DISSERTAÇÃO DE MESTRADO

UNDERSTANDING PORTUGUESE CONSUMER ACCEPTABILITY OF SEAWEED-BASED SNACKS

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RESUMO

Não é novidade que a população mundial está a crescer, e que, portanto, de uma forma natural os recursos mundiais estão a ficar cada vez mais escassos. Durante anos a indústria alimentar tem ficado mais competitiva, em que por outro lado, os consumidores expressão mais preocupações em relação aquilo que comem, sobretudo ao ganho nutricional e saudável dos alimentos que ingerem. O consumo de algas é provado como uma alternativa à saturação ambiental resultante da produção de alimentos mais tradicionais, e, portanto, a promoção do consumo de algas urge com grande importância, uma vez que tende a ser uma alternativa saudável e benéfica tanto ao ser humano como ao ecossistema do planeta, promovendo a sustentabilidade do planeta.

Este estudo tenta validar uma alternativa de consumo de algas: snacks de algas. De forma a entender a aceitabilidade dos consumidores português em relação aos produtos de snacks de algas será tido em avaliado o impacto das variáveis independentes: familiaridade, conhecimento sobre algas, neofobia e certificação e rotulagem dos produtos, na variável independente.

Observa-se que os inquiridos alegam não têm conhecimento suficiente sobre as algas, apesar de já terem alguma experiência previa com estas: ver e comer comida à base de algas.

O produto que mais se destacou foi o snack à base de algas, confirmando que poderá ser uma boa aposta do mercado para ultrapassar as barreiras inerentes ao consumo de algas. Os rótulos surgem também como uma ajuda na escolha de produtos alimentares mais saudáveis, estes podem também ser bastante uteis na propaganda de informação nutricional e saudável dos alimentos à base de algas

ABSTRACT

The world's population is growing and that. As a result, the world's resources are becoming increasingly scarce. Over the years, the food industry has become more competitive, while consumers have become more concerned about what they eat, especially the nutritional and health benefits of the food they eat. The consumption of algae has proven to be an alternative to the environmental saturation resulting from the production of more traditional foods, and therefore the promotion of the consumption of algae is of great importance, since it tends to be a healthy alternative that benefits both human beings and the planet's ecosystem, promoting the sustainability of the planet.

This study attempts to validate an alternative way of consuming seaweed: seaweed snacks. In order to explore understand the Portuguese consumer acceptability of seaweed-based snacks, will be evaluate the impact of the independent variables: familiarity, knowledge of seaweed, neophobia and product certification and labelling, on the independent variable will be assessed.

It was observed that the respondents claimed not to have sufficient knowledge about seaweed, despite having some previous experience with it: seeing and eating seaweed-based food. The product that stood out the most was the seaweed-based snack, confirming that it could be a good bet for the market to overcome the barriers inherent in seaweed consumption. Labelling is also an aid in choosing healthier food products and can also be very useful in spreading nutritional and health information about algae-based foods.

Keywords: seaweed, seaweed consumption, consumer acceptance, consumer attitudes, neophobia, product labelling.

TABLE OF CONTENTS

FIGURE INDEX

TABLE INDEX

1. INTRODUCTION

In fact, the global population is growing, and consequently, the world's resources are becoming scarce, therefore, environmental pressures and climate change mean that the population needs to change the way they approach food and economic systems (European Commission, 2022). For years, the food industry has been registering greater competitiveness and an increasingly global market, while consumers have been expressing more stringent demands and greater concern about the quality and health benefits of the products they buy and consume (Barrena & Sánchez, 2013). As a result, problems such as market saturation and changing consumer preferences arise, which leads producers to develop new products to meet consumer needs and demands to be competitive in the market (Barrena & Sánchez, 2013). Siddiqui et al. (2022), claim that there is growing criticism of meat-based food products as they have a detrimental negative impact on the environment, animal welfare, and public health. As many consumers are progressively becoming aware of these issues, they are starting to adopt a healthier and more environmentally friendly diet (Siddiqui et al., 2022). To address challenges of consumers' environmental and health / physical well-being, Onwezen et al. (2021) point to replacing meat consumption with protein-rich food sources. This opens market space for alternative food products, such as plant-based, algae-based, and insect-based products (Siddiqui et al., 2022)

In fact, algae are beneficial for human health, as pointed out by the Portuguese Nutrition Association report in which it states that algae (macroalgae and microalgae) are an alternative source of protein, fibre, vitamins and minerals, and predicts that in 2054 it will

occupy 11% of the total consumption of alternative proteins (Craveiro et al., 2019). Also, the strategy Farm to Fork Strategy developed by the European Commission highlights the role of algae as an important alternative source of protein, contributing to a sustainable food system and global food security. In the same report presented by the European Commission, it is pointed out that European demand for seaweed could increase from around 270,000 tonnes in 2019 to 8 million tonnes in 2030 and reach a value of EUR 9 billion in 2023 in all sectors, the main ones being food for human and animal consumption and biostimulants for plants (European Commission, 2022). According to Lamont & McSweeney (2021) , as seaweed consumption increases, it may have the potential to reduce the effects associated with dietary diseases, however, it must first be included in food products that are accepted by consumers.

This emerging market still faces the challenges of consumer acceptance of these new and innovative foods (Siddiqui et al., 2022). Despite this encouraging data, barriers have been identified as limiting the growth of this industry, including limited knowledge of the market and consumer needs, thus, there is a need to bridge these gaps in terms of knowledge and data, as well as technology and innovation (European Commission, 2022). However according to Embling et al. (2022) despite the seaweed potential use as a nutritious and sustainable food source, little is known about the acceptability of seaweeds for UK consumers. Onwezen et al. (2021) also state that the acceptance of protein alternatives is relatively low compared to meat consumption. Siddiqui et al. (2022) argue that consumer preferences for alternative and innovative foods are still relatively unknown and uncertain due to the various factors acting on the purchase decision. Therefore, Siddiqui et al. (2022) recognise the need to understand which factors or sensory attributes are related to consumer acceptance of such alternative food products. Understanding the motivations that drive

consumers to eat seaweed is necessary for the development of the most appropriate product and marketing strategies (Young et al., 2022).

With the aim of finding a food product that encourages seaweed consumption by increasing its acceptance Birch et al. (2019) point out that seaweed consumption is linked to consumption as a snack, representing an opportunity for the respective industry to develop a healthy, tasty and convenient seaweed snack that appeals to the market segment. In the same view, Li et al. (2021) state that the commercialization of seaweed food products as snacks is effective because, among the products described, American consumers prefer to buy seaweed snacks, considering the convenience of snack consumption. Young et al. (2022) also reach the same conclusion among young Australians: there is a general acceptability and willingness to consume seaweed in snack form.

That said, the primary objective of this dissertation is to explore the acceptance of seaweed-based snacks among Portuguese consumers. It will also specifically study the following objectives:

1. Determine the influence that familiarity and product knowledge have on neophobia.
2. Determine the influence that familiarity has on product knowledge.
3. Determine the influence of knowledge, familiarity, and neophobia on Portuguese consumers' acceptance of seaweed-based food products.
4. Understand the influence of product labelling and packaging certification on the acceptance of seaweed-based food products in the form of snacks.
5. Identify the typical consumer of seaweed food products in the form of snacks.

Therefore, a quantitative methodology will be used, and data will be collected by the distribution of a survey. The main results of the study show that there is still little familiarity with and knowledge of seaweed consumption among Portuguese consumers; however,

neophobic attitudes do not slow down their acceptance and willingness to try and consume these new foods. It is concluded that the snack product is widely accepted by those surveyed and that it appears to be a viable alternative to the commercialization of these products. In addition, food product labels are also sources of information that help consumers choose healthier products. This study contributes to a general perception of the current acceptance of Portuguese consumers in relation to the consumption of seaweed, and also validates the idea that the commercialization of seaweed in the form of snacks is an effective way of boosting and implementing a more regular consumption of seaweed in the diet of Portuguese consumers.

For that purpose, the following dissertation starts with a literature review. In a nutshell, it´s concluded that the acceptance of seaweed is still very low, and it is influenced by consumer attitudes - with neophobia representing a huge importance on consumer choice-, the consumer also pays attention to the information provided by the product labelling, although sometimes the consumer doesn't have the knowledge to interpret it; and finally, demographics have a significant impact on consumer behaviour towards seaweed consumption, as more education and income could represent a greater willingness to try and to buy which leads to greater acceptance. Afterwards, based on the literature review, the conceptual model and the respective hypotheses are sketched and explained. It´s also demonstrated how the hypotheses will contribute to the objectives studied. The chapter still explains how the data will be collected. The methodology used for this purpose will be quantitative, using a survey. After the data has been collected, it will be analysed, and the appropriate conclusions drawn by comparing it with the studies reviewed. Finally, in the last chapter, the main conclusions will be drawn, as well as the limitations of the study and future investigations.

2. Literature Review

The structure of the literature review is based on three research focuses: consumer behaviour in relation to algae; the impact of product certification and labelling on consumers' purchasing decisions; and the demographic impact in relation to the acceptance of algae-based products. Therefore, the first focus area is divided into the subtitles "Consumer Behaviour" and "Consumer consumption towards seaweed snack products". The former investigates consumer behaviour in general, from the definitions outlined by the authors as well as what affects decision-making and how consumers make decisions to clarifying what food acceptance is and how it is formed. Next, in the same subtitle, the consumer's attitudes towards willingness to buy are addressed in a more general way, i.e., without focusing on seaweed consumption, namely knowledge, familiarity, and neophobia. The second title, "Consumer consumption towards seaweed snack products", addresses the same issues as the previous one, but with a focus on seaweed consumption and everything related, such as healthy foods, organic foods, and superfoods, among others. After this, the impact of product certification and labelling on consumer behaviour is dealt with under the subheading 2.3 "Certification and labelling impact on seaweed consumption", which presents several of the authors' opinions on the importance given to this variable, as well as some forms of labelling and the impact they have on consumer behaviour. The literature review on the demographic impact on the acceptance of seaweed consumption is presented in subheading 2.4 "Demographic Impact", in which the most decisive demographic characteristics are pointed out based on the literature review and the conclusions regarding the typical consumer of the various studies in the articles are

detailed. At the end, a summarized table is presented with the definitions of the main concepts of the literature review.

2.1. Consumer Behaviour

Consumer behaviour is the study of the processes involved when individuals or groups select, purchase, use, or dispose of products, services, ideas, or experiences to satisfy needs and desires (Solomon, 2017, p.28). Being the consumer the individual who identifies a need or desire when faced with issues that influence the purchase decision process in its before, during and after (Solomon, 2017). For Pachauri (2001), in the marketing context, the term "consume" refers not only to the act of purchase itself but also to patterns of aggregate buying, which include pre-purchase (activities that consist of the growing awareness of need or want and the search for evaluation of information about the products that might satisfy it) and post-purchase (activities that evaluate the purchased item in use and the reduction of any anxiety that accompanies the purchase of expensive and infrequently bought items).

When the consumer recognises an unfulfilled need and believes that a product will satisfy it, they have created a want (Stankevich, 2017). Thus, once a person recognises and admits to having a consumer problem, it must be defined in such a way that the consumer can initiate some buying action that will bring a solution (Bruner & Pomazal, 1988).

According to Blackwell et al. (2005) the consumer begins by defining the product image in his mind, with associations to symbols, people, advertising campaigns, product features and attributes, then he examines what he knows about the product, including its attributes and associations with the product. This knowledge encompasses the product purchase as well as its consumption and use, at the first stage the consumer analyses the information they

have about the product, such as price, when and where to buy, while at the second stage the consumer uses the information in his memory about how the product can be consumed and what is necessary to actually use it (Blackwell et al., 2005). Thus, according to Blackwell et al. (2005) one of the main barriers to the consumption of a certain product is the lack of information that the consumer holds about the respective product. The consumer acquires knowledge of consumption through a variety of sources, the opinion of other individuals, or by sources of information, even so, one of the most reliable sources of knowledge for the consumer is his experiences (Blackwell et al., 2005).

The choice of food, in the opinion of Ahmed et al. (2020) is influenced by a number of factors including demographic characteristics such as age, sex, education level, health status, and income and time constraints. And by factors associated to the product's attributes such as price, taste, and information obtained from its label Sunelle et al., 2010 cited by Ahmed et al., 2020), p. 3). Also Nestle et al. (1998) affirms that many factors, ranging from biological to anthropologic, interact in complex and changing ways to influence the development and maintenance of food choice. According to Cardello (1994) food acceptance is understood as a hedonic response to evaluate the perception of the product's final integration of sensorial information with higher-order variables. That hedonic response falls on the continuum of 'pleasantness/unpleasantness' or 'like/dislike', and is interpreted as phenomenological experience (Cardello, 1994). L. L. Birch (1999) understand that preference refers to the selection of one item over others, and that food preference are learned via experience with food and eating. Eating preferred foods is a major source of pleasure, and fear of having to give up eating preferred foods is reported as a major obstacle to consuming healthier diets (L. L. Birch, 1999). In the perspective of L. L. Birch (1999), the human predisposition bias makes them like sweet and salty foods, but it doesn't have to be that way. Humans are predisposed to learn to prefer energy-dense foods over those that are

more energy-dilute, and for new foods, especially those that are not sweet or salty, they will initially be rejected because of neophobia (L. L. Birch, 1999). This analysis according to L. L. Birch (1999) suggest why "healthy" foods such as complex carbohydrates vegetables, which are neither sweer, salty, nor energy dense, are initially rejected by children. According to Gil & Soler (2006) consumers will choose healthy foods if the perceived marginal benefit of improving their diet or preserving the environment is higher than the marginal cost of buying that product. The perceived marginal benefit will depend on the information that consumers have about food products, even though the level of knowledge will be determined by factors that affect the expected value or the costs associated with purchasing it (Gil & Soler, 2006). Therefore, product choice depends on both tangible and intangible attributes, making the purchase process more complex, especially for neophobic consumers (Barrena & Sánchez, 2013).

Forbes et al. (2016) state that there are several characteristics that consumers evaluate when making a decision about a particular snack, thus dividing them into intrinsic factors such as taste or flavour, texture, energy, and satiety, and extrinsic factors such as advertisements and promotions, price, brand name, and product package. Another important factor in healthy snack choice is the perceived availability of purchase and preparation of the healthy snack, thus, for American college consumers, cost and availability of purchase, as well as various modes of preparation and storage of the product, are important factors in choosing healthy snacks (Lambert et al., 2020). Forbes et al. (2016) state that the snack industry should pay special attention to segmentation, taking in account demographics variables, namely in relation to the gender of the consumer, which, according to the authors, has an impact on the value perceived by the consumer in terms of intrinsic and extrinsic elements of the snack. Forbes et al. (2016) also suggest that younger consumers are more

likely to snack for the simple fact that younger people are easily bored, and therefore snacking is just one of the ways they alleviate this condition.

Piha et al. (2018) state that willingness to buy, a variable referring to a consumer behaviour, is determined by general attitudes. These attitudes are distinctively grouped into behavioural, cognitive, and affective components (Breckler, 1984). On one hand, behavioural components include past actions, behaviours, or experiences in relation to the stimulus (Breckler, 1984). Therefore, familiarity with the product or experiences related to the product is a behavioural antecedent of attitude (Breckler, 1984; Piha et al., 2018). On the other hand, cognitive components refer to beliefs and cognitive structures such as subjective knowledge and/or objective knowledge associated with the stimulus (Breckler, 1984; Piha et al., 2018. That being said, objective knowledge is the exact information about the class of products stored in the individual's long-term memory, in which deeper information is processed and where the individual thinks about the meaning of the stimulus and relates it to the information already retained (Kotler & Keller, 2012; Piha et al., 2018; Solomon, 2017. In contrast, subjective knowledge is an individual's perception of what or how much they know about a product class (Park et al., 1994). In the same sense Gil & Soler, (2006) state that the higher the knowledge, the higher the probability of market participation. Affective components are associated with emotional responses to the stimulus, such as neophobia towards food, and can be measured through physical monitoring or by collecting reactions, comments, feelings, or moods (Breckler, 1984; Piha et al., 2018).

According to Blackwell et al. (2005) product knowledge is a key aspect in the purchase decision process since before a product becomes part of the consideration set, needs to be in the consumer's memory, so according to Blackwell et al. (2005) it is essential to gain awareness among consumers, especially when it comes to new products. By understanding consumer knowledge, it is possible to identify which knowledge gaps exist, i.e., to identify

which knowledge gaps reflect the absence of information in their memory, which are not only limited to whether the consumer knows that the product exists or not, but also reflect on the lack of knowledge about its most important associations and attributes (Blackwell et al., 2005). In addition, the consumer may have a misperception about the product that is often fuelled by consumer misinformation, thus representing a barrier to the consumption of the product, furthermore it can modify the image of the product in the consumer's mind (Blackwell et al., 2005).

Considering the complex process that a product or brand faces to affirm itself in the consumer's memory, and the importance it has during the purchase decision process, particularly in the pre-purchase phases, Blackwell et al. (2005) points out five different types of knowledge - subset of the total information stored in the consumer's memory that is relevant to the purchase and consumption of the product - namely product knowledge, product attributes and association, purchase knowledge, consumption and use knowledge and persuasion knowledge. For Park et al. (1994) knowledge assessment is based more on product related experience memory in form of information search, product usage, and/or ownership than on the memory for product class information.

Piha et al. (2018) refer to familiarity as a behavioural antecedent of attitude. For Alba & Hutchinson (1987) familiarity is the number of product experiences that have been accumulated by the consumer. That products related experience can include advertising exposures, information search, interactions with salespersons, choice and decision making, purchasing, and product usage in various situations (Alba & Hutchinson, 1987).

Tuorila & Hartmann (2020) state that neophobia is one of the main barriers to wider consumer acceptance of alternative food sources and foods. Barrena & Sánchez (2013) define neophobia as the rejection of new or unfamiliar food by certain consumers. According to L. L. Birch (1999) food neophobia is manifested by omnivores, including

humans, in the avoidance of new foods and serves a protective function. The neophobic response function is concerned with learning mechanisms that serve to reduce initial neophobic reactions: predisposition to learn preferences and versions (L. L. Birch, 1999). However, with experience, learning can transform the initial neophobic rejection of a new food into a preference (L. L. Birch, 1999). Neophobia can manifest itself in two ways, it can be a momentary reaction in a particular situation, or it can be something linked to the personality trait of the human being (Barrena & Sánchez, 2013). Naturally, the most neophobic consumers have difficulties accepting new foods (Henriques et al., 2009). Also Barrena & Sánchez (2013) conclude that the higher the levels of neophobia, the greater the reluctance to consume new food. Regardless of levels of neophobia, consumers consume innovative foods primarily for hedonic reasons (the flavour and satisfaction it provides), ease of preparation, nutritional value and quality, and for the boost to their quality of life and safety, in addition to enabling them to eat properly (Barrena & Sánchez, 2013).

2.2.Seaweed snack products Consumer Behaviour

2.2.1.Seaweed as food source

According to the UN Food and Agriculture Organisation report, algae (macroalgae and microalgae) are photosynthetic aquatic organisms (Food and Agriculture Organization of the United Nations, 2021). Seaweeds are autotrophic organisms of simple structure, with little or no cell differentiation and complex tissues, and are therefore thallophytes (Peñalver et al.,

2020). They are taxonomically categorised into three groups: *Chlorophyta*, *Phaeophyceae* and *Rhodophyta*, corresponding to green, brown, and red algae, respectively (Peñalver et al., 2020). Although algae exhibit very similar characteristics to aquatic and terrestrial plants, they are not classified as true plants (Lamont & McSweeney, 2021). However, some of the rich nutrients in algae cannot, according to Pandey et al. (2020), be obtained from terrestrial plants.

"Edible seaweed represents one of the trendy foods in the market. Their nutritional and health characteristics adapted to our prevailing living conditions explain why edible algae are being labelled as "superfood."" (Losada-Lopez et al., 2021, p.1). Seaweed is a nutrient-rich food with many healthy components, as this food is a source of fibre and minerals, almost a complete protein, and is low in fat (Lamont & McSweeney, 2021). Moreover, Govaerts & Ottar Olsen (2023) state that algae have a high potential as a natural, healthy, and sustainable food source. Due to their rich biochemical and antioxidant properties, seaweeds are important not only for the nutraceutical and pharmaceutical industries, but also for the food and beverage industries (Pandey et al., 2020). However, seaweed is considered a novel food in Western countries, and therefore few studies, according to Govaerts & Ottar Olsen (2023), have focused on the influencing factors on consumer behaviour towards this type of novel food. Peñalver et al. (2020) conclude that algae can be considered interesting natural sources for various purposes since they contain compounds with numerous biological properties, such as antioxidant, anti-inflammatory, anticancer, and antidiabetic, among others. In addition, they can be used as functional ingredients in various technological applications to obtain functional foods (Peñalver et al., 2020).

2.2.2.Consumer consumption toward seaweed snacks products

Embling et al., (2022), state that seaweed consumption in Western countries remains low and that not much is known about the individual acceptability to its consumption. Nevertheless, Embling et al. (2022) state that most English participants show an acceptability to eating seaweed-based food products, especially hypothetical products such as sushi, hamburger, biscuits, and others. At another study develop by Palmieri & Forleo (2022) 75% of respondents had heard about the edibility of seaweed, although only 57% had eaten seaweed - a number that they denote as being relatively low, yet 77% show a willingness to eat seaweed products, which demonstrates the high acceptance among Italian consumers. Hence also Palmieri & Forleo, (2022) conclude that there is indeed a potential market for seaweed-based food products in the Italian market, but that information on their organoleptic and nutritional characteristics, past experiences, and positive dispositions towards seaweed are crucial factors to improve consumer acceptance. From another continent's perspective, Li et al. (2021) concur that there is a potential market in the United States of America for the commercialisation of seaweed as a food product, as 36% to 43% of participants chose to buy at least one of the seaweed products presented (seaweed salad, seaweed pasta and seaweed snacks). Birch et al. (2019) justify the success of algae-based snack development by the fact that snack consumers are unlikely to believe they will gain direct health benefits but rather believe they will gain indirect benefits by replacing 'unhealthy' snacks with algae-based snacks.

Grace et al. (2010) state that consumer knowledge of seaweed as a food alternative has a significant and positive relationship with the acceptance of seaweed consumption as a food source. Zafar et al. (2022) also share the same opinion, suggesting that creating and increasing awareness as well as building trust towards functional foods will be helpful in

promoting them among consumers. Embling et al. (2022) add that the acceptability of algae is regularly accompanied by positive evaluations of product attributes. In addition, Yousuf et al. (2019) state that attitudes and beliefs, as well as habit persistence (measured by past and current seafood consumption frequency) significantly influence consumers' purchase intention. On the same view, Kraus (2015) stated that the consumer´s characteristics, such as demographics background and personal motivation to engage in pro-health activities, play an important role in the acceptance of functional food. As well as the socio-demographic characteristics of the consumer, such as gender, education, and age (Kraus, 2015). According Govaerts & Ottar Olsen, (2023) seaweed consumption is associated more with those consumers who support collective values, such as biospherics, rather than those consumers who place more importance on hedonic values. Still, consumers with hedonic values are more likely to consume algae if they perceive algae-based food products as a unique product (Govaerts & Ottar Olsen, 2023). Plasek et al. (2020) add that factors such as communication information, the shape, and colour of the product packaging, the ingredients of the product, the category of the product, as well as its origin, and the taste and other sensory characteristics of the product, influence the consumer when he/she evaluates the product as healthy or unhealthy. Forbes et al. (2016) found that in terms of nutrition when purchasing seaweed-based food snacks, the concentration of sugar and fat in the product is the most important nutritional factor. In addition to these, additives and calories are also considered by consumers, albeit with less impact (Forbes et al. 2016). Furthermore, the production location, quality and labelling of organic food products also influence, yet in a lesser extent, their purchase intention (Katt & Meixner, 2020). The same is confirmed by Kraus (2015): information on the label, such as health benefits and nutrition facts, plays a leading role in making the decision to purchase function food. Additionally for a greater acceptance of novel food products, O. Martins et al. (2022). suggest that it is important to identify pioneer

users since they can influence group behaviour, as these have a range of characteristics that according to O. Martins et al. (2022) are important to influence group behaviour, such as their age, whether they live in rural areas and whether they are university students. Although, for Katt & Meixner, (2020), demographics do not necessarily influence the purchase intention of organic food products, on the other hand, consumer values and attitudes, especially linked to health and the environment, positively influence the purchase intention for such products.

2.2.3.Consumer attitudes towards seaweed consumption

Birch et al. (2019) conclude that the main barriers to seaweed consumption are related to the lack of familiarity and knowledge about this product category, thereby suggesting that the marketing of seaweed in the form of packaging, labelling, and packaging, points of sale and other marketing communication strategies can be points of contact to educate the consumer. Palmieri & Forleo (2022) add that the attention people pay to environmental and healthy aspects related to their food choices and neophobic traits in food consumption are attitudes that influence individuals' willingness to eat seaweed. In addition, Palmieri & Forleo (2022) reflect on the importance of familiarity and experience with novel food as motivators to consume seaweed and the fact that it increases consumer acceptability. In the study conducted by Piha et al. (2018) they concluded that general attitudes, namely: objective and subjective knowledge, past experiences and neophobia towards food, positively relate to the willingness to buy insect-based food products. These results in the study by Piha et al. (2018) are peculiar because unlike the regular purchase of organic food, the purchase of insect-based products is an unfamiliar and new situation for most of the

individuals surveyed, so general attitudes may be a key factor in the willingness to consume insect-based food, unlike the regular purchase of organic products where factors such as sensory taste, price and availability play a greater role in the individual's purchase choice (Piha et al., 2018).

2.2.3.1. Seaweed base food product knowledge

Joshi & Rahman (2015) conclude after an intensive search of articles that, the generality of the studies considered by the authors, demonstrate that the consumers' knowledge about environmental and social problems positively affects their attitudes and the purchase of organic products. Therefore, more information will lead to increased consumer knowledge which in turn can strengthen trust in organic products and reinforce the relationship between attitude and behaviour (Joshi & Rahman, 2015). With the same perspective regarding superfoods, Franco Lucas et al. (2021) argue that nutritional knowledge about superfoods positively influences the consumption of such foods, thus increasing superfood consumption increases the nutrition knowledge about the properties of the respective food. Hansmann et al. (2020) shares the same view in which knowledge and information deficits are critical barriers to the consumption of environmentally and health beneficial products by consumers. Conversely, Gil & Soler (2006) state that there is a negative relationship between objective knowledge and the experience of consuming organic food, a fact that is pointed out with relative surprise by the authors, but which they explain by the existing confusion in the Spanish market about what an organic food product really is. According to Gil & Soler, (2006) individuals who receive information via family or friends and newspapers show better objective knowledge regarding organic food, demonstrating that oral communication

is more effective than written communication. Tuorila et al. (1994) state that verbal information, either the name or description of the ingredients and the product used, improves the acceptability of unfamiliar food. Therefore, consumers who are informed about the benefits and understand the nutritional properties look for foods that fulfil these requirements such as functional foods and superfoods (Franco Lucas et al., 2021). Park et al. (1994) state that in relation to information search, some products have more objectively identifiable and communicable attributes and features than other, leading to less susceptibility to processing biases and difficulties. Regarding demographic variables, Gil & Soler (2006) show that they significantly influence the level of knowledge about organic food: income is negatively related to knowledge, while level of education is positively related to knowledge.

According to the study conducted by Embling et al. (2022), consumers have limited prior knowledge regarding seaweed as a food source, however they are willing to try it, this prior acceptance is influenced by various product attributes such as perceived novelty, edibility, beneficial to health, sustainability, and affordability. Birch et al. (2019) also noted that one of the reasons why some respondents do not eat seaweed is due to a lack of knowledge of the product category, including issues such as how to prepare it, not having recipes, shelf life, what to serve it with, how to store it and where to buy it. Birch et al. (2019), conclude that people who are more aware of the environmental and food safety impact of their food choices are associated with a higher willingness to consume seaweed compared to the rest. In the study carried out by Young et al. (2022) state that the most known form of seaweed consumption among the respondents of their study is in the form of seaweed leaf (*nori*), followed by *wakame* and *laminariales* (*kelp*), in relation to the most consumed form, seaweed leaves (*nori*) stand out, followed by *wakame* and finally and toasted seaweed snacks. Palmieri & Forleo (2022) conclude that people who focus more on algae's organoleptic and nutritional characteristics, as well as its environmental and ethical impact,

are more likely to consume it than others. The same is observed by Lucas et al. (2019) in relation to French consumers in which those who eat seaweed pay attention to the environmental impact of their food choices. In addition, the study developed by Embling et al., (2022) shows that consumers may associate negative connotations with seaweed products and thus reduce their willingness to consume them, particularly those who focus on edibility as the main reason for accepting seaweed as a food source.

2.2.3.2. *Seaweed based food product familiarity*

Birch et al. (2019) assume that the most critical barrier to seaweed consumption is a lack of familiarity and product category knowledge. In the same sense, Palmieri & Forleo (2022) claim that consumers who have had past experiences with edible seaweed are more predisposed to consume it than others. Tan et al. (2016) also found that familiarity with the ingredient has a positive effect on the sensory evaluation that Dutch participants attribute to the food product. In a similar vein, Lamont & McSweeney (2021) state that seaweed consumption has been limited in Western countries due to its undesirable odour, as well as its characteristics and unfamiliarity.

Therefore, the frequency and degree of consumption experience, as well as having already disliked and being aware of the edibility of the food are factors that contribute to consumer acceptance of the ingredient (Tan et al., 2016). Henriques et al. (2009) conclude that familiarity or the lack of it has an important impact on the moderation of neophobic behaviour by the consumer. The study developed by Birch et al. (2019) which relates familiarity to neophobia, states that respondents with a higher level of neophobia were less likely to have eaten seaweed in the past, to have eaten it less frequently in the past 12 months,

and less likely to eat seaweed in the next 12 months. On the other hand, Raudenbush & Frank, (1999) state that regardless of consumers' neophobia, consumers are more willing to try, expect to like, actually like and be willing to try again those foods that were familiar to them before the experiment.

Nevertheless, Li et al. (2021) conclude that American consumers are not yet familiar with algae-based food products, leading price to be the factor with the highest weight in the purchase consideration for such products, thus, according to the authors, as consumers become familiar with algae products, they may focus their purchase intention on product attributes, such as benefits for human health and the environment.

2.2.3.3. Neophobia towards seaweed based food products

Embling et al. (2022) find that neophobia is mediated by beliefs about the product's taste/edibility and familiarity, suggesting that these attributes may mitigate the negative effect that neophobia has on consumer acceptability of novel food. Barrena & Sánchez (2013) note that neophobic consumers transfer more of their personal values to product attributes during the purchase process. Moreover Raudenbush & Frank, (1999) suggest that for neophobic consumers, the sensory properties of foods are the main component by which they will evaluate the satisfaction and enjoyment of the food. In the case of neophobic consumers, the decision to purchase or consume novel food products is influenced by the potential impact on other family members, as high levels of neophobia are associated with a higher risk of aversion, and by factors related to cultural identification (Barrena & Sánchez, 2013). Barrena & Sánchez (2013) show that when a product is consumed regularly, the cognitive structure remains unchanged regardless of the degree of neophobia. On the

contrary, when they are presented with innovative products, the cognitive structure of non-neophobes is not altered, while in the case of neophobic consumers, their cognitive structure is altered, which suggests that they have a more complex cognitive structure. This implies that higher levels of neophobia lead to a more complex purchasing process, possibly due to a more cautious choice motivated by fear (Barrena & Sánchez, 2013).

In the study conducted by Nørgaard et al. (2014) on adolescents aged 9-16, they found that more neophytes were interested in social activities around snacks. Therefore, Nørgaard et al. (2014) suggest that marketers apply measures that include social activities complemented with individual activities, such as confluence in snack product combinations. Complementarily Barrena & Sánchez (2013) note that in comparison between neophobic and non-neophobic consumers, the first ones give greater importance to product information. Y. Martins et al. (1997) conclude that information does not affect the intention to try familiar foods; however, some types of information are effective in reducing neophobia towards novel non-animal foods. Especially participants exposed to flavour and nutritional information were more willing to try the non-animal food product than those who were not exposed to the same conditions; nevertheless, nutritional information alone is not effective and must be accompanied by information about the accessibility of the product (Y. Martins et al., 1997)

Losada-Lopez et al. (2021) conclude in their study that neophobia negatively influences consumers' interest in the edibility of seaweed and therefore affects their satisfaction and willingness to consume. Palmieri & Forleo, (2020) show that Italian consumers report the perception of seaweed attributes and the option to taste the product as potential mitigators of consumers' neophobia towards seaweed-based food products, thus increasing their acceptability. In the same vein, Birch et al. (2019) suggest providing product samples and developing innovative algae-based products to attract those consumers who are more

neophobic towards these products, and facilitating the trialling of such products may attract those consumers who are more adventurous in their food choices. Furthermore, improving sensory characteristics during the production process, such as odour, appearance, and texture, will be critical for greater market acceptance (D. Birch et al., 2019).

2.3. CERTIFICATION AND LABELLING IMPACT ON SEAWEED CONSUMPTION

The label can be a simple tag attached to the product or an elaborate graphic design that forms part of the packaging, it can contain just the bran (Kotler & Keller, 2012). The label has several functions: firstly, it must identify the product or brand; secondly, it must classify the product to describe the product: who made it and when; what it contains; how to use it; and what the safety measures are and finally, it can promote the product with attractive illustrations (Kotler & Keller, 2012). Kai et al. (2013) state that certification of product labels is critical for consumers to feel confident about organic food, positively influencing their willingness to pay for organic products. The information provided by the nutritional labels, along with knowledge of basic nutrition principles and interest in and confidence in adopting a healthy diet, is intended to contribute to informed food purchase decisions (Cowburn & Stockley, 2005). And still, the provision of on-pack nutrition information also forms an important element of consumer protection, to the extent that consumers have as much right to know the nutrient content of the foods they choose to purchase as they do to know their country of origin and that they are safe to eat (Cowburn & Stockley, 2005). Labelling or product information can mediate the negative effects of trying novel food products by reducing the uncertainty associated with what the product is (Tuorila et al., 1994). Considering that product appearance and packaging attributes are determinants in the

acceptance of functional food products, Zafar et al. (2022) confirm that the packaging appearance can influence the consumer or their attitudes in buying or not buying the food product. In addition, the packaging material is also very important; in this way, a good, attractive, and aesthetically beautiful material can influence the consumer's purchasing decision process (Zafar et al., 2022). Forbes et al. (2016) state that nutritional information on product labels helps consumers make healthy food choices. Ahmed et al. (2020) found that nutrition and/or health claim labelling were the most influential attributes of enriched snack products. These factors, according to Ahmed et al. (2020), revelled that consumers prefer the existence of nutrition and/or health importance such as disease prevention claims and risk reduction claims on the package of the snack food products. Thus, consumers are willing to pay the highest premium for nutrition and/or health claim labelling, which shows the relative importance of nutrition and/or health claim labelling traits over all other traits of enriched snack products (Ahmed et al., 2020).

However, according to Talagala & Arambepola (2016) although most adolescent respondents frequently read and pay attention to the labels of the snacks they consume, their interpretation of the information on the labels is inadequate. In addition, consumers decisions about snack packaging are often guided by false claims made on labels rather than by the nutritional value of the product, even though most respondents have, according to Talagala & Arambepola (2016) a good knowledge of the nutritional content of products. Therefore, Forbes et al. (2016) conclude that about half (55%) of the respondents read and processed the information on the labels, i.e., half of the consumers are interested in making informed purchasing decisions regarding the quality and safety of the snack product they are going to buy. Mejean et al. (2013) found that linking, attractiveness (contribution to information, ease of identification, and reliability), and indicators of perceived cognitive workload (complexity level and time span required) enabled recognising labels on a gradient of

acceptability. In addition, the multiple traffic lights (MTL), simple traffic lights (STL) and green tick labels were preferred, unlike the colour range was largely reject (Mejean et al., 2013). Mejean et al. (2013) affirms that among the Front of pack (FOP) labels tested, the MTL performed strongest compared to other logos, particularly in terms of liking and attractiveness. The authors justify it by explaining that the MTL label provides more detailed information on the nutritional composition of packaged foods and was best appreciated by consumers because of its more rapid and easier identification, understanding, and use, compared to the simplistic approach of the STL (Mejean et al., 2013). In addition to back-of-pack detail nutrient content information, food labelling forms on the front of a package are potential tools for helping consumer make healthier choices in their purchase (Cowburn & Stockley, 2005; Grunert & Wills, 2007 cited by Mejean et al., 2013, p.494).

Young et al. (2022) noted the existence of an incongruence between the promotion of seaweed as a sustainable and environmentally beneficial food and the plastic packaging that surrounds the product itself, i.e., they draw attention to the fact that in their study, Australian respondents were particularly aware of these incongruent situations, stating that the excessive use of plastic in the packaging constitutes a barrier to their consumption of such a product. With the same perception, Forbes et al. (2016) indicated that snack consumers are also concerned about the recyclability and biodegradability of the material that makes up the product packaging, showing that they are concerned about the environmental impact of the packaging post-purchase. Plasek et al. (2020) confirm that when companies provide information to consumers related to nutritional value and beneficial health effects on product packaging, it has a positive effect on the perceived healthiness of the product. Even so, it is necessary that the information be clear so that consumers understand it correctly in order not to evoke mistaken associations (Plasek et al., 2020). In addition, consumer scepticism towards healthiness claims should also be considered, since in this case, the information may

even have a negative effect on the evaluation of healthy characteristics (Plasek et al., 2020). All this interpretation of consumer information depends on the consumer's prior knowledge (Plasek et al., 2020). Considering that reading product packaging labels is associated with higher levels of education, Forbes et al. (2016) suggest that snack product packaging labels should be less technical to allow all consumers, regardless of education level, to understand and interpret the information highlighted on the labels. On the same view, Cowburn & Stockley (2005), state that in the studies that observed, although some consumer could understand some of the information on nutrition labelling, in general the reported finding nutrition labelling confusing, especially the use of some technical a Cowburn & Stockley (2005) argue that while consumers claim to look at nutrition labels often, or at least sometimes, looking at labels influences their purchase, especially for unfamiliar foods. In the view of Cowburn & Stockley (2005) , label readers reported using labels to avoid certain nutrients and to access the specific nutrient content (particularly fat, calories, and sugar) of different products. On the contrary, Cowburn & Stockley (2005) indicate that the lack of time, size, or print on packages, the lack of undertesting of terms, and concerns about the accuracy of the information are plausible hypotheses for why consumers do not read nutrition labels.

It is noted by Cowburn & Stockley (2005) that men were less likely to report an interest in reading nutrition labels, and women, those on higher income and people who have attained a higher level of education were most likely to report looking at labels. Consumer with a special interest or positive attitude to diet and health were more likely to report higher levels of label reading (Cowburn & Stockley, 2005). Ahmed et al. (2020) indicate in their study of Ethiopian snack consumers that children are the ones who consume this type of food the most and whose decisions are highly affected by the design and shape of the products.

Therefore, Ahmed et al. (2020) suggests that age-based segmentation of consumers for snack food production and promotion is the right strategy for snack food producers.

2.4. Demographic Impact on seaweed consumption

The fact that women are more aware of and give importance to their health is denoted in several studies (Franco Lucas et al., 2021; Roininen et al., 1999; Young et al., 2022. Also, Li et al. (2021) show that female participants were 18% less likely than males to buy the products presented (salad, pasta, and seaweed snacks). In addition, the person primarily responsible for buying food for the family is 20% less likely to buy the products described than other family members (Li et al., 2021). Roininen et al. (1999) conclude that older consumers, in general, are more interested than younger ones in practising a healthy diet and using natural products. Hansmann et al. (2020) justify the fact that higher levels of education are positively related to a higher willingness to consume organic products by pointing out that better educated people more easily realise the importance of sustainable and environmentally beneficial products than people with lower levels of education. On the contrary, Yousuf et al. (2019) conclude in their study on seafood that people with higher education are not always more likely to know about the nutritional and health aspects of seafood and that this knowledge is not always likely to have a positive influence on seafood consumption.

Young et al. (2022) note that respondents who had ever eaten seaweed were mainly metropolitan and typically identified flavour, family or friend preferences, cost, and ease of preparation as the most important influences on their decision-making regarding seaweed

consumption. In the study by Birch et al. (2019) they conclude that younger consumers with higher levels of income and education are more likely to eat seaweed-based food products, suggesting that women under the age of 35 with high levels of education should be the target market for seaweed-based food products. Lambert et al. (2020) confirm that female students have more positive attitudes towards eating healthy snacks than male students; consequently, they are more likely to try healthy snacks than males. On the other hand, respondents who showed a higher degree of neophobia were characterised by being younger and having lower education and income levels (Young et al., 2022) Thus, Young et al. (2022) characterise seaweed consumers as predominantly female, well-educated, with a high income, and with low levels of neophobia.

3. HYPOTHESES AND MODEL DEVELOPMENT

The following conceptual model, with its respective hypotheses, was developed to achieve the proposed main objective: explore the acceptance of seaweed-based snack foods for Portuguese consumers; also the model promises to response to the following specific objectives: determine the influence that familiarity and product knowledge have on neophobia; determine the influence that familiarity has on product knowledge; determine the influence of knowledge, familiarity, and neophobia on portuguese consumers' acceptance of seaweed-based food products; understand the influence of product labelling and packaging certification on the acceptance of seaweed-based food products in the form of snacks: identify the typical consumer of seaweed food products in the form of snacks.

According to Piha et al. (2018) ood neophobia will be negatively associated with knowledge constructs. That being said, the first hypothesis (H1) of the proposed conceptual model will be the relationship between knowledge and neophobia. affirm that product-related experiences are positively correlated with objective and subjective knowledge, which justifies the second hypothesis (H2) between the independent variables familiarity and knowledge. Regarding familiarity and neophobia, there is an actual sense in the literature that the more familiar the consumer is with the product, the less neophobic they are in relation to it (Embling et al., 2022; Henriques et al., 2009; Raudenbush & Frank, 1999). Taking that into consideration, it´s expected that the third hypothesis (H3), which takes into consideration familiarity and neophobia, will be positively correlated. Embling et al., (2022) state that familiarity impacts consumer acceptance significantly, Tan et al. (2016) agree by affirming that consumption frequency, degree of consumption experience, and having a taste experience contribute to better ingredient acceptability. It´s concluded that the independent variable familiarity has a positive impact on the dependent variable, making this relationship the fourth hypothesis (H4). Grace et al. (2010) clearly affirm that there is a significant relationship between consumer knowledge about seaweed and his acceptance of new seaweed food products. Joshi & Rahman, (2015) corroborate that by affirming that the literature mentions knowledge as an influence that affects green purchase intention and behaviour, Piha et al. (2018) onclude that the general attitudes towards insect food are significantly predicted by consumer knowledge. Based on those statements, the fifth hypothesis (H5), which correlates the indented variable, knowledge, with the dependent variable, consumer acceptance, is assumed to be positively correlated Again, regarding the independent variable neophobia, there is a strong conviction in the literature that neophobia negatively impacts consumer acceptance of a product (Embling et al., 2022; Henriques et al., 2009; Losada-Lopez et al., 2021; Pliner & Hobden, 1992; Verbeke, 2015). Based on the

literature review, it´s formed the sixth hypothesis (H6), which evaluates the independent variable impact, consumer neophobia, and the dependent variable, consumer acceptance. It´s expected a negatable result. It´s also noted in the literature by Ahmed et al., (2020); Hirogaki, (2013); Tuorila & Hartmann, (2020) the importance of product labelling and certification to improve consumer acceptability serves as an assumption to construct the last hypothesis (H7), which takes into consideration the independent variable, product labelling and certification, and the dependent variable, consumer acceptability—a relationship that is expected to be positively related.

Those seven hypotheses form the proposed model at Figure 1.

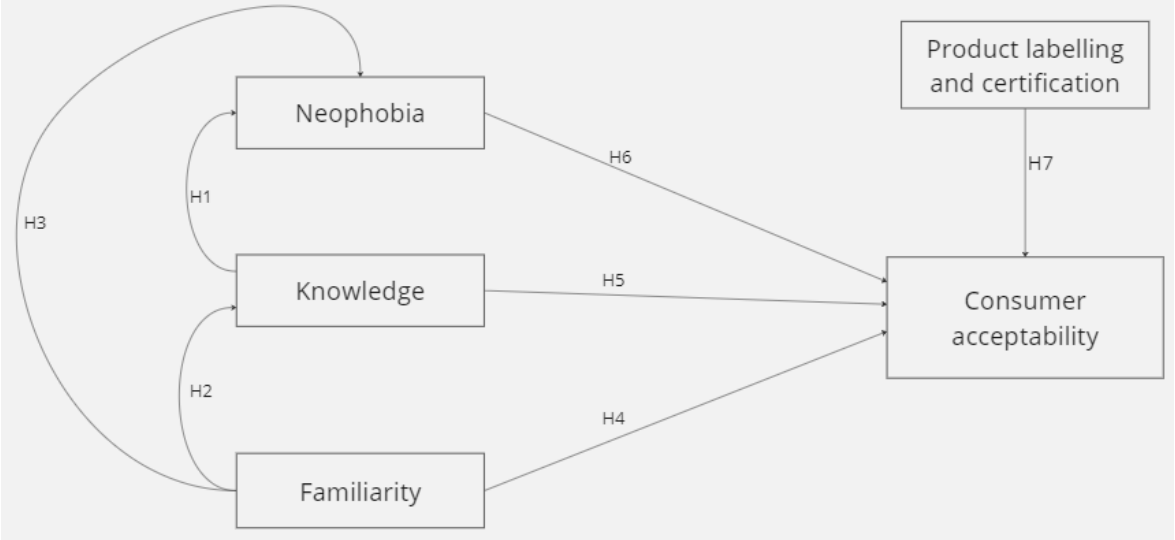

Figure 1 - Conceptual Model

The design of this conceptual model is inspired by those developed by D. Birch et al., 2019; Embling et al., 2022; Piha et al., 2018. The three models mentioned cover the independent variables neophobia, knowledge, familiarity, and consumer demographics, none of which addresses the influence of product labelling. Therefore, the independent variable "product labelling" is added to the model, as used by Kai et al., 2013. Furthermore,

consumer acceptance will be measured in terms of linking of linking, willingness to try, willingness to buy, and readiness to adopt, as suggested by Embling et al., 2022.

The following table (**Table 1**) summarises the development of hypothesis for more information on the statements made by the authors cited, see the Table 14 at Appendix.

Hypotheses	Validation	Authors
H1 (Knowledge & Neophobia)	It´s expected that neophobia is negativity associated with the consumer knowledge	Piha et al., 2018
H2 (Familiarity & Knowledge)	It´s expected to be a positively relationship between familiarity and knowledge. The more experiences the consumer has with the product, the more knowledge they will have about it.	Piha et al., 2018
H3 (Familiarity & Neophobia)	Also, it is expected to be a negativity relationship between familiarity and neophobia. As the more neophobic the consumer is, less willingness to try the product he will be.	Embling et al., 2022; Henriques et al., 2009; Raudenbush & Frank, 1999
H4 (Familiarity & Consumer Acceptability)	According to the literature, it´s expected to be a positive relationship	Embling et al., 2022; Tan et al., 2016

	between familiarity and consumer acceptability	
H5 (Knowledge & Consumer Acceptability)	It is expected to be not only a positive relationship between knowledge and consumer acceptance, but also that knowledge to be a significant predictor of consumer acceptance.	Grace et al., 2010; Joshi & Rahman, 2015; Piha et al., 2018
H6 (Neophobia & Consumer Acceptability)	For new foods on the market, overcoming the consumer fear to try it (neophobia) is a critical point for the more range of acceptance.	Embling et al., 2022; Losada-Lopez et al., 2021; Piha et al., 2018; Verbeke, 2015
H7 (Product labelling and certification & Consumer Acceptability)	Product labelling information such as health benefits and nutrition facts, plays a leading role decision making process. The inclusion of a product labelling on a novel food is expected to increase the consumer acceptance	Ahmed et al., 2020; Hirogaki, 2013; Kai et al., 2013; Kraus, 2015; Tuorila & Hartmann, 2020

Table 1 - Hypotheses Development

[1]The first three objectives will be achieved by the following hypotheses: H1, H2, H3, H4, H5 and H6. In relation to the influence of knowledge on consumer acceptance, it is expected to be positively correlated with it (D. Birch et al., 2019; Franco Lucas et al., 2021; Joshi & Rahman, 2015). Although it is observed by Grace et al. (2010) that consumer knowledge is negatively correlated with consumer acceptance, fact that they point out with relative surprise, but that justify it by the existing confusion in the Spanish market about what organic food really is. Regarding the relationship between familiarity and consumer acceptance, it is expected to be positive (D. Birch et al., 2019; Embling et al., 2022; Palmieri & Forleo, 2020; Tan et al., 2016). It is expected that neophobia will negatively correlate with consumer acceptance (Barrena & Sánchez, 2013; Grace et al., 2010; Losada-Lopez et al., 2021; Pliner & Hobden, 1992; Verbeke, 2015).

The next objective that promises to understand the relation between product labelling and consumer acceptance will be determined by the Hypothesis 7 (H7). It´s also expected that product labelling will positively influence consumer acceptance, in terms that the information provided by product labelling and its ease of interpretation will encourage consumers to buy, solidifying their confidence on the product (Ahmed et al., 2020; Hirogaki, 2013; Kai et al., 2013; Kraus, 2015; Tuorila et al., 1994).

Finally, the fourth objective will be to determine the general acceptance of the respondents. This acceptance will be measured in terms of "linking", "willingness to try", "willingness to buy" and "readiness to adopt". This rate was adopted by Embling et al. (2022) in their study about edible seaweeds in the United Kingdom.

[1] Consult Table 16**Error! Reference source not found.** for a summary of the information between hypotheses and the purpose of the objectives.

4. METHODOLOGY

As proposed in the literature about the consumption of seaweed, the commercialization of this product in the form of a snack could be an effective way to promote better seaweed consumption and acceptance (D. Birch et al., 2019; Li et al., 2021; Young et al., 2022). Despite the generally concluded findings that there is a relative acceptance and willingness to consume seaweed-based products, little is known about consumer acceptance, motivation, and barriers to their consumption, especially in the Portuguese market (D. Birch et al., 2019; Embling et al., 2022; Palmieri & Forleo, 2020). Therefore, the aim of this study is to explore the Portuguese consumer acceptability of seaweed-based snacks, for that it will be carried out a quantitative conclusive casual research design by mean a survey. According to Cohen et al. (2007) a quantitative analysis is powerful research form, many times associated with large scale research, but can also serve smaller scale investigations, like case studies, action research, correlational research, and experiments. Malhotra & Birks, (2006) point out the several advantages of using a survey on this type of study research, for example, the simplicity of administering the questionnaire, the data collected is consistent because the responses are limited to alternatives stated, the use of fixed responses questions that reduce the variability in the results that may be caused by differences in interviewers. And the interpretation of data is relatively simple. The survey sample is a non-probabilistic non-random sample, since the conclusions only relate to the sample, and because it is practically

impossible and expensive to reach the entire population. Since there is little or no research on acceptance of seaweed consumption applied to the Portuguese consumers, the quantitative conclusive research design methodology will be the most effective in measuring Portuguese consumer acceptance of seaweed-based snacks, as well as more effective in identifying intrinsic consumer characteristics that make their acceptance of this product easier. Additionally, considering the proposed objectives and with the aim of finding relationships between the variables, the method of data collection will be quantitative to subsequently provide a description through statistical treatment of the data and to test the equated theory. The use of a quantitative methodology by means of a survey to measure the study variables has been used in several studies with similar objectives as this one and also with similar theme, as can be as can be summarised in the following table (Table 2).

Variables	Quantitative Study	Qualitive Study
Knowledge	D. Birch et al., (2019); Embling et al., (2022); Piha et al., (2018)	Young et al., (2022)
Familiarity	D. Birch et al., (2019); Embling et al., (2022); Piha et al., (2018)	Li et al., (2021); Tan et al., (2016)
Neophobia	D. Birch et al., (2019); Embling et al., (2022); Pliner	Losada-Lopez et al., (2021)

	& Hobden, 1992; Verbeke, (2015)	
Consumer Acceptance	Embling et al., (2022)	
Product Labelling	Hirogaki, (2013); Kai et al., (2013); Lucas et al., (2019); Talagala & Arambepola, (2016)	Young et al., (2022)

Table 2 - Methodology used in by the literature review

4.1. Collection Data Method

4.1.1. Dependent variable

The dependent variable - "Consumer acceptance" - is established according to Embling et al. (2022) guidelines. Therefore, consumer acceptability is rated regarding food liking, willingness to try, willingness to buy, and readiness to adopt as proposed by Embling et al. (2022). For measuring food liking it is used 100-mm visual analogue scale as it used by Embling et al. (2022), to measure willingness to try and willingness to buy a 7-point Likert agreement scale is used as proposed by Gómez-Luciano et al. (2019), finally to measure readiness to adopt it is also used a 7-point Likert scale following Verbeke (2015). The provides information on the original items and scales.

4.1.2.Independent variables

It is considered six independent variables associated with the dependent variable, in addition there is also a particular relationship between knowledge, familiarity and neophobia

The first three are associated with consumer attitudes, namely, familiarity, knowledge, and neophobia towards seaweed-based food products. In order to measure the impact of product knowledge on consumer acceptability, a 7-point Likert scale is used for four items, following the procedure done by Piha et al. (2018). To measure the impact of familiarity on consumer acceptability, a two-item question is used on a yes/no scale, as suggested by Piha et al. (2018). For neophobia, the original scale developed by Pliner & Hobden, (1992) is used to measure six items on a 7-point Likert scale.

To measure the impact that product labelling has on consumer acceptance, two of aspect are been taking in consideration: product labelling attitude and perceived cognitive workload. For the first one is used a 7-point Likert scale used by Mejean et al. (2013) to evaluate the respective four items. Regarding to product labelling perceived cognitive workload is used a 7-point Likert scale to measure four items as suggested by Vargas-Meza et al. (2019).

4.2. PRE-TEST

"To obtain high-quality outcomes, a good research study with relevant experimental design and accurate performance is required." (In, 2017, p.601). The pilot study often precedes the main trail to analyse its validity (In, 2017). In this way, according to In, (2017), a pilot study provides necessary information not only for calculations the sample size, but also for assessment of all other aspects of the main study.

The feedback collected at the pre-test count with 10 participants—family and friends, with ages between 80 and 23 of both genders, who mainly didn't have eaten seaweed before—was mainly regarding some orthographic errors, with one question that mostly all the participants assumed was confusing. For those reason, the question "Compared to most other people, I know more about algae-based food" was removed from the survey.

4.3. PROCEDURE

Firstly, when the participants started the survey, it is provided a consent form, and those who consented moved on to the next short briefing about seaweed consumption: *"Algae are widely recognised as a valuable natural resource for improving human health. When consumed regularly, they play a key role in improving general well-being and promoting a*

balanced diet. Extensive research has demonstrated the multiple benefits of seaweed consumption, such as anti-cancer, anti-viral, anticoagulant and hypocholesterolaemia effects. In addition, algae are a rich source of essential nutrients, some of which are not found in terrestrial plants. Their nutritional value stems from their high concentrations of proteins, minerals, vitamins, dietary fibre, fatty acids, polysaccharides, and bioactive compounds with vast therapeutic potential. A variety of innovative algae-based food products are now available on the Portuguese market, including snacks, nori for sushi (temaki rolls and cones), processed algae in breads and pastas, as well as the use of algae as ingredients in salads and even functional algae-based drinks such as kombu seaweed.". This short brief includes information adopted from Embling et al. (2022); Pandey et al. (2020); Peñalver et al. (2020) about the health and nutrition benefits of algae consumption, in addition also it is described some seaweed food products that are consumed by the Portuguese consumer.

The main objective of the first part of the survey, which includes items related to attitudes towards seaweed-based food products (knowledge, familiarity, and neophobia), is to evaluate and gain a sense of the actual relationship and image that algae-based products have in consumer minds.

After the participants concluded the first three questions, they were randomly assigned to three different algae food products with the respective product images, namely seaweed snacks, seaweed drink and seaweed seasoning (see images at Table 18; Table 19; Table 20Table 20). They were asked to rate their acceptability according to likelihood, willingness to try, willingness to buy, and readiness to adopt that specific product. This kind of procedure was also done by Aschemann-Witzel & Peschel (2019). The objective of this part of the survey is to compare the acceptability of seaweed-based snack products among other possible similar market products.

For the third part of the survey, the participants are also assigned to four product labelling images: multi traffic light, nutri score, product star rank, warning label(Table 21), as done by Vargas-Meza et al. (2019). Like the previous section, they are also asked to rate the product labelling in terms of attitudes and perceived cognitive workload. The purpose of this section is to identify which labels perform better and, if the product does not have any kind of labelling if it represents an obstacle or barrier to the consumption of such products.

Finally, the conclusion of the survey ends with the demographic questions to identify if there is any typical consumer of seaweed-based food products as identify and segmented by D. Birch et al. (2019); Embling et al. (2022); Palmieri & Forleo, (2022). The survey can be consulted at the Table 17 at appendix.

4.4.PARTICIPANTS

The survey began to be distributed on 16 November 2023, and by its closing date of 20/01/2024, 67 questionnaires were distributed via social networks and groups of friends/family. Only 2 people were not over 18 and therefore could not continue with it, so their answers did not count in the further statistical analysis. Only 63 people confirmed that they were over 18 and wanted to take part in the study. Of the 63 people who confirmed that they were 18 years old or older and went on to take the quiz, yet only 56 people finished it. Of all the respondents in the sample, 34 were male and 22 were female, with only one respondent selecting the "Other" option. Their ages ranged from 18 to 87. Most of the respondents were between the ages of 18 and 30, totalling 54.4% of the total. In terms of individual income, the first 3 categories (less than or equal to €760, between €761 and €1000,

and between €1001 and €2000) are fairly evenly distributed, with 16 respondents in the first category, 15 in the second and 15 in the third, so these 3 groups account for 80.7% of the sample's income. Only 5 people have an income of between €2001 and €3,000 and 6 people have an income of more than €3,001. The majority of those surveyed are working, with 52.6 % only working and 17.5 % studying and working. In terms of level of education, the majority of respondents have a degree, with 49.1 % having a bachelor's degree and 15.8 % also having a postgraduate degree.

5. ANALYSIS AND RESULTS

In general, people still have little knowledge about the edibility of algae as it can be seen at Figure 1Figure 2 and at Figure 3. When asked about their intrinsic knowledge of algae, the majority said they knew almost nothing about it, 42.9 per cent totally disagreed that they knew almost everything about algae-based food and 26.8 per cent disagreed with the same statement. When it came to comparing their knowledge with other people, there was an even

distribution of responses. Even so, it appears that a large proportion of those surveyed think they know less about algae compared to other people.

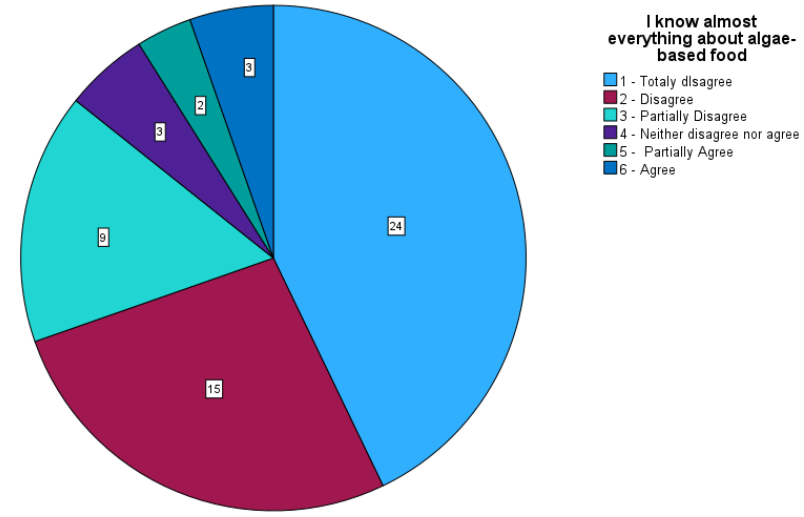

Figure 2 – Knowledge question Q1.1

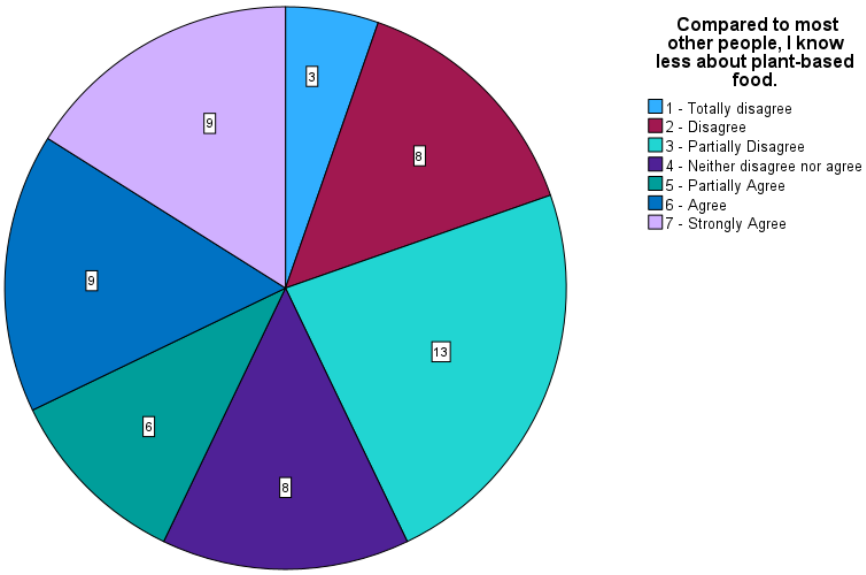

Figure 3 – Knowledge question Q1.2

Regarding familiarity with seaweed, in fact, the majority of respondents have seen and tried seaweed-based food. Even so, there are still some people who have seen seaweed-based food but haven't tried it yet, as there are 41 people who have seen it, but only 33 who have tried it. Therefore, although in the second question on familiarity, which asks whether you have tried seaweed-based food, the majority have, there is not as much of a difference as there is in the first question, indicating that more effort is needed to get people to take the next step of regularly trying and eating seaweed-based food. These kinds of results corroborate the findings of (Embling et al., 2022; Verbeke, 2005).

Have you ever seen seaweed food

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	Yes	41	73,2	73,2	73,2
	No	15	26,8	26,8	100,0
	Total	56	100,0	100,0	

Table 3 - Familiarity Question Q2.1

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	Yes	33	58,9	58,9	58,9
	No	23	41,1	41,1	100,0
	Total	56	100,0	100,0	

Table 4 – Familiarity question Q.3.1

When it comes to the respondents' neophobic attitudes towards trying new food, there is a mixed feeling with a slight weighting towards favourable attitudes towards trying new

food, as it can be seen at Figure 4. Due to this slight motivation to try new foods, in general, respondents' trust in new foods is positive, with 62.5 % willing to trust new foods, and 62.5 % trying the food even if they don't know what it contains. The respondents are peremptory in stating that they are not afraid to try food they have never eaten before, as can be seen at

.

I'm constantly trying new and different foods

		Frequency	Percentage	Valid percentage	Accumulative percentage
Válido	1- Totally disagree	4	7,1	7,1	7,1
	2 - Disagree	8	14,3	14,3	21,4
	3 - Partially Disagree	7	12,5	12,5	33,9
	4 - Neither disagree nor agree	12	21,4	21,4	55,4
	5- Partially Agree	16	28,6	28,6	83,9
	6 - Agree	6	10,7	10,7	94,6
	7 - Strongly Agree	3	5,4	5,4	100,0
	Total	56	100,0	100,0	

Figure 4 – Neophobia question Q3.1

I'm afraid of eating things I've never eaten before

		Frequency	Percentage	Valid percentage	Cumulative percentage
Válido	1 - Totally disagree	8	14,3	14,3	14,3
	2 - Disagree	16	28,6	28,6	42,9
	3 - Partially Disagree	11	19,6	19,6	62,5
	4 - Neither disagree nor agree	8	14,3	14,3	76,8
	5- Partially Agree	8	14,3	14,3	91,1
	6 - Strongly Agree	5	8,9	8,9	100,0
	Total	56	100,0	100,0	

Figure 5 - Fourth neophobia question Q 3.4

After the questions about attitudes towards seaweed-based food, the participants were randomly assigned to one of the three seaweed-based food products that served as examples to assess their acceptability. Thus, 17 respondents were randomly assigned to the seaweed-based snack product, 19 people were assigned to the seaweed-flavoured seasoning product and another 19 to the seaweed-flavoured energy drink product. In general, respondents would be willing to try seaweed-based food, based on the comparison between the total percentage of positive responses ("Agree", "Partially agree" and "Totally agree") and the total percentage of negative responses ("Disagree", "Partially disagree", and "Totally disagree". However, there is a difference in their disposition towards the product they were given, i.e. it is clear that the disposition of the respondents who have been given the seaweed-based drink product is slightly less intense than that of the other respondents who have seen different products, as can be seen in the following Table 5.

Product	Positive Responses%	Neutral Responses%	Negative Reponses%
Seaweed Snack	70.5%	17.6%	11.8%
Seaweed seasoning	73.8%	10.5%	15.8%
Seaweed drink	42.1%	42.1%	5.4%

Table 5 - Willingness to eat algae-based products

This less expressed desire on the part of the respondents who were assigned the seaweed

drink product can be explained by the fact that there is no clear desire to try the product itself; in fact, there is still uncertainty about trying this particular product, which is not the case with the others: seaweed snacks and seaweed seasoning, where there is a clear desire on the part of the majority to try the product, as can be seen at Table 6.

Product	Positive Responses%	Neutral Responses%	Negative Reponses%
Seaweed Snack	58.8%	5.9%	41.2%
Seaweed seasoning	79.0%	10.5%	10.5%
Seaweed drink	33.1%	21.1%	36.8%

Table 6 - Willingness to try the seaweed product.

The seaweed snack product, on a proportional level, was the one with the highest purchase intention, as can be seen at Table 7, but it is worth note that two fewer people assigned this product than the rest of the products. There was also a decline in the seaweed seasoning product, where, in general, the respondents' intention to buy did not match their prior willingness to try the same product, a reduction of 21 percentage points. This decline is clearly moving towards a negative willingness to buy the seaweed seasoning product. The same doesn't happen with the seaweed snack product, where, generally speaking, the respondents' willingness to try the product was slightly balanced - even though there was a majority of positive responses, it wasn't that clear - unlike what was observed in their intention to buy, where there was a general willingness on the part of the respondents to buy this type of product. Finally, with regard to the algae-based drink product, the respondents' willingness to try and buy did not help significantly.

Product	Positive Responses%	Neutral Responses%	Negative Reponses%
Seaweed Snack	70.5%	0.0%	29.4%
Seaweed seasoning	57.9%	10.5%	31.6%
Seaweed drink	31.6%	36.8%	31.6%

Table 7 - Willingness to purchase the seaweed product.

In line with the expressive desire to buy seaweed snacks, this product is also, in proportional terms, the one that ranks highest in the expectation of liking the respective product, as can be seen in the Table 8. As such, the total number of positive evaluations—the total percentage of evaluations above 50% expecting to like the product—contains 64.7% of the total evaluations given to the seaweed snack, which is why it can be concluded that the evaluations of this product are very positive: around 29.5% of the respondents attributed to this product expect to like it 80%, with some respondents giving it a 100 percent rating. Next, the seaweed seasoning product also received a positive evaluation from its respondents, 57.9 % of whom rated their expectation of liking this product positively. However, their evaluations are more moderate, with only two people rating the product at more than 80% of their expectations of liking it. In fact, the worst product in terms of expectations of liking it was the seaweed drink, which is not unreasonable given the results of willingness to try and buy the product. As such, only 27.3 per cent of those surveyed rated this product positively. It can be seen that there are still some people who are undecided as to whether they expect to like the respective products that have been attributed to them; this indecision is most noticeable in the last two products: seaweed seasoning and seaweed drink.

Expectation of liking the product: seaweed snacks

		Valid percentage	Cumulative percentage
Valid	,00	5,9	5,9
	27,00	5,9	11,8
	39,00	5,9	17,6
	40,00	5,9	23,5
	41,00	5,9	29,4
	50,00	5,9	35,3
	52,00	5,9	41,2
	53,00	5,9	47,1
	54,00	5,9	52,9
	60,00	11,8	64,7
	61,00	5,9	70,6
	80,00	5,9	76,5
	83,00	5,9	82,4
	86,00	5,9	88,2
	90,00	5,9	94,1
	100,00	5,9	100,0
	Total	100,0	

Expectation of liking the product: seaweed seasoning

		Valid percentage	Cumulative percentage
Valid	10,00	5,3	5,3
	25,00	5,3	10,5
	29,00	5,3	15,8
	45,00	5,3	21,1
	49,00	5,3	26,3
	50,00	15,8	42,1
	60,00	10,5	52,6
	62,00	5,3	57,9
	72,00	10,5	68,4
	74,00	5,3	73,7
	75,00	10,5	84,2
	76,00	5,3	89,5
	80,00	5,3	94,7
	90,00	5,3	100,0
	Total	100,0	

Expectation of liking the product: seaweed drink

		Valid percentage	Cumulative percentage
Valid	9,00	5,3	5,3
	10,00	5,3	10,5
	15,00	5,3	15,8
	18,00	5,3	21,1
	20,00	5,3	26,3
	25,00	5,3	31,6
	30,00	15,8	47,4
	35,00	5,3	52,6
	40,00	5,3	57,9
	49,00	5,3	63,2
	50,00	10,5	73,7
	52,00	5,3	78,9
	60,00	5,3	84,2
	66,00	5,3	89,5
	72,00	5,3	94,7
	83,00	5,3	100,0
	Total	100,0	

Table 8 - Expectation seaweed product liking

Given these results, it can be concluded that there is a relative openness to accepting eating seaweed-based food. Even so, it is necessary to pay attention to the sensory aspects of seaweed-based products, bearing in mind that these products are generally new to the majority of respondents. Therefore, the more appealing the product, the greater the

willingness to try it, eat it, and expect to like it, thus increasing consumer acceptance of algae-based products. In this way, taking into account the results analysed, the marketing of seaweed products in the form of snacks can be a great way to overcome the slight aversion that consumers have to trying new food, and this product can bridge the gap between neophobia and the willingness of consumers to try and eat seaweed-based food.

Therefore, the commercialisation of seaweed-based products in the form of snacks is indeed a plausible alternative, confirming the hypotheses for this product's success pointed out by D. Birch et al. (2019); Li et al. (2021); Young et al. (2022).

As for the results obtained for the questions on product labels, 15 respondents were assigned to the multi-traffic light label, 13 to the nutri-score label, 14 to the product star rank label, and 14 to the warning label. Respondents show that they generally would trust on the labels they have been given as can be seen at. Observing the first question on product labelling, it can be seen that the nutriscore label would not be the first choice among respondents, as can be seen at Table 9, with multi-traffic being the preferred. However, these results are not in line with those taken from question 5.3 (Table 22), where respondents are asked whether they would choose certain products based on their assigned product label, where the label that received the most recognition from respondents was the nutriscore, with 46.1% positive responses standing out from the others.

Product Label	Positive Responses%	Neutral Responses%	Negative Reponses%
Multi-Traffic Light	26.60%	26.7%	46.7%
Nutri- Score	46.1%	15.4%	38.5%
Product Star Rank	28.6%	14.3%	57.1%
Warning Label	28.6%	14.3%	57.1%

Table 9 - Answers to question Q5.1

Although respondents trust labels to choose certain products, they don't trust labels to choose all their food products (Table 23). The fact that respondents still prefer to base their decisions on nutritional facts (Table 10) and assume that labels don't provide them with viable information (Table 24), even assuming that labels help them choose healthier products (Table 11), may explain this slight gap in trusting labels only to choose certain products and not the totality of all their desired food products.

Product Label	Positive Responses%	Neutral Responses%	Negative Reponses%
Multi-Traffic Light	46.7%	40.0%	13.3%
Nutri- Score	30.7%	46.2%	23.1%
Product Star Rank	35.7%	14.3%	50.0%
Warning Label	14.3%	57.1%	28.6%

Table 10 - Answers to question Q5.2

Product Label	Positive Responses%	Neutral Responses%	Negative Reponses%
Multi-Traffic Light	53.3%	40.0%	6.7%
Nutri- Score	46.1%	30.8%	23.1%
Product Star Rank	64.3%	28.6%	7.1%
Warning Label	71.5%	21.4%	7.1%

Table 11- Answers to question Q6.1

Regarding the interpretation of the labels, for all the labels the majority of respondents said they understood the nutritional information that the label conveys, as can be seen at Table 12 and Table 13. All the labels are evaluated almost equally, but the nutriscore label

gets a better evaluation in terms of ease of understanding what it conveys. While in terms of the time it takes to understand the label, the warning label performs better, but with very little difference to the nutri score label.

Product Label	Positive Responses%	Neutral Responses%	Negative Reponses%
Multi-Traffic Light	26.7%	33.3%	40.0%
Nutri- Score	23.1%	7.7%	69.2%
Product Star Rank	14.3%	21.4%	64.3%
Warning Label	11.3%	24.4%	64.3%

Table 12 - Answers to question Q6.3

Product Label	Positive Responses%	Neutral Responses%	Negative Reponses%
Multi-Traffic Light	13.4%	33.3%	53.3%
Nutri- Score	15.4%	7.7%	76.9%
Product Star Rank	21.5%	7.1%	71.4%
Warning Label	14.3%	7.1%	78.6%

Table 13 - Answers to question Q6.4

That being said, it can be concluded that the respondents believe that labels are a valuable aid in making purchasing decisions, especially as they add value when choosing healthy food products, as it´s conclude and observed by Forbes et al. (2016). Although they say that they understand what is said on the labels and that it doesn't take long to understand them, the respondents generally prefer to base their opinions on nutritional facts. These conclusions are in contrast to those presented by Talagala & Arambepola, (2016) , who summarised that

the young respondents in his study often read the labels, but don't understand the information they contain. It is understood that there are no product label that stands out.

6.MAIN CONCLUSION AND FUTURE RESEARCH

6.1.Main conclusion

In conclusion, this dissertation aspire to respond to the following main objective: explore the acceptance of seaweed-based snack foods for Portugues consumer; and to the specific objectives determine the influence that familiarity and product knowledge have on neophobia; determine the influence that familiarity has on product knowledge; determine the influence of knowledge, familiarity, and neophobia on Portuguese consumers' acceptance of seaweed-based food products; understand the influence of product labelling and packaging certification on the acceptance of seaweed-based food products in the form of snacks; identify the typical consumer of seaweed food products in the form of snacks. The main objective was validated: there is indeed little familiarity and knowledge of seaweed consumption, but consumers' willingness to try and eat this type of new product is, in general, very receptive, and the seaweed-based snack product, in relation to the others demonstrated, is held in high esteem and regard by those surveyed. It was also possible to see, in relation to specific objective O4, that the labelling and certification of food products is a factor that consumers consider when making a healthier choice. On the other hand, due to the small size of the sample, the specific objectives relating to intrinsic consumer attitudes were not fully achieved.

Trought this research endeavour the personal and academic gain exceeded the challenges encountered.

The findings presented in this dissertation underscore the importance studying the market before launching a product, which is why this study can be important in improving an algae product already on the market or serve as a basis for launching new algae products.

The results show that there is still very little knowledge about the edibility of seaweed, since most of the respondents assume that they know practically nothing about it. On the other hand, in terms of familiarity, the Portuguese consumers questioned in the study show a relative familiarity with the edibility of seaweed, given that a large proportion of those questioned have seen seaweed-based food, but only 33% have eaten seaweed-based food. Neophobic issues (aversion to trying new food) shouldn't be a problem for respondents trying new food: they prove to be a less neophobic group. Therefore, in affecting attitudes towards the acceptance of seaweed consumption, it is clear that little knowledge about seaweed can have a negative impact. It would therefore be interesting to promote actions aimed at promoting the nutritional and healthy benefits of eating algae-based foods. Appropriate labelling can be a valid alternative for promoting knowledge and information about this type of food.

When it comes to the respondents' favourite product, seaweed-based snacks and seaweed seasoning are the most popular, with these two clearly standing out from the other product: seaweed-based drinks. The product under study: seaweed snacks only clearly stands out in terms of intention to buy, lagging far behind the seaweed seasoning product in terms of intention to taste, but with practically equal results in terms of intention to eat. When it comes to the expectation of liking the product, seaweed snacks have a very positive evaluation, which leads to the conclusion that marketing this type of product in snack form could be an alternative for promoting acceptance of the edibility of seaweed. In addition, the fact that the

snack type of product is, as a rule, quite common in the consumer's daily life means that they will not be so surprised by this new product, although this sample shows that Portuguese consumers do not have neophobic characteristics. It will also be important for the flavour, touch and visual appearance to be somewhat similar to the most common snacks in consumers' diets.

As far as product labelling is concerned, it is also assumed that it can help to strengthen the positive beliefs that respondents have about seaweed products. In addition, labelling can also provide consumers with additional information, thus increasing their knowledge about seaweed, which in a way will bring consumers closer to buying seaweed products. It is not only necessary for the labels to contain the necessary information, they also need to be appealing to the consumer. In the study conducted, there was no clear highlighting of the labels displayed. In general, respondents trust labels to choose healthier products, but they still prefer to base their decisions on nutritional facts. They also have a clear perception of what is conveyed by the labels. It can therefore be concluded that appealing labels with clear, concise and important information are a strong ally in promoting the consumption of algae-based food products.

6.2.Limitation and Future Research

In the spirit of continuous inquiry, it is crucial to acknowledge the limitation of this study. Although this study is probably the first to explore Portuguese consumers' acceptance of

seaweed-based foods, particularly in the form of snacks, it is important to consider and emphasise its limitations.

Obviously, the biggest limitation of this study is the number of responses collected, which may not concretely represent the general Portuguese population. Cultural and economic variances could also influence the outcomes, potentially being relevant to nations sharing cultural values akin to those of Portugal. Increasing the sample size should also be important point to consider in order to obtain more accurate data and validate the outcomes. It would also be interesting to take into account the proportionality of the demographic data, trying to collect data in an equitable way across all demographic variables since this type of study extends to a country's population, which in itself is quite broad. An exploration of seaweed consumption across different cultural contexts could enrich our understanding of how seaweed consumption vary across diverse populations. Cross-cultural studies would contribute to a more global perspective on seaweed consumption.

Another constraint to take into account pertains to the data collection process. Employing surveys to gather information may introduce specific limitations to the study. Surveys are susceptible to response biases, where certain individuals may be more or less inclined to participate, potentially impacting the validity of the results. Regarding the survey, the product images that serve as examples could not be appreciated by the participants as if they were seen in an in-person study where they could touch, smell, and taste the product. The time frame allocated for this research may have restricted the depth and breadth of the study. A more extended research duration could have allowed for a more comprehensive exploration of seaweed consumption. Due to the possibility that in these quantitative studies there is a lack of control over the honesty, motivation, and environment of the participants, leading to erroneous conclusions, one way to overcome this limitation would be to carry out

a complementary qualitative study. So, in future research, a qualitative study could also provide more concrete data and evaluations when it comes to understanding which algae-based food product stands out the most, assuming that the participant can touch, smell, see, and eat the algae-based food product.

There are also other important variables in consumer acceptance and purchasing decisions, namely the evaluation of sensory factors, the inclusion of price and distribution, among others. For this reason, not including these variables can affect a more complete conclusion about the product. The evaluation of sensory factors will also be of great interest in order to understand the best type of product for marketing seaweed. Investigating the impact of related variables such as product price, product distribution, product commercialization place, among others on seaweed consumption could provide a more comprehensive understanding of the complex interplay between various factors. This would contribute to a more holistic view of the phenomena under investigation.

Another recommendation to be included in future studies is the addition of more diverse algae-based food products, such as pasta, bread, and salad, among others. In addition, it would be useful to further explore this topic by comparing algae-based food with other emerging food categories, such as insect edibility.

Despite efforts to maintain objectivity, the interpretation of findings is inherently subjective. The researcher's perspective and biases may have influenced the analysis and conclusions. While these limitations are acknowledged, they do not diminish the significance of the contributions made by this research. Instead, they provide opportunities for future researchers to refine methodologies, expand sample sizes, and address additional variables to further enhance the understanding of seaweed consumption.

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APENDIX

Hypotheses	Validation	Authors
H1 (Knowledge & Neophobia)	"Food neophobia is expected to be negatively associated also with the knowledge constructs"	(Piha et al., 2018, p.4)
H2 (Familiarity & Knowledge)	"The current results also indicate that product-related experiences are positively" ... "as well as with objective and subjective knowledge"	(Piha et al., 2018, p.4)
	"Food neophobia is expected to be negatively associated also with the knowledge constructs."	(Piha et al., 2018, p.4)
H3 (Familiarity & Neophobia)	"Participants comprising both groups were more willing to try, expected to like, actually liked, and were more willing to try again those foods that were familiar to them prior to the experiment"	(Raudenbush & Frank, 1999, p.269)
	"Food familiarity or the lack thereof, has a key role in neophobic behavior."	(Henriques et al., 2009, p.89
	"However, we also found evidence that the effect of food neophobia in particular was partially mediated by beliefs about the taste/ edibility and familiarity of products, suggesting	(Embling et al., 2022, p. 7)

	that these attributes may potentially mitigate the negative effect of food neophobia on consumer acceptance"	
H4 (Familiarity & Consumer Acceptability)	"Familiarity significantly predicted acceptance"	(Embling et al., 2022, p. 1)
	"This meant that consumption frequency, degree of consumption experience, having a taste experience, and being aware of a food's edibility all contributed to the degree of the ingredient's acceptability."	(Tan et al., 2016, p.297)
H5 (Knowledge & Consumer Acceptability)	"The current results suggest that the general attitudes towards insect food are significantly predicted by consumer knowledge."	(Piha et al., 2018, p.18)
	"Extant literature mentions knowledge as one of the most influential factors that affect green purchase intention and behaviour"	(Joshi & Rahman, 2015, p. 137)
	"There is a significant relationship between the consumer's knowledge about seaweed and his acceptance of the new seaweed food products"	(Grace et al., 2010, p.99)
H6 (Neophobia & Consumer Acceptability)	"These results suggest that practical attempts to increase the acceptance of unfamiliar foods may be differentially successful depending on individuals' own levels of trait neophobia."	(Pliner & Hobden, 1992, p. 119)

	"The present study also found lower acceptability by both neophilics and neophobics, with the neophobics showing a more pronounced effect."	(Henriques et al., 2009, p.89)
	"Having greater food neophobia and stronger beliefs about the benefits of meat significantly predicted decreased acceptance for hypothetical seaweed-based food products"	(Embling et al., 2022, p. 6)
	"Food neophobia makes the largest contribution to consumers' readiness to adopt insects"	(Verbeke, 2015,p.147)
	"Food neophobia and food technology neophobia were both significant determinants of consumers' readiness to adopt insects as a meat substitute."	(Verbeke, 2015, p.151)
	"The results confirm that neophobia affects the intention to consume algae."	(Losada-Lopez et al., 2021, p.1)
H7 (Product labelling and certification & Consumer Acceptability)	"Labelling and certification on organic products will have positive effect on the willingness to pay."	(Kai et al., 2013, p.1173)
	"Information on the label, such as health benefits and nutrition facts, plays a leading role in making the decisions to purchase functional food."	(Kraus, 2015, p.7)

	"The result of the willingness to pay space consistently shows the relative importance of nutrition and/or health claim labeling over all the traits of enriched snack food products"	(Ahmed et al., 2020, p. 18)
	"Novel foods with labels were rated highest in terms of likelihood of consumption"	(Tuorila et al., 1994, p.244)
	"Food prices with product labels are important influencing factors in attracting consumers. Similarly, prices per unit also affect a consumer 's purchase intention"	(Hirogaki, 2013, p. 542)

Table 14 - Information on Hypotheses development

Dimensions	Concept	Authors
Consumer Attitudes	"An attitude is a lasting, general evaluation of people (including oneself), objects, advertisements, or issues. We call anything toward which one has an attitude an attitude object"	(Solomon, 2017, p.285)
	"Attitude is defined as a response to an antecedent stimulus or attitude object. The stimulus may or may not be	(Breckler, 1984, p. 1191)

	observable, and can best be thought of as an independent or exogenous variable."	
	"Is defined as an individual's overall positive and negative evaluation of an attitude object"	(Govaerts & Ottar Olsen, 2023, p.2)
Familiarity	"Familiarity is defined as the number of product- related experiences that have been accumulated by the consumer. Expertise is defined as the ability to perform product-related tasks successfully."	(Alba & Hutchinson, 1987, p. 411)
	"Product-related experiences (i.e., familiarity) refers to behavioural antecedents of attitude"	(Piha et al., 2018, p.3)
Knowledge	The first is objective knowledge: accurate information about the product class stored in long-term memory.	(Park et al., 1994, p. 71)
	"The second is self-assessed knowledge or subjective knowledge: people's perceptions of what or how much they know about a product class"	(Park et al., 1994, p. 71)
	"Refers to the information that a person possesses such as the linkages between diet and health or about	(Goode et al., 1995 cited by Grace et al., 2010, p 99)

	processed and packaged foods; so as to form a basis for food choice”	
Neophobia	“Neophobia is a personality trait which exerts a major influence on consumers’ acceptance of new products”	(Losada-Lopez et al., 2021, p. 1)
	“Research on this topic has shown that people vary dramatically in their willingness to try new foods, with some people showing a strong bias toward novel food avoidance. This tendency is referred to as food neophobia”	(Ritchey et al., 2003, p. 163)
	“Food neophobia is defined as the unwillingness or refusal to eat or the tendency to avoid new foods”	(Pliner & Hobden, 1992 cited by (Barrena & Sánchez, 2013, p. 72)
	“Neophobia as a personality trait is evaluated with measuring scales, the most widely used being the food neophobia scale (FNS), which is the one used for the segmentation of consumers in this study”	(Barrena & Sánchez, 2013, p. 82)

Product Attributes	"There are number of the attributes of the functional foods such as perceived quality, label, appearance and package, Organoleptic, functionality, brand and price attributes"	(Zafar et al., 2022, p 792)
Product Labelling and Certification	"Basically, labels provide information on ingredients of the food products, nutritional properties, preparation, and storage"	(Sajdakowska et al., 2022, p.1)
	"Therefore, a label may provide as much information as a description of ingredients or use contexts (the situation or event in which a product is normally consumed), and it may also contribute to affective responses"	(Tuorila et al., 1994)
	"In this regard, labels on packaged snacks serve as a reliable source of nutrition-related information. These labels provide simple visual guides that enable the consumers to make healthier choices at a glance"	(Talagala & Arambepola, 2016, p.2)
	"Front-of-pack (FOP) labelling systems provide simplified information at a glance on the nutritional content;	(Cowburn & Stockley, 2005; Feunekes et al., 2008, cited by byMejean et al., 2013, p. 494)

	consequently, they offer a comprehensive interpretation of the nutrition profile of packaged foods"	
	"Nutrition labelling is one example of a population-based approach aimed at helping to make the food selection environment more conducive to healthy choices by providing information to consumers about the nutrient content of a food"	(Cowburn & Stockley, 2005, p. 21)
Consumer Acceptance	"The acceptance or rejection of a given food occurs when the human brain jointly processes: (a) information obtained from observing, handling, and consuming the food in question; (b) information acquired from the surrounding social and cultural context; (c) information gained from the physiological effects (pleasure, satiety, dislike, discomfort, etc) experienced when eating and after eating a certain food; and (d) comparison with information stored in the memory of past experiences."	(Costell et al., 2010, p. 47)

	"Food acceptability is considered to be a behavioural phenomenon, which is the result of the interaction between a stimulus and a consumer."	(Mcewan & Thomson, 1988, p. 3)
	"The study of food acceptability is essentially a study of human behaviour in response to food."	(Mcewan & Thomson, 1988, p. 3)
	"Measuring consumer acceptance in response to food descriptions can be particularly useful to identify initial interest in novel products (as developing and testing real food items can be costly in terms of time and resources)."	(Embling et al., 2022, p. 7)

Table 15 - Dimensions definitions

Hypotheses	Variable	Variables Scales	Authors	Hypothesis response to objectives
H1	Knowledge	7-point Likert scale	Piha et al., (2018)	O1

	Neophobia	7-point Likert		Pliner & Hobden, (1992; Verbeke, (2015)	
H3	Familiarity	Yes/No		Palmieri & Forleo, (2022; Piha et al., (2018)	O1
	Neophobia	7-point Likert		Pliner & Hobden, (1992; (Verbeke, 2015)	
H2	Familiarity	Yes/No		Palmieri & Forleo, (2022); Piha et al., (2018)	O2
	Knowledge	7-point Likert scale		Piha et al., (2018)	
H4	Familiarity	Yes/No		Palmieri & Forleo, (2022; Piha et al., (2018)	O3
	Consumer Acceptability	Liking	100mm VAS	Embling et al., (2022)	
		Willing to try	7-point Likert	(Embling et al., 2022; Gómez-Luciano et al., 2019)	
		Willing to buy	7-point Likert	Embling et al., (2022; Gómez-Luciano et al., (2019)	
		Readiness to adopt	7-point Likert	Embling et al., (2022); Verbeke, (2015)	

H5	Knowledge	7-point Likert scale		Piha et al., (2018)	O3
	Consumer Acceptability	Liking	100mm VAS	Embling et al., (2022)	
		Willing to try	7-point Likert	Embling et al., (2022; Gómez-Luciano et al., 2019)	
		Willing to buy	7-point Likert	(Embling et al., 2022; Gómez-Luciano et al., 2019)	
		Readiness to adopt	7-point Likert	(Embling et al., 2022; Verbeke, 2015)	
H6	Neophobia	7-point Likert (agreement)		(Pliner & Hobden, 1992; Verbeke, 2015)	O3
	Consumer Acceptability	Liking	100mm VAS	(Embling et al., 2022)	
		Willing to try	7-point Likert (agreement)	(Embling et al., 2022; Gómez-Luciano et al., 2019)	
		Willing to buy	7-point	(Embling et al., 2022; Gómez-Luciano et al., 2019)	

			Likert (agreement)		
		Readiness to adopt	7-point Likert (agreement)	(Embling et al., 2022; Verbeke, 2015)	
H7	Product labelling and certification	7- point Likert scale (agreement and frequency)		(Kai et al., 2013; Talagala & Arambepola, 2016)	O4
	Consumer Acceptability	Liking	100mm VAS	(Embling et al., 2022)	
		Willing to try	5-point Likert (agreement)	(Embling et al., 2022; Gómez-Luciano et al., 2019)	
		Willing to buy	5-point Likert (agreement)	(Embling et al., 2022; Gómez-Luciano et al., 2019)	

		Readiness to adopt	5-point Likert (agreement)	(Embling et al., 2022; Verbeke, 2015)	

Table 16 - Hyptothesis and Objectives

Independent Variables	Adapted item	Original Item	Source	Scales
Knowledge	Q1.1 I know a lot about seaweed	I know pretty much about insect food	Piha et al., 2018	7-point Likert for four items
	Q1.2 Compared to most other people, I know less about seaweed food.	Compared to most other people, I know less about insect food		
	Q1.3 Compared to most other people, I know more about seaweed food.	Compared to most other people, I know less about insect food		

	Q1.4 When it comes to seaweed food, I really don't know a lot.		When it comes to insect food, I really don't know a lot		
Familiarity	Q2.1 Have you ever seen seaweed food		I have eaten or tasted insect food in the past	Piha et al., 2018	Yes/No for two items
	Q2.2 I have seen seaweed food in "real life"?		I have seen insect food in real life		
Neophobia	Q3.1 I am constantly sampling new and different foods		I am constantly sampling new and different foods	Pliner & Hobden, 1992	7-point Likert for six items
	Q3.2 I don't trust new foods		I don't trust new foods		
	Q3.3 If I don't know what is in a food, I won't try it		If I don't know what is in a food, I won't try it		
	Q3.4 I am afraid to eat things I have never had before		I am afraid to eat things I have never had before		
	Q3.3 I will eat almost anything		I will eat almost anything		
	Q3.4 Some foods look too weird to eat		Some foods look too weird to eat		
Acceptance	Readiness to adopt	Q4.1 I would be prepared to eat seaweed.	I would be prepared to eat insects as a substitute for meat.	Verbeke, 2015	7-point Likert for three items
	Willings to try	Q4.2 Would you personally be willing to try this product?	Would you personally be willing to try "X"?	Gómez-Luciano et al., 2019	

	Willings to buy	Q4.3 Would you personally be willing to purchase this product?	Would you personally be willing to purchase "X"?		
	Linking	Q4.4 I expected to like this product	I expect to like	Embling et al., 2022	100-mm visual analogue scale
Product Labelling (Attitude)	Q5.1 I would not take this logo into account		I would not take this logo into account	(Mejean et al., 2013)	7-point Likert for four items
	Q5.2 This logo is helpful, but I prefer basing my opinion on nutrition facts		This logo is helpful, but I prefer basing my opinion on nutrition facts		
	Q5.3 I would choose certain food products based on this logo		I would choose certain food products based on this logo		
	Q5.4 I would choose all my food products based on this logo		I would choose all my food products based on this logo		
Product Labelling (Perceived cognitive workload)	Q6.1 This label will help me choose a healthier product		This label will help me choose a healthier product	Vargas-Meza et al., 2019	5-point Likert for four items
	Q6.2 This label provides reliable information		This label provides reliable information		
	Q6.3 This label is too complex to understand		This label is too complex to understand		

	Q6.4 This label takes too long to understand	This label takes too long to understand		

Table 17 - Survey Constructor (Items and Scale)

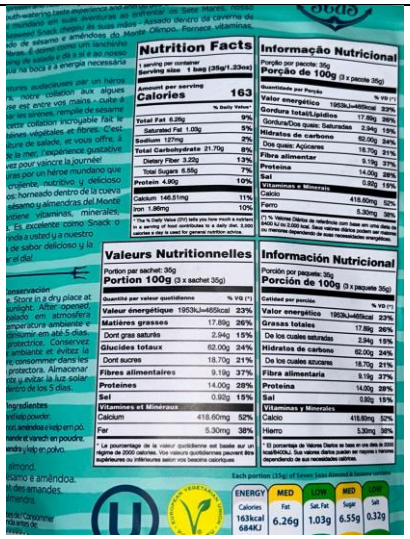
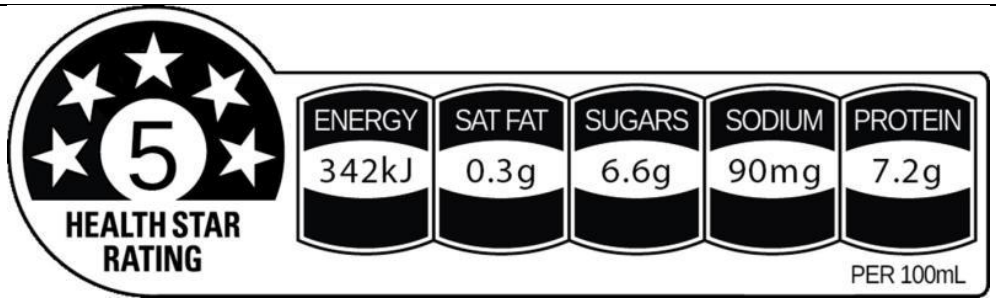
	
	

Table 18 - Seaweed snack product

Table 19 - Drink seaweed product

Table 20 - Season seaweed product


5
HEALTH STAR RATING
ENERGY
342kJ
SAT FAT
0.3g
SUGARS
6.6g
SODIUM
90mg
PROTEIN
7.2g
PER 100mL


GORDURA (Lípidos)
GORDURA SATURADA
AÇÚCARES
SAL
ALTO
mais de 17,5g
mais de 5g
mais de 22,5g
mais de 1,5g
MÉDIO
entre 3 e 17,5g
entre 1,5 e 5g
entre 5 e 22,5g
entre 0,3 e 1,5g
BAIXO
3g ou menos
1,5g ou menos
5g ou menos
0,3g ou menos

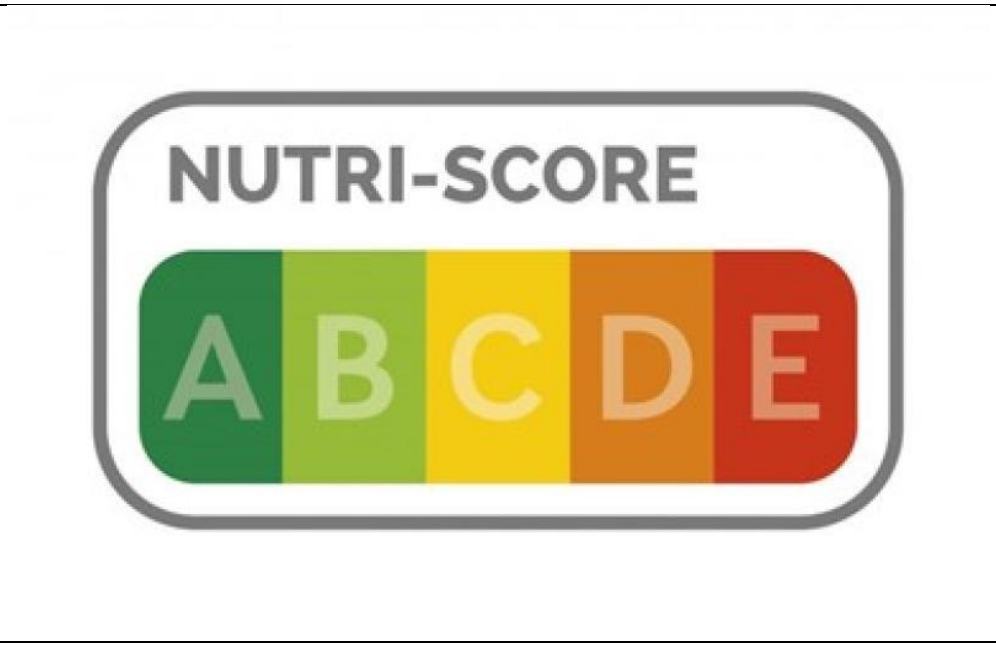

NUTRI-SCORE
A B C D E

Table 21 - Product labelling images

Product Label	Positive Responses%	Neutral Responses%	Negative Reponses%
Multi-Traffic Light	26.7%	53.3%	20.0%
Nutri- Score	46.1%	7.7%	46.2%
Product Star Rank	35.7%	42.9%	21.4%
Warning Label	42.8%	28.6%	28.6%

Table 22 - Answers to question Q5.3

Product Label	Positive Responses%	Neutral Responses%	Negative Reponses%
Multi-Traffic Light	6.7%	40.0%	53.3%
Nutri- Score	23.1%	23.1%	53.8%
Product Star Rank	28.6%	14.3%	57.1%
Warning Label	14.3%	21.4%	64.3%

Table 23 - Answers to question Q5.4

Product Label	Positive Responses%	Neutral Responses%	Negative Reponses%
Multi-Traffic Light	33.4%	33.3%	33.3%
Nutri- Score	23.0%	30.8%	46.2%
Product Star Rank	35.7%	28.6%	35.7%
Warning Label	35.7%	21.4%	42.9%

Table 24- Answers to question Q6.2