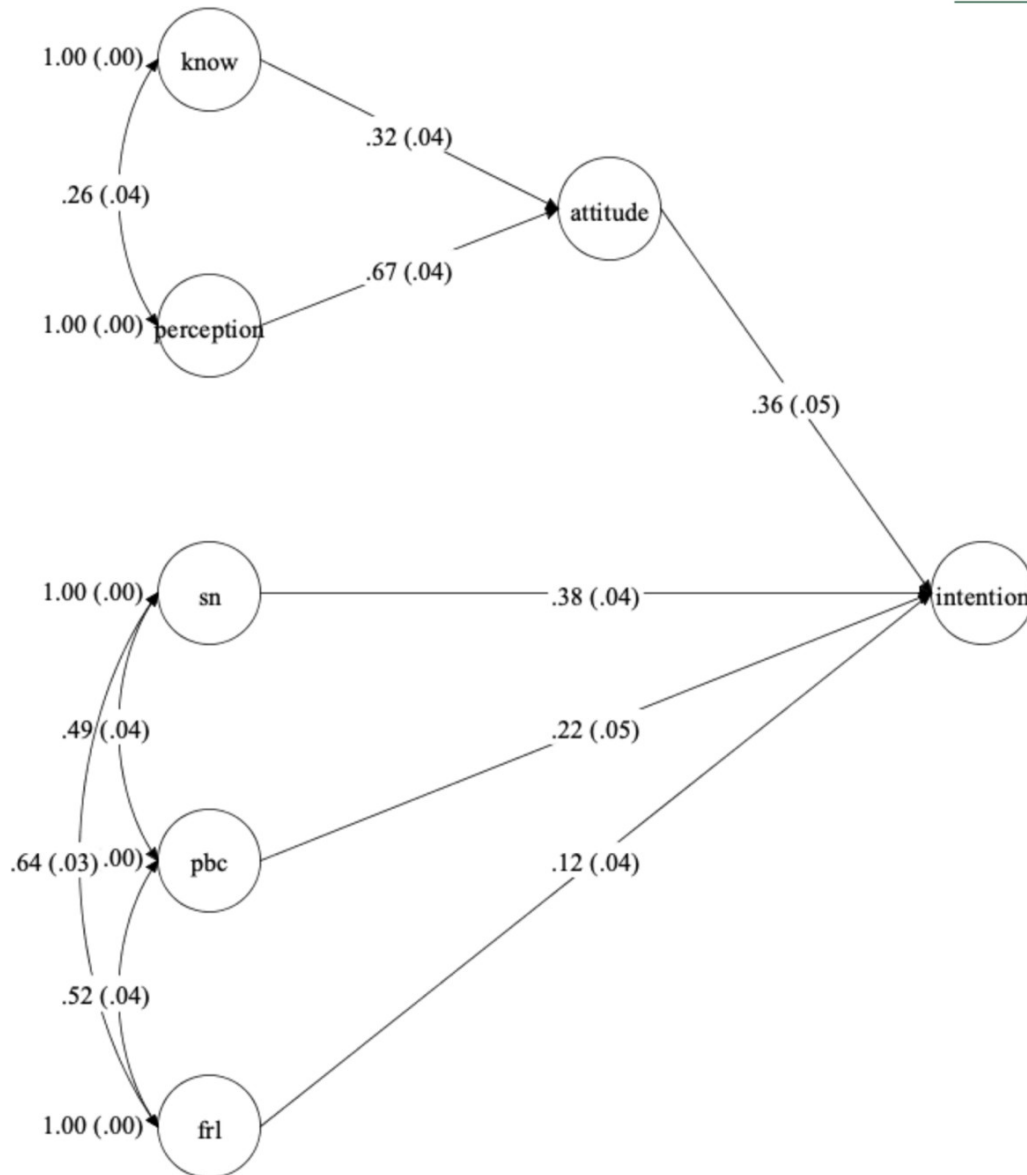


Figure 23. The estimated SEM model

All hypotheses have not been falsified. The model holds and is robust.

## 2.4 Conclusion

Despite being widely available in the Mediterranean region, sea fennel is a product with a low level of consumer awareness. In fact, more than half (54%) of consumers surveyed in the study stated that they had not heard of sea fennel. As a result, the tasting rates in countries other than Tunisia, as well, are less than 50%. Similarly, in all countries except Tunisia, the level of subjective knowledge is below average.

Given the low levels of awareness and knowledge of sea fennel across most of the Mediterranean countries studied, one of the main conclusions of this research is the need for further introduction of the plant to potential consumers.

According to the results, 35% of consumers "somewhat" or "strongly agree" that it is easy to find sea fennel food products, 53% that it is a low-processed product, 56% that it is a pleasant product, 54% that it is a tasty product, 71% that it is a safe

product, 44% that it is an expensive product, 81% that it is a natural product, 77% that it is a healthy product, 69% that it is a sustainable product and 41% that it is a modern product.

These findings as well as the limited consumer awareness confirm the limited availability of sea fennel products in the consumer markets, which requires to be improved. On the other hand, consumers reveal considerably positive attitudes towards the natural, healthy, and sustainable characteristics of sea fennel, when they are given brief information on its properties. Therefore, these features could be underlined in promotional efforts. The results also put forward that sea fennel recipes could be further optimized.

It was determined that a significant portion of the consumers intend to purchase sea fennel primarily fresh. Ensuring the accessibility of fresh sea fennel in organic markets, local markets, and grocery stores is important in the mobilization of the market potential. At the same time, and since it is not a well-known product by consumers, different recipes should be developed in which fresh, pickled and powdered sea fennel can be used. Establishing tasting stands for these products in the markets where the product is sold is important in terms of increasing awareness.

The usage areas of this product should be increased in the health and cosmetics sector as well as in the food sector. Explaining the health benefits of this product by experts through radio, television, and social media is an important key point for the recognition of the product.

Market segmentation, targeting, and positioning strategies should be developed to reveal possible trends towards sea fennel. It is possible to develop different marketing strategies since consumers in each country have different personal characteristics such as education, age, employment status, geographical origin, and their levels of awareness and knowledge of this product, attitudes, purchasing intentions, and behaviours.

The SEM results show that if the product is not previously known or experienced there will be hardly a relevant purchase intention.

Besides, purchase intention highly depends on attitude, but – most importantly - on peer pressure, so the perceptions of others are also significant.

This again shows the importance of better communicating the product benefits, increasing product awareness and knowledge beyond the current niche, while possibly organizing testing events and using word-of-mouth and social (media) networks to increase purchase intentions and, consequently, behaviour.

## 3 Report on Business Model Evaluation

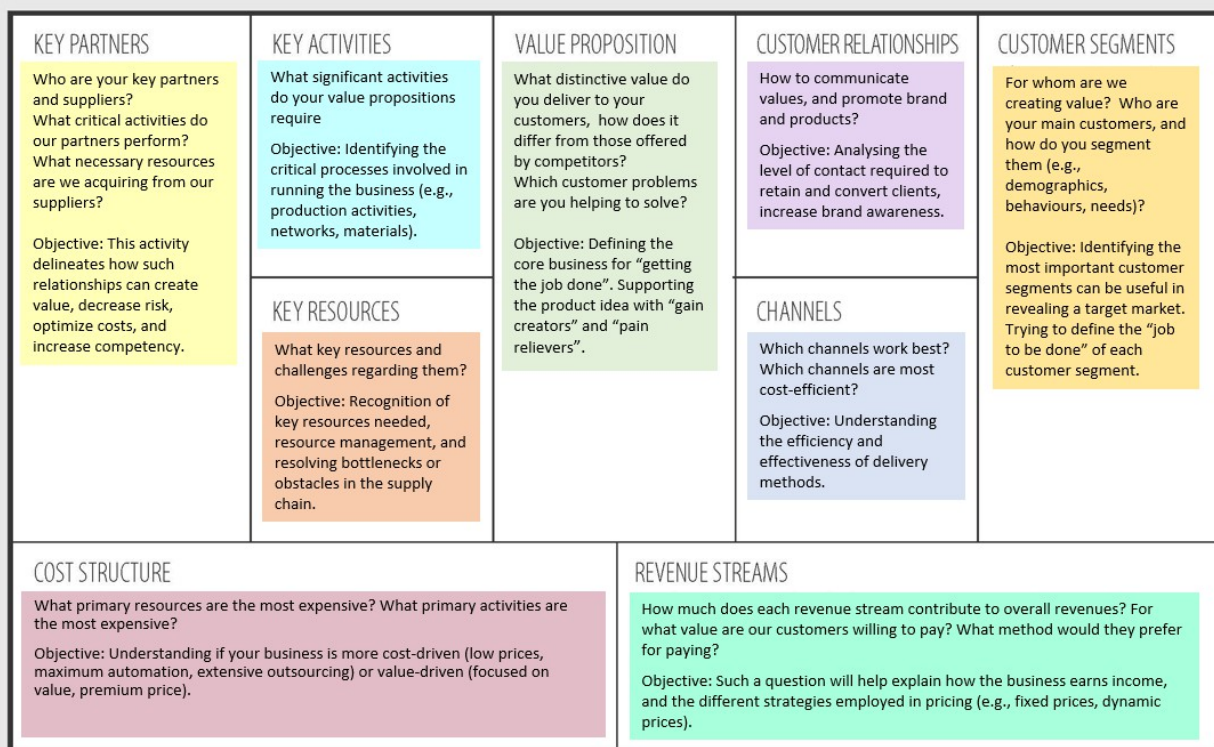
### 3.1 Material and Methods

#### 3.1.1 Business Model Canvas (BMC) and Value Proposition (VP)

Alternative business models for the sea fennel supply chain were evaluated using Osterwalder's Business Model Canvas (BMC) and Value Proposition Canvas (VPC) (Osterwalder et al., 2014; Osterwalder & Pigneur, 2009), with a participatory approach to integrate stakeholder insights. These tools are essential for sustainable product development as they provide a structured approach to understanding and designing business strategies.

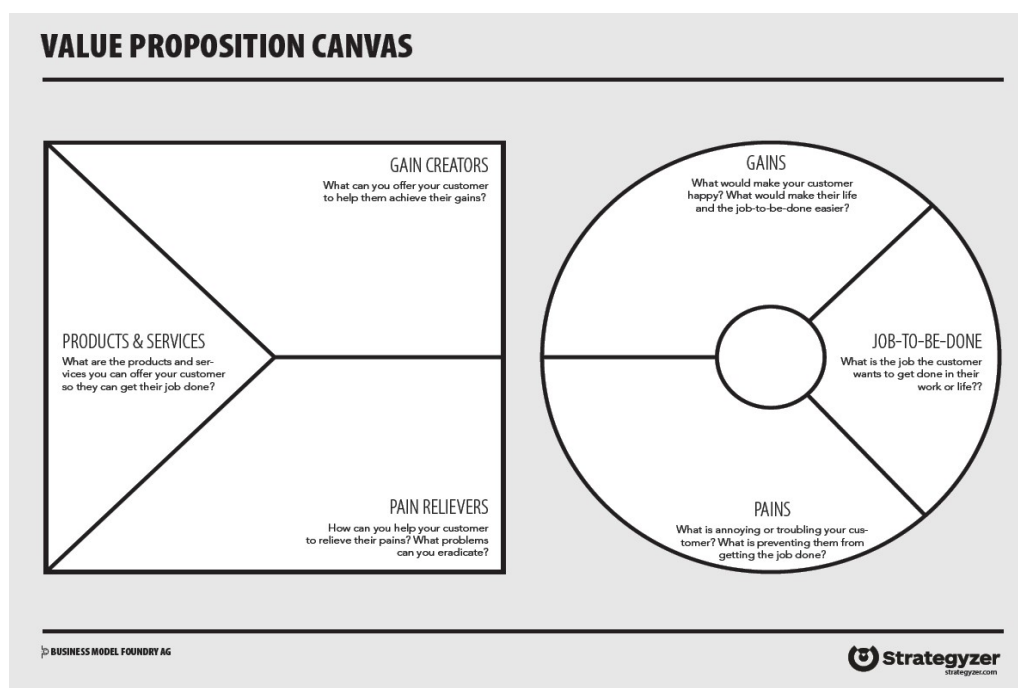
According to Osterwalder and Pigneur (2009), a business model (BM) outlines the rationale for how an organization creates, delivers, and captures value. They describe BM through nine fundamental building blocks that illustrate the logic of how a company plans to generate revenue. These nine blocks include four primary areas of a business: customers, offerings, infrastructure, and financial viability. They are presented in a one-page tool known as the BMC. Similar to a painter's canvas, it enables the visualization of new or existing business models. It is possible to work together with different partners on the BMC to generate, refine, and enhance business ideas or to organize diverse data in alignment with specific business goals. See Figure 1 for the BMC together with the details of each block.

### BUSINESS MODEL CANVAS



**Figure 1. Business Model Canvas** (Osterwalder & Pigneur, 2009; [strategyzer.com](http://strategyzer.com))

To design products or services for customers, it is recommended to begin planning the business model from the value proposition. The value proposition emphasizes delivering unique benefits to customers. To support and facilitate this process, the Value Proposition Canvas (VPC) was developed (Osterwalder et al., 2014). The VPC consists of two components: the Value Map and the Customer Profile. The Value Map provides a structured and detailed illustration of the key attributes of a value proposition, breaking it down into products and services, pain relievers, and gain creators. On the other hand, the Customer Profile focuses on a specific customer segment, offering a detailed breakdown of the customer's jobs, pains, and gains (see Figure 2).



**Figure 2. The Value Proposition Canvas** (Osterwalder, et al. 2014; [strategyzer.com](http://strategyzer.com))

The BMC and VPC together guide businesses in developing products that align with customers' expectations. In this study, both tools were used for data collection and outlining the business strategies for sea fennel products.

### 3.1.2 Data collection

Data collection was carried out in two phases: expert workshops and a stakeholder validation survey. The first phase involved two separate workshops, each with the participation of 10-12 experts, with a focus on two types of sea fennel-based product development:

1. Sea fennel-based food products: This workshop focused on the potential of sea fennel in developing new food products and exploring its consumer acceptance.
2. Sea fennel-based nutraceuticals: This workshop brought together experts to explore the potential of sea fennel in the nutraceutical market, discussing its health benefits, formulations, and applications in supplements.

In each workshop, a moderator and an assistant were engaged to guide the discussion according to the

components of BMC and VPC. Participants were asked to express their opinions verbally, and all ideas were captured on canvases using post-it notes (See Figure 3). Except for Cost Structure and Revenue Streams, all blocks of BMC were discussed.



**Figure 3. Images from expert workshops**

The second stage included the stakeholder validation survey. The question form used in this survey was prepared based on the information gathered during the workshops (See Annex 1 for the survey questions). Each question in the survey corresponded to one of the building blocks of the business model – except Cost Structure and Revenue Streams- and all items to be rated or ranked under the questions reflected the results of the workshops. The aim was to validate the findings from the workshops, ensuring that the proposed ideas and market potential for each concept were aligned with stakeholders' views. A total of thirteen stakeholders, including various experts such as farmers, public administrators, certifiers, retailers, and academics, responded to the survey.

## 3.2 Results

### 3.2.1 Sea fennel-based food products

The BMC for sea fennel-based food products, derived from workshop results and validated through the expert survey, is presented in Table 1. Answers are listed according to their level of importance within each block of the BMC. Quantitative results of the survey are given in Annex 2 in detail.

*Table 1. BMC for sea fennel-based food products*

| Key Partners                                                                                                                                                                                                                                                                                                                                                                                                                                          | Key Activities                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Value Propositions                                                                                                                                                                                                             | Customer Relationships                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Customer Segments                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>✓ Processors</li> <li>✓ Scientists and research institutions</li> <li>✓ Promoters/Advertisers</li> <li>✓ Farmers/Collectors</li> <li>✓ Packaging companies</li> <li>✓ Restaurants and/or chefs</li> <li>✓ Distributors for delivering final products</li> <li>✓ Certifiers for product verification</li> <li>✓ Retailers for reaching targeted customers</li> <li>✓ Schools</li> <li>✓ Transporters</li> </ul> | <ul style="list-style-type: none"> <li>✓ Consumer education/product promotion</li> <li>✓ Crop production</li> <li>✓ Processing sea fennel into finished food products</li> <li>✓ Promoting sea fennel products to chefs and restaurants</li> <li>✓ Permanent supply of sea fennel through contracted farming</li> <li>✓ Distribution of sea fennel food products</li> <li>✓ Managing a professional website for online sales</li> <li>✓ Planning and management of the collection of wild sea fennel</li> <li>✓ Transportation of sea fennel</li> </ul> | <ul style="list-style-type: none"> <li>✓ Distinct taste and flavour</li> <li>✓ High nutritional value (e.g., vitamin C)</li> <li>✓ Healthy product</li> <li>✓ A cultural value</li> <li>✓ A sustainable food option</li> </ul> | <ul style="list-style-type: none"> <li>✓ Promotions through show cooking events</li> <li>✓ Websites of companies with recipes and nutritional information of sea fennel</li> <li>✓ Promotional events in supermarkets and gastronomies offering free tastings of sea fennel-based products</li> <li>✓ Product labels with QR codes linked to websites providing information</li> <li>✓ Newsletter campaigns</li> <li>✓ Online assistance for ordering sea fennel products</li> </ul> | <ul style="list-style-type: none"> <li>✓ Chefs looking for innovative dishes</li> <li>✓ Tasters of delicacies interested in niche/artisanal products</li> <li>✓ Tourists interested in local foods</li> <li>✓ Consumers interested in local foods</li> <li>✓ Young consumers interested in healthy foods</li> <li>✓ Middle-aged consumers interested in healthy foods</li> <li>✓ Consumers interested in sustainable products</li> <li>✓ Vegetarian and vegan consumers</li> </ul> |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>Key Resources</b> <ul style="list-style-type: none"> <li>✓ Creative marketing teams</li> <li>✓ Specialized teams for product development</li> <li>✓ Resources for primary production</li> <li>✓ Educational teams about sea fennel</li> <li>✓ Dedicated experts for e-commerce</li> <li>✓ Laboratories</li> <li>✓ Sensory panel to test proposed recipes</li> <li>✓ Packaging materials</li> </ul>                                                                                                                                                   |                                                                                                                                                                                                                                | <b>Channels</b> <ul style="list-style-type: none"> <li>✓ Specialty/healthy food/delicatessen shops</li> <li>✓ Online sale</li> <li>✓ Restaurants</li> <li>✓ Shops located in tourist areas</li> <li>✓ Supermarkets</li> <li>✓ Food fairs</li> <li>✓ Shops/kiosks in airports or harbours</li> </ul>                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Cost Structure</b>                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Revenue Streams</b>                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| -                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | -                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

Value propositions: The most significant value propositions of sea fennel validated by experts were its distinct taste and flavour, high nutritional value (e.g., Vitamin C content), and potential as a healthy product. Additionally, the cultural value of sea fennel, reflecting traditional and local uses, and its promise as a sustainable food option, were highlighted among the key attributes.

Customer segments: Experts ranked chefs seeking innovative dishes and tasters of delicacies interested in niche/artisanal products as the top customer segments that can be interested in sea fennel-based food products. Tourists interested in local foods and consumers focused on locally sourced products followed them. Additionally, young consumers and middle-aged consumers were mentioned by the experts, highlighting the demand for healthy products. Consumers interested in sustainable products and vegetarian/vegan consumers were the last groups indicated as potential consumer segments. These groups can be interested in sea fennel

food products due to their prioritization of sustainability and plant-based choices.

**Channels:** The importance of channels varies across customer segments, but specialty/healthy food/delicatessen shops and online sales were ranked as the top two channels overall. Specialty/healthy food/delicatessen shops were deemed particularly important by chefs seeking innovative dishes and customers looking for local, healthy, and sustainable food options. Restaurants were considered important, especially for segments such as chefs, tourists, and tasters of delicacies. Supermarkets and food fairs were identified as key channels for middle-aged and young consumers interested in healthy foods, as well as vegetarian and vegan consumers. Shops and kiosks in airports or harbours were rated as less important channels.

**Customer relationship:** According to expert ratings, the most effective customer relationship included promotions through show cooking events, followed by websites offering recipes and nutritional information. Promotional events in supermarkets and gastronomies providing free tastings were also highly rated. While product labels with QR codes linked to informational websites were considered significant, other methods, such as newsletter campaigns and online assistance for ordering products, received lower ratings.

**Key resources:** Creative marketing teams for promoting sea fennel products and specialized teams for product development were ranked as the most crucial key resources for sea fennel-based food products. Resources needed for primary production (e.g., land, labour, and capital) and educational teams providing information about sea fennel followed them. Dedicated experts for e-commerce, laboratories for analysing and certifying nutritional content, and sensory panels for testing recipes were also mentioned as essential resources. Although packaging materials are necessary for preserving and presenting products, they are considered less important compared to other resources.

**Key activities:** Experts ranked consumer education and product promotion to consumers as the most important key activities for sea fennel-based food products. This was followed by crop production (involving growing and harvesting of sea fennel) and the processing of sea fennel into finished food products. Promoting sea fennel products to chefs and restaurants is also considered highly important. Other key activities, according to level of importance, are as follows: Ensuring a permanent supply of sea fennel through contracted farming, distributing products to various sales points, managing a professional website for online sales, planning and managing the collection of wild sea fennel, and transportation of sea fennel.

**Key partners:** The most important key partners were processors for transforming sea fennel into final products and scientists and research institutions for product optimization. Promoters and advertisers, including food influencers and bloggers, were considered important for reaching consumers. Following, farmers and collectors, who source the sea fennel, were ranked as the other most important key partners. Packaging companies ensuring proper packaging, laboratories testing products, and transporters were ranked as less important compared to other partners, but remained important for the operational aspects of the business.

### 3.2.2 Sea fennel-based nutraceuticals

Similar to the previous section, the results obtained from the workshop and the survey were given in the BMC for sea fennel-based nutraceuticals (Table 2). Answers are listed according to their level of importance within each block. See Annex 3 for the detailed survey results.

*Table 2. BMC for sea fennel-based nutraceuticals*

| Key Partners                                                                                                                                                                                                                                                                                             | Key Activities                                                                                                                                                                                                                                                                                                                                               | Value Propositions                                                                                                                                                                                                                                                                                  | Customer Relationships                                                                                                                                                                                                                                                                                                                                                              | Customer Segments                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>✓ Food processors</li><li>✓ Farmers/Collectors</li><li>✓ Scientists and research</li><li>✓ Seed producers</li><li>✓ Pharma companies</li><li>✓ Nutraceutical labs</li><li>✓ Certifiers</li><li>✓ Cosmetic companies</li><li>✓ Packaging/capsul companies</li></ul> | <ul style="list-style-type: none"><li>✓ Product formulation (research &amp; development)</li><li>✓ Certification (e.g., organic, health claims)</li><li>✓ Quality control</li><li>✓ Intellectual property (IP) protection of formulation</li><li>✓ Packaging</li></ul>                                                                                       | <ul style="list-style-type: none"><li>✓ The organic and sustainable production of sea fennel</li><li>✓ Vitamin C content</li><li>✓ Anti-diabetic properties</li><li>✓ Providing nourishment for healthy skin</li><li>✓ Anti-aging properties</li><li>✓ Weight loss benefits of sea fennel</li></ul> | <ul style="list-style-type: none"><li>✓ Providing guidance through nutritionists</li><li>✓ Informing consumers through health specialists</li><li>✓ Promotion of the product benefits by influencers or brand ambassadors</li><li>✓ Online communities or forums where consumers can share experience</li><li>✓ In-store consultations by health professionals or experts</li></ul> | <ul style="list-style-type: none"><li>✓ Healthy food lovers</li><li>✓ Sports people interested in improving their performance /recovery</li><li>✓ People suffering from illness</li><li>✓ Food innovators interested in new tastes/ingredients</li><li>✓ Women interested in healthy products</li><li>✓ Mothers supporting their children's health</li><li>✓ Students seeking quick and affordable supplements</li></ul> |
|                                                                                                                                                                                                                                                                                                          | Key Resources                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                     | Channels                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                                                                                                                                                                                                                                                                                                          | <ul style="list-style-type: none"><li>✓ Production in suitable areas (e.g., regions with the right climate and land)</li><li>✓ Qualified workers with expertise</li><li>✓ Laboratories for testing product quality and safety</li><li>✓ Seed production</li><li>✓ Processing facilities with adequate equipment (e.g., evaporators, freeze dryers)</li></ul> |                                                                                                                                                                                                                                                                                                     | <ul style="list-style-type: none"><li>✓ Online sale</li><li>✓ Organic and other specialized shops</li><li>✓ Pharmacists</li><li>✓ Women communities</li><li>✓ Health centres</li><li>✓ Yoga centres</li><li>✓ Beauty/hair salons</li></ul>                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Cost Structure                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                     | Revenue Streams                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                          |
| -                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                     | -                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                          |

**Value propositions:** The results highlighted several key benefits of sea fennel as a nutraceutical, with the most valued properties being organic and sustainable production, which can align with consumer demand for environmentally responsible and natural ingredients in nutraceutical products and high vitamin C content. Experts emphasized that sea fennel nutraceuticals can be promoted for a healthier and more youthful lifestyle. Its anti-diabetic properties and skin-care abilities were mentioned as important value propositions. Additionally, its anti-aging and weight loss benefits were also pointed out.

**Customer segments:** Healthy food lovers were indicated as the potentially most interested consumer segment for sea fennel-based nutraceuticals, followed by sports enthusiasts focusing on their performance and recovery. In addition, individuals suffering from illness, food innovators seeking new ingredients, and women interested in healthy products were ranked among the key groups. While mothers supporting their children's health and students seeking quick, affordable supplements are also relevant, they were ranked less important in the validation survey.

**Channels:** Online sales and organic or specialized shops were rated as the most crucial channels for all customer segments. However, for consumers suffering from health conditions, pharmacists emerged as the primary channel, followed by online sales and health centres. Although other channels, including women's communities, yoga centres, and beauty/hair salons were considered as significant channels during the workshops, they were ranked less important during the expert validation.

**Customer relationships:** The results revealed that nutritionists and health specialists can help build strong customer relationships and effectively market sea fennel as a nutraceutical. Detailed information on the product's benefits, ingredients, and personalized recommendations provided by experts was considered crucial to build a trust-based customer relationship. Promotion of product benefits by influencers or brand ambassadors was rated next, as they effectively engage with a wide audience and build brand credibility. Although online communities or forums, where consumers can share experiences, and in-store consultations by health professionals or experts were mentioned as important, they received lower ratings compared to other options in the expert survey.

**Key resources:** The most important key resource for sea fennel-based nutraceuticals included production in suitable areas, such as regions with the right climate and land, ensuring optimal growth conditions. Qualified workers with specialized expertise were ranked in the second place as they are needed for the product development and process. Additionally, laboratories for testing product quality and safety were mentioned in key resources to ensure that the final product meets necessary standards. Despite their lower ranking in the survey, seed production for the sustainable growth of the sea fennel market and processing facilities equipped with advanced equipment, such as evaporators and freeze dryers, were also considered among the key resources.

**Key activities:** Product formulation (research and development) and certification were ranked as primary activities to ensure high-quality, safe, and regulatory-compliant sea fennel-based nutraceuticals. These are followed by quality control and intellectual property (IP) protection of formulations to maintain a competitive advantage. Product packaging was ranked as less important compared to other activities.

**Key partners:** Food processors, who transform the sea fennel into final products, and farmers/collectors, who source the raw material, were determined as the most important key partners in developing sea fennel-based nutraceuticals. They are followed by the scientists and research institutions contributing to product optimization. Additionally, seed producers can ensure a consistent, high-quality seed supply, and pharma companies can play a key role in distributing nutraceuticals. Finally, nutraceutical labs for testing, formulating, and optimizing products, certifiers ensuring product quality and compliance with standards, cosmetic companies developing beauty and skincare products, and packaging/capsule companies responsible for ensuring proper packaging were mentioned among the other key partners.

### 3.3 Conclusion

In this study, BMCs and VPCs for both “sea fennel-based food products” and “sea fennel-based nutraceuticals” markets were generated based on the findings of stakeholder workshops. In addition, these preliminary models are revised through an online expert validation survey.

Sea fennel has a distinctive taste and flavour with high nutritional value. It is a healthy product containing valuable compounds. These properties should be considered as principal value propositions for attracting the attention of different consumer segments and gaining an advantage in the food market. The target consumer groups for sea fennel-based food products include innovative chefs, health-conscious consumers, gourmet enthusiasts, and tourists. Distribution channels like specialty/health food shops, online platforms, and restaurants will increase visibility and stimulate demand. These products are expected to be most effectively promoted to consumers through show cooking events, free tasting opportunities, creation of websites containing recipes and nutritional information, and informative packaging such as those with QR codes. Successful development of the sea fennel-based foods market requires raising consumer awareness, laboratory testing, and agricultural partnerships to ensure supply chain reliability. Addressing the existing awareness gap through creative marketing and forming strategic partnerships along the supply chain, from primary crop production to final product optimisation, will be essential for the development of the sea fennel market.



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Concerning the nutraceutical market, the most prominent value proposition of sea fennel is its organic and sustainable production. Therefore, maintaining and improving these properties of sea fennel production as well as communicating this information to consumers are of crucial importance to align with consumers' increasing demand for environmentally responsible and natural ingredients in nutraceutical products. Furthermore, the high vitamin C content, anti-diabetic properties, skin care abilities, anti-ageing, and weight loss benefits of sea fennel should be highlighted in product development and promotion. Although sea fennel-based nutraceutical products appeal to different consumer segments, potential consumers of these products include those who prioritise health and wellness. Distribution should focus on organic or specialized stores, online channels, and pharmacies. Information on the product's benefits and ingredients, as well as personalized recommendations given by the nutritionists and health specialists, can help build strong customer relationships. An adequate supply of sea fennel in terms of quantity and quality, qualified staff, and quality and safety testing laboratories are essential for the business. The formulation of products (R&D) is of great importance for the success.