

Segmenting and profiling seaweed consumers: A cross-cultural comparison of Australia, the United Kingdom and Croatia

Marina Tomić Maksan¹, Daniel Matulić², Željka Mesić³, Juliet Memery⁴

¹ University of Zagreb Faculty of Agriculture Department of Marketing and Innovation in Agribusiness, Svetošimunska cesta 25, Zagreb, Croatia (matomic@agr.hr), corresponding author

² University of Zagreb Faculty of Agriculture Department of Fisheries, Apiculture, Wildlife management and special Zoology, Svetošimunska cesta 25, Zagreb, Croatia (dmatulic@agr.hr)

³ University of Zagreb Faculty of Agriculture Department of Marketing and Innovation in Agribusiness, Svetošimunska cesta 25, Zagreb, Croatia (zmesic@agr.hr)

⁴ Bournemouth University Business School, Department of Marketing, Strategy & Innovation, Fern Barrow, Poole, Dorset, BH12 5BB, United Kingdom (jmemery@bournemouth.ac.uk)

Abstract

Seaweed is increasingly recognised as a highly nutritious and sustainable food source. While it has a long tradition in many Asian countries, it still only plays a minor role in the Western diet. The aim of this study was to identify and describe consumer segments that are more likely to intend to consume seaweed. An online survey was conducted with 1,621 participants from three Western countries (Australia, the United Kingdom and Croatia) with different cultures, culinary traditions and levels of development in the seaweed industry. Two consumer segments were identified: Food Enthusiasts and Food Conservatives. The profiling of these segments is based on factors oriented to consumers' food innovativeness, food neophobia, food involvement, food responsibility, health consciousness, and symbolic value. The segments differ significantly in terms of food innovativeness, food neophobia, food involvement, eating and dietary style, past behaviour around seaweed consumption, future intention to eat seaweed and socio-demographic characteristics. These results provide valuable insights for the seaweed industry to develop effective marketing strategies that will meet the demands of different Western consumers.

Keywords: multinational study; sustainable food; seaweed consumption; segmentation; intention

1. Introduction

By 2050, the world's population is expected to reach 9.7 billion (UN DESA, 2022), with significant increases in urbanization and population density, particularly in developing countries (Cohen, 2003). As a result, demand for food will intensify, requiring a substantial increase in global food production. In response to growing demand, over recent decades' aquaculture has emerged as the fastest growing food-producing industry in the world and an important source of sustainable food (Eroldoğan et al., 2023; Fao, 2020). In 2022, the global seaweed cultivation market was worth US\$16.7 billion, and it is estimated to reach US\$30.2 billion by the end of 2028 (Market Data

Forecast, 2023). This represents a great opportunity for the seaweed industry in developed countries where seaweed aquaculture is still at an early stage (Gómez and Lähteenmäki-Uutela, 2021).

The consumption of seaweed has a long tradition in many Asian countries, whereas to date it has not played a significant role in the Western diet (Palmieri & Forleo, 2020; Chapman et al., 2015). However, recent studies indicate a growing interest in the consumption of algae in Western countries, particularly due to consumers' desire to eat healthier food (Monteiro et al., 2019). This shift is in line with the increasing acceptance of seaweed products in Western countries due to factors such as their high nutritional and health value, low carbon footprint and sustainability (Redway & Combet, 2023). de Boer et al. (2013) suggest that highly involved consumers can play a role as 'trendsetters' by valuing authentic protein sources, particularly seaweed products. Building on this, the findings of Birch et al. (2019a) suggest that healthconscious consumers are more inclined to include algae in their diet. Taken together, these findings point to a potential synergy where healthconscious consumers can act as trendsetters to contribute to the wider acceptance and adoption of algae as a nutritious and sustainable food source.

A growing number of studies highlighting the health benefits of seaweed consumption confirm this trend. Seaweeds are rich in essential macro- and micro-nutrients, including calcium, sodium, potassium, iodine, iron and zinc (Circuncisão et al., 2018). In addition to their nutritional value, the cultivation of seaweed also offers a promising solution to mitigate climate change (Froehlich et al., 2019). Bjerregaard et al. (2016) found that seaweed cultivation could contribute to the removal of around 135 million tons of carbon, which corresponds to about 3.2 % of the annual carbon input to seawater from greenhouse gas emissions. Due to their composition, seaweeds have significant potential as a sustainable resource for food production, with cultivation offering environmental benefits such as reduced dependence on fertilizers, pesticides, and freshwater (Froehlich et al., 2019).

Despite the recognized benefits of seaweed consumption and the increasing demand for sustainable products, consumers often deviate significantly from their intended purchasing behaviour (Van der Stricht et al., 2024). This deviation could be attributed to various barriers that prevent consumers from realizing their intentions, such as lack of knowledge and familiarity, as well as perceptions of affordability and availability (Birch et al., 2019a; Trondsen et al., 2003). A key factor influencing the acceptance of new foods is food neophobia (Hoek et al., 2011; Pelchat & Pliner, 1995). According to Pliner and Hobden (1992), food neophobia is "the aversion to eating and/or avoiding new foods". Previous studies (Birch et al., 2019b; Moons et al., 2018), cite this as the main barrier to the intention to consume seaweed.

The current study was conducted in three different western countries (Australia, the United Kingdom and Croatia) that offer favourable conditions for the cultivation of seaweed. These countries have extensive coastlines, access to the sea and abundant marine resources – ideal growing conditions for high-quality seaweed. However, they are all at different stages of seaweed industry development. The Australian seaweed industry is expanding rapidly and has ambitious plans to build a 1.5-billion-dollar industry by 2040. In the UK there are a growing number of commercial seaweed farms (Capuzzo, 2022a), and it is expected to hold the largest share of the

European seaweed market in 2023 (Market, 2023). Croatia's seaweed industry is still in its infancy with neither commercial seaweed producers nor commercial data on seaweed consumption. Recently in Croatia, the National Development Plan for Aquaculture for the period until 2027 was adopted, which, in the context of possible future seaweed farming, provides for the promotion of investments focused on technologies and innovation and the development of new products with higher added value in aquaculture (2022). However, before investing in this industry, it is important to better explore consumer profiles and preferences for seaweed as a food product, as emphasized by Birch et al. (2019a) and Van der Stricht et al. (2024).

According to Jenkins et al. (2021), most studies use demographic and geographic variables to segment target groups in the context of food, while psychological variables are used to provide a more explanatory and predictive approach (Kitunen et al., 2019). However, there are numerous segmentation studies based on psychological variables in the food context (Grunert, 2019). Grunert (2019) based his review on international segmentation in the food sector and came to the conclusion that there are three dominant approaches: segmentation according to (1) the importance of product benefits, (2) mid-end chains, and (3) food-related lifestyles. The most recent study (Govaerts & Olsen, 2024) aimed to understand segments of seaweed consumers based on the importance of consumer values and self-identity. They identified three segments, with the 'progressive' segment most likely to consume seaweed foods. Consumers in the progressive segment describe themselves as food innovative and healthy and place a high value on the environment and their enjoyment.

Although several studies have been conducted in different countries, e.g. Australia (Birch et al., 2019a), Italy (Palmieri & Forleo, 2022), France (Lucas et al., 2019), Norway (Govaerts & Olsen, 2022) and the United Kingdom (Redway et al., 2022), cross-country studies on consumer segmentation in the area of seaweed consumption are lacking (Van der Stricht et al., 2024).

This study aimed to fill the existing research gap and provide valuable information that can improve the understanding of consumer behaviour related to the intention to consume seaweed products. The objectives of this study were: (1) a segmentation of consumers based on psychological determinants i.e. food innovativeness, food neophobia, food involvement, food responsibility, health consciousness, and symbolic value, and (2) a description of the obtained segments based on socio-demographic data, intention to consume seaweed, past behaviour in seaweed consumption, and eating and dietary style.

2. Related literature

Consumer segmentation is the process of dividing a market into smaller groups of consumers who have similar needs or characteristics (Dickson & Ginter, 1987), and it is one of the key factors in successful marketing. Although the variable-centred approach is the traditional and predominant approach in the social sciences, the person-centred approach (e.g., cluster analyses) is rapidly gaining popularity (Howard & Hoffman, 2018). This study utilised the person-centred approach, which is best suited for investigating research questions and hypotheses that aim to categorize subjects into common subpopulations based on substantive variables (Howard & Hoffman, 2018).

Previous studies on consumer behaviour around seaweed consumption have used different variables to explore the consumer market, including food neophobia (Losada-Lopez et al., 2021), environmental values and self-identity (Govaerts & Olsen, 2022), purchase attributes (Jang & Kim, 2017), knowledge, personal norms and attitudes (Govaerts, 2023), as well as socio-demographic characteristics (Palmieri & Forleo, 2020). They have found that food neophobia, food innovativeness and health consciousness play an important role in seaweed consumption (Birch et al., 2019a; Birch et al., 2019b; Govaerts & Olsen, 2022). In addition, consumers with higher food involvement tend to prioritize their health and nutrition, and seaweed consumption is associated with many health benefits as detailed in the Introduction. Previous studies have shown that there is a shift towards sustainable food sources such as some seaweed species from an environmental perspective (Brunsø et al., 2021). According to Birch et al. (2019a; 2019b), consumers attach more symbolic value to seaweed when making food choices, which has a significant impact on understanding the motives for choosing seaweed. Finally, socio-economic factors such as gender, age, income and education are also included, as previous studies have highlighted their importance for seaweed consumption (Birch et al., 2019a; 2019b).

Although these constructs have been examined individually in previous research related to seaweed consumption behaviour, to our knowledge they have not yet been used together for the purposes of consumer segmentation. By summarizing the analysis and confirming the validity of the scales, we provide deeper insight into the various factors that influence consumers intention to eat seaweed.

2.1. Food innovativeness

Although the consumption of seaweed has a long tradition in Asia, it is still unfamiliar and unknown to most Western consumers. Consequently, the impact of food innovativeness level on seaweed consumption is important as previous studies suggest that it plays a crucial role in people's willingness to purchase and consume new foods (Persaud & Schillo, 2017). Consumer innovativeness or 'consumption of novelty' is the tendency to buy new products more often and faster than other people (Midgley & Dowling, 1978). Consumer innovativeness in food therefore refers to the propensity of consumers to buy new food products. Previous studies have found that consumer innovativeness is positively related to the consumption of novel foods (Huotilainen et al., 2006), such as seaweed (Govaerts & Olsen, 2022). In general, the most innovative consumers are younger, well-educated and have a higher income (Sajdakowska et al., 2018).

2.2. Food neophobia

It is important to understand what psychological factors influence consumers' intention to eat new foods (like seaweed). Psychological factors are key to understanding people's behaviour (Jenkins et al., 2021). Earlier studies found that food neophobia makes the greatest contribution to the likelihood of people consuming seaweed. Losada-Lopez et al. (2021) confirm that food neophobia influences the intention to consume seaweed. Birch et al. (2019a), identified food neophobia as a major barrier to seaweed consumption. Palmieri et al. (2023) investigated consumer perceptions of alternative proteins like seaweed, insects, and jellyfish, focusing on their gastronomic potential and found that seaweed is seen most favourably for health, while jellyfish is viewed as most beneficial for the environment. They also identified consumer preferences for different food

preparations and introduced a gastronomic index, showing a positive correlation between health perceptions and willingness to consume, but a negative correlation between age and food neophobia. Camire and Banus (2020) also reported limited consumption of seaweed by neophobic consumers in the northeastern states of the United States. Consumers of seaweed products tend to be neophilic and willing to try new products (Altintzoglou et al., 2016). Palmieri and Forleo (2020) found low levels of food neophobia among surveyed seaweed consumers in Italy. Previous studies found neophobic consumers are older, have a lower level of education and belong to a lower social class (Hazley et al., 2022; Mascarello et al., 2020). Van den Heuvel et al. (2019) found a small number of studies show adult men have higher food neophobia than adult women (Siegrist et al., 2013; Tuorila et al., 2001), explaining these results by the fact that women are exposed to and familiar with a greater variety of foods because they are more often responsible for food shopping and preparation (Siegrist et al., 2013).

2.3. Food involvement

The concept of involvement can be explained as the level of cognitive arousal and interest that consumers demonstrate while making specific purchase decisions (Kamrath et al., 2019). Involvement is one of the most commonly used constructs to explain consumer behaviour in food purchase and consumption (Sharma & Klein, 2020; Borgogno et al., 2015), allowing researchers to better predict and understand food consumption behaviour (Kamrath et al., 2019). Consumers who are more engaged with food tend to prioritize their health and nutrition. Consumers who are more concerned with their health and nutrition tend to consume functional foods (Chen, 2011). Seaweeds are often considered functional foods because they are rich in bioactive antioxidants, soluble fibre, proteins, minerals, vitamins, phytochemicals and polyunsaturated fatty acids (Mohamed et al., 2012). The results of previous studies indicate that there is a positive and significant relationship between food involvement and food variety seeking (Derinalp Çanakçı & Birdir, 2020). Highly involved consumers may become 'trendsetters' who value authentic protein sources such as seaweed (de Boer et al., 2013).

2.4. Food responsibility

In recent years, the concept of food responsibility has gained considerable attention (Brunsø et al., 2021; Birch et al., 2019a), reflecting growing consumer concern about the origin and content, production methods and environmental impact of food. Food responsibility encompasses several dimensions, including ethical considerations and environmental impact. Brunsø et al. (2021) state that, from an environmental perspective, there is a shift towards sustainable food sources such as some seaweed species, which offer a protein-rich alternative that can help reduce the carbon footprint associated with conventional animal proteins (de Boer et al., 2013).

2.5. Health consciousness

Health is one of the strongest determinants of food choice (Wongprawmas et al., 2021). Seaweeds are considered to be beneficial to consumer health (Pereira, 2016), with previous studies finding a strong correlation between consuming sustainable food and health benefits (Bryła, 2016; Lea & Worsley, 2005). Loebnitz and Grunert (2018) found that health-conscious consumers have a higher purchase intention for sustainable food. Health consciousness refers to the extent to which health

concerns are integrated into a person's daily activities (Jayanti & Burns, 1998). The consumption of nutrient-rich seaweed is a fast-growing trend among health-conscious consumers (Skonberg et al., 2021). Ready-to-eat meals and snacks containing seaweed have been developed, targeting health-conscious consumers and further utilizing the nutritional properties of seaweed. According to Birch et al. (2019b), health-conscious consumers are more likely to consume seaweed. This finding is also consistent with the willingness to consume seaweed in Italy (Palmieri & Forleo, 2020), suggesting that the Italian population is becoming more open to novel foods, especially those that represent a healthy option.

2.6. Symbolic value

Previous studies have found that food not only has nutritional value, but also significant symbolic value (Beagan et al., 2017; Cairns & Johnston, 2015). Symbolic value refers to the symbolic meanings associated with food (May, 2011). Many top chefs have initiated a trend towards a new seaweed gastronomy (phycogastronomy) (Mouritsen et al., 2019), so it can be concluded that the consumption of seaweed may have a certain symbolic value for the consumer. Moreover, edible seaweeds are one of the trending foods on the market (Losada-Lopez et al., 2021). According to Perrea et al. (2017), consumers make a connection between the new foods and a certain reference group affiliation and thus obtain a symbolic value from eating the new foods, e.g. that they are health-oriented and edible seaweed is labelled as a "superfood". In Birch et al. (2019a; 2019b), seaweed consumers were more likely to assign a symbolic value to food choice, which had a significant influence on seaweed choice motives. The authors concluded that the use of associations such as "you are what you eat" and the possibility of seaweed being seen as a "chic" or "trendy" food should drive branding strategies and promotional activities for new seaweed products.

2.7. Socio-demographic characteristics

In terms of socio-demographic characteristics, gender, age, income and education were found to correlate significantly with the intention to consume seaweed. Women, younger consumers, consumers with higher household income (Birch et al., 2019b) and with higher education (Birch et al., 2019a) are more likely to consume seaweed products.

3. Material and methods

This study employed a quantitative research design that allowed for the identification of consumer types based on psychological determinants (food innovativeness; food neophobia; food involvement; food responsibility; health consciousness; and symbolic value) and seaweed consumption behaviour (past behaviour; future intention). The questionnaire also included measures of socio-demographic characteristics and dietary style.

3.1. Data collection

An online survey instrument utilising commercial consumer panels was employed to collect data from three countries (n = 1,621: Australia n = 521; UK n = 519, Croatia n = 574). Respondents were filtered to ensure compliance with the study's requirements i.e. over 18 years of age; main/shared responsibility for purchasing and cooking food in the household.

The survey was developed and carried out in English in Australia and the UK. In Croatia it was translated to Croatian language. First, by a professional translator familiar with agricultural economics topics, then this translation was revised by three Croatian scientists with an excellent knowledge of English language (from University of Zagreb Faculty of Agriculture). A pilot study was performed with 30 respondents to test the clearness of the items in the Croatian language.

The questions asked were identical across the three countries, with the exceptions of region of residence, household income, ethnicity, and country of origin questions which were adapted to the particular country in question (Ares, 2018).

During data collection submitted responses were checked for 'straight-lining' (Zhang & Conrad, 2014) and completion time (Goldammer et al., 2020), with those who appeared not to have responded accurately by choosing the same response option multiple times or to have completed the questionnaire too quickly, considered as potentially affecting the data quality (Jaeger & Cardello, 2022) and so were excluded from the process and other respondents sought.

3.2. Measures

Measures in this study utilised six scales taken from previous studies, chosen based on a combination of their substantive suitability and prior performance. Food innovativeness borrowed 4-items from Brunsø et al. (2021). Food Neophobia (14 items) was measured through a combination of the 10 items utilised by Pliner and Hobden (1992) in their Food Neophobia Scale, and four newly developed items (I only eat foods which are familiar to me; I dislike anything that will change my eating habits; When traveling, I search for familiar foods to eat; I am quite adventurous with food) to reflect contemporary issues and behaviour. To identify Food Involvement three items from Brunsø et al. (2021) were used. Food Responsibility was measured with three items taken from Brunsø et al. (2021). Health Consciousness utilised 3-items taken from the research of Gould (1988). Symbolic Value represents a 6-item scale borrowed from research by Kapferer and Laurent (1985) and Jain and Srinivasan (1990) consumer involvement profile scales.

Each item was measured on a 7-point Likert scale ranging from 1 = strongly disagree to 7 = strongly agree. Past behaviour was measured with 2 questions: "Have you ever eaten or tasted seaweed?" with yes, no and not sure categories, and "How often have you eaten seaweed products in the past 12 months?" with an 8-point scale from 'Daily' to 'Less than once in the past 12 months' as well as the options of 'I have never eaten seaweed products' and 'I don't know if I have eaten seaweed or not'. Future intention was measured with one question (How likely is it that you will eat seaweed products in the next 12 months?) on a 7-point scale from 1 = not at all likely to 7 = highly likely.

3.3. Data analysis

The data were analysed using the statistical package SPSS v.28. Whilst the three countries in the study were all considered 'westernised', each country was analysed separately to allow for any differences and nuances to be seen.

Univariate (descriptive) analysis was performed to examine the overall profile of the sample. Subsequently, an exploratory factor analysis (EFA) using principal components analysis with varimax rotation was applied as an estimation method to identify the dimensions of food

innovativeness, food neophobia, food involvement, food responsibility, health consciousness and symbolic value. The criteria proposed by Hair et al. (2009) was followed: (1) eigenvalues equal to or above 1.0 and (2) factor loadings equal to or above 0.50. Furthermore, KMO values should exceed 0.6 and Bartlett's Test of Sphericity values should be significant (i.e. 0.05 or less) (Pallant, 2010).

A forced 6-factor solution was determined. Following this procedure and in accordance with the recommendations of Hair et al. (2009) three items from the food neophobia scale ("I will eat almost anything", "If I don't know what is in the food, I won't try it" and "I am very particular about foods I will eat") were excluded from further analysis as they had low factor loadings in all three countries. Two items from the food involvement scale were removed as they cross-loaded or had low factor loadings in all three countries ("Decisions about what I eat and drink are very important to me" and "I take food preparation very seriously"). In addition, one item was removed from the food involvement scale as the factor loadings were < 0.5 in all countries ("I rarely talk about food and meals").

The EFA was re-run, and the resulting rotated component matrix (Table 2) shows a clear and substantively explainable set of factors (Nunnally & Bernstein, 1994). Factor scores for each respondent were then stored and used for clustering into market segments. Cronbach's α was used to check the internal consistency of the items with all six factors. According to Hair et al. (2009), a reliability of more than 0.7 ($\alpha > 0.7$) is required for practical significance. In order to identify the different consumer types, a hierarchical cluster analysis was carried out.

Factor scores were then used to cluster respondents into market segments, with Euclidean distances and Ward's aggregation method applied in the analyses.

Subsequently, a bivariate analysis (chi-square test) was performed to explore the differences between the clusters in terms of sociodemographic characteristics, eating and dietary habits and experience of seaweed consumption. Finally, a chi-square analysis was used to test whether there were differences between consumer segments in terms of intention to eat seaweed.

4. Results

4.1. Sample descriptive data

Females dominated the sample in all three countries (Australia: $n = 315$ (60.5 %); UK: $n = 355$ (68.4 %); Croatia: $n = 358$ (62.4 %)) – see Table 1 – and is likely reflective of the requirement that participants were the person with the main/shared responsibility for purchasing and cooking food in the household. According to Alsini et al. (2023) females more often do food shopping, and they are more inclined to fill out online surveys (Moore & Tarnai, 2002).

All age ranges were reflected in the data collected, however those aged 30–44 years were the dominant age range in all three countries (Australia: $n = 153$ (29.4 %); UK: $n = 242$ (46.6 %); Croatia: $n = 223$ (38.9 %)) followed by 45–49 years, under 30 years, and 60 + years respectively. In terms of the highest level of education achieved, this varied by country with Australia finding the highest number of respondents had obtained a trade or technical certificate ($n = 171$ (32.8 %)), whilst in the UK it was secondary school ($n = 186$ (35.8 %)), and in Croatia an undergraduate degree ($n = 201$ (35.0 %)). However, despite this difference, the majority of respondents had one of these three

levels of education, with just a small number only having finished primary school (Australia: n = 2 (0.4 %); UK: n = 5 (1.0 %); Croatia: n = 4 (0.7 %)). Croatian respondents were more likely to have a postgraduate degree (n = 131 (22.8 %)) than either respondents in Australia (n = 65 (12.5 %)) or the UK (n = 61 (11.8 %)).

Table 1. Sample characteristics

Socio-demographics		Australia (n=521)		UK (n=519)		Croatia (n=574)	
		N	%	N	%	N	%
Gender	Male	202	38.8	164	31.6	213	37.1
	Female	315	60.5	355	68.4	358	62.4
	Prefer not to say	4	0.8	0	0.0	3	0.5
Age	Under 30	124	23.8	122	23.5	93	16.2
	30-44 years	153	29.4	242	46.6	223	38.9
	45-59 years	135	25.9	125	24.1	181	31.5
	60 + years	109	20.9	30	5.8	77	13.4
Highest educational level	Primary School	2	0.4	5	1.0	4	0.7
	Secondary School	157	30.1	186	35.8	152	26.5
	Trade or Technical certificate	171	32.8	122	23.5	86	15.0
	Undergraduate degree	126	24.2	145	27.9	201	35.0
	Postgraduate degree	65	12.5	61	11.8	131	22.8
Eating and dietary style	Vegan (no animal products at all)	9	1.7	15	2.9	28	4.9
	Vegetarian (I do not eat meat or fish, but I will eat eggs and dairy)	25	4.8	25	4.8	24	4.2
	Pescetarian (I only eat fish/seafood)	9	1.7	18	3.5	17	3.0
	I prefer to eat fish, but I will eat other animal proteins such as red meat, pork or chicken	59	11.3	66	12.7	83	14.5
	I eat red meat, fish/seafood, eggs and dairy	300	57.6	235	45.3	301	52.4
	I prefer to eat red meat, pork and or chicken rather than fish or seafood	119	22.8	160	30.8	121	21.1
Have you ever eaten or tasted seaweed?	Yes	370	71	355	68.4	305	53.1
	No	132	25.3	139	26.8	208	36.2
	Not sure	19	3.6	25	4.8	61	10.6
How often have you eaten seaweed products in the past 12 months?	Daily	3	0.6	3	0.6	12	2.1
	More than once each week but not daily	41	7.9	16	3.1	31	5.4
	About once each fortnight	74	14.2	22	4.2	30	5.2
	About once each month	77	14.8	45	8.7	28	4.9
	About once in the past 3 months	46	8.8	56	10.8	48	8.4
	About once in the past 6 months	39	7.5	57	11.0	38	6.6
	About once in the past 12 months	32	6.1	48	9.2	55	9.6
	Less than once in the past 12 months	68	13.1	114	22.0	97	16.9
	I have never eaten seaweed products	93	17.9	114	22.0	235	40.9
	I don't know if I have eaten seaweed or not	48	9.2	44	8.5	0	0.0

The main dietary style in all three countries was the consumption of red meat, fish/seafood, eggs and dairy (Australia: n = 300 (57.6 %); UK: n = 235 (45.3 %); Croatia: n = 301 (52.4 %)). Only a small number identified their dietary style as vegetarian (Australia: n = 25 (4.8 %); UK: n = 25 (4.8 %);

Croatia: n = 24 (4.2 %) or vegan (Australia: n = 9 (1.7 %); UK: n = 15 (2.9 %); Croatia: n = 28 (4.9 %)). More than half of the respondents in each country stated they had at some point eaten or tasted seaweed (Australia: n = 370 (71.0 %); UK: n = 355 (68.4 %); Croatia: n = 305 (53.1 %)). Seaweed consumption tended to have occurred more recently for Australian respondents than those in the UK or Croatia, with 241 (46.3 %) Australian respondents indicating they had eaten seaweed products at least once in the past three months compared to 142 (27.4 %) UK respondents and 149 (26.0 %) Croatian respondents.

4.2. Principal component analysis

A Kaiser–Mayer–Olkin measure yielded > 0.6 in all three countries, so indicated that the data were appropriate for principal components analysis. The results yielded a six-factor solution that explained between 66.40 % and 70.31 % (Australia = 70.31 %; United Kingdom = 66.40 %; Croatia = 69.70 %) of the total variance. All factors showed high reliability based on Cronbach’s alpha coefficients ranging from 0.763 to 0.927. The final results of the factor analysis are presented in Table 2.

Table 2. Factor analysis

Australia	UK	Croatia	Construct	Australia			UK			Croatia		
Cronbach alpha				Factor loading	Mean	SD	Factor loading	Mean	SD	Factor loading	Mean	SD
.927	.910	.915	Food innovativeness		4.84	1.16		4.69	1.24		5.58	1.05
			I like foods from different countries	.563			.545			.695		
			I like to try new foods that I have never tasted before	.651			.620			.728		
			I am constantly sampling new and different foods	.717			.678			.769		
			Recipes and articles on food from other culinary traditions encourage me to experiment in the kitchen	.789			.683			.594		
			I like to try out new recipes	.741			.648			.589		
			I look for ways to prepare unusual meals	.784			.720			.704		
			I am quite adventurous with food	.734			.758			.735		
			I like to try new ethnic restaurants	.750			.744			.746		
			At dinner parties, I will try a new food	.613			.582			.523		
			Food neophobia									
.868	.843	.859	I am afraid to eat things I have never had before	.816	3.55	1.27	.714			.702	3.38	1.27
			Food from other cultures looks too weird to eat	.777			.732			.748		
			I don't trust new foods	.773			.720			.728		

			I only eat foods which are familiar to me	.772			.805	3.64	1.27	.731		
			I dislike anything that will change my eating habits	.748			.722			.808		
			When travelling, I search for familiar foods to eat	.607			.633			.692		
			Food involvement									
.866	.837	.866	Food and drink is an important part of my life	.747	5.40	1.13	.824	5.23	1.23	.832	5.51	1.20
			Eating and drinking are a continuous source of joy for me	.727			.774			.812		
			I just love good food	.771			.741			.820		
			Food responsibility									
.828	.820	.865	I try to choose food that is produced in a sustainable way	.812	4.78	1.37	.814	4.81	1.24	.798	5.31	1.20
			It is important to understand the environmental impact of our eating habits	.776			.833			.815		
			I am concerned about the conditions under which the food I buy is produced	.788			.768			.801		
			Health consciousness									
.816	.771	.845	I reflect about my health a lot	.806	4.84	1.12	.753	4.77	1.24	.825	5.34	1.07
			I'm usually aware of my health	.776			.703			.824		
			I'm very self-conscious about my health	.684			.759			.716		
			Symbolic value									
.866	.763	.879	What and where someone eats, says something about who they are as a person	.855	4.21	1.30	.819	4.18	1.36	.891	4.05	1.47
			You can tell a lot about a person, by what they eat	.822			.816			.885		
			The food you eat is an expression of your personality	.794			.683			.774		

Extraction Method: Principal Component Analysis; Rotation Method: Varimax with Kaiser Normalization

Trying new recipes, being adventurous with food, liking foods from different countries, trying and liking new and different food, visiting new ethnic restaurants, preparing unusual meals, and experimenting in the kitchen, are the focus of factor 1, which relates to 'food innovativeness'. Factor 2, 'food neophobia', focuses on fear of new foods, searching for familiar foods when travelling, eating only familiar foods, distrusting new foods, considering foods from other cultures weird and disliking anything that might change eating habits. Factor 3 relates to 'food involvement', which means loving good food, considering food and drink as an important part of life and a constant source of joy. Choosing food that has been produced with minimal impact on the environment, produced in a sustainable way and trying to buy organically produced food is related to factor 4, which is best described as 'food responsibility'. 'Health consciousness' (Factor 5) means being aware of your state of health and being very self-conscious

about your health, so that you think about it a lot. 'Symbolic value' (factor 6) refers to food and its consumption as an expression of personality. Croatian respondents scored highest on food innovativeness, food involvement, food responsibility, health consciousness and symbolic value, while respondents in Australia scored highest on food neophobia.

The Pearson product correlation matrix of the study variables is presented in Table 3. As expected, past behaviour (PB) is highly positively correlated with intention ($r_{PB-I} = 0.770$). High and positive correlations were also found between food innovativeness (INN) and the intention to consume seaweed ($r_{INN-I} = 0.439$). Additionally, the intention to consume seaweed was also positively correlated with food responsibility ($r_{FR-I} = 0.322$) and symbolic value (SV) ($r_{SV-I} = 0.319$). Negative and significant correlations were found between food neophobia (FN) and the intention to consume seaweed ($r_{FN-I} = 0.340$). All the constructs had a significant correlation with past behaviour ($p < 0.01$). The remaining interrelationships between the variables are listed in Table 3.

Table 3. Correlation matrix

	Mean	Std. Deviation	Food neophobia	Food innovativeness	Health consciousness	Symbolic value	Food involvement	Food responsibility	Past behaviour	Intention
Food neophobia	3,38	1,27	1	-,432**	-,043	-,035	-,203**	,056	-,342**	-,340**
Food innovativeness	4,58	1,05		1	,366**	,399**	,540**	,321**	,375**	,439**
Health consciousness	5,34	1,07			1	,364**	,335**	,545**	,316**	,302**
Symbolic value	4,05	1,47				1	,321**	,353**	,264**	,319**
Food involvement	5,51	1,20					1	,263**	,237**	,241**
Food responsibility	5,31	1,20						1	,331**	,322**
Past behaviour	3,00	2,37							1	,770**
Intention	3,86	1,96								1

** . Correlation is significant at the 0.01 level

4.3. Distinguishing consumer types (Cluster analysis)

Subsequently a cluster analysis procedure was used to segment consumers into different types using the dimensions of food neophobia, food innovativeness, health consciousness, symbolic value, food involvement, food responsibility and relevant socio-demographics and seaweed consumption variables. ANOVA tests reveal that all six factors contributed to differentiating the two consumer segments ($p < 0.01$). To evaluate how well the clusters are differentiated based on specific variables, we conducted a discriminant analysis. The results indicated that 86.6 % of respondents in Australia 91.9 % in the UK, and 84.7 % in Croatia were correctly assigned to their respective clusters. This high accuracy suggests that the respondents are grouped according to their true similarities and differences. Additionally, we tested alternative analyses with a larger number of clusters (3 and 4), and visually inspected the resulting dendograms, but these results were notably less effective. Specifically, a lower percentage of respondents were correctly classified, indicating that these additional clusters were less coherent and did not accurately capture the data patterns. Therefore, the two-cluster solution provides the clearest and most accurate segmentation of respondents.

Two obtained market segments were named and interpreted using original variables (food innovativeness, food neophobia, food involvement, food responsibility, health consciousness and symbolic value) entered into factor analyses (Table 2), past behaviour in seaweed consumption (have they ever tasted seaweed, frequency of seaweed products consumption in the past 12 months), dietary style and socio-demographics (gender, age, educational level).

Identified market segments were named and characterised as:

4.3.1. Cluster 1: The 'Food Enthusiasts'

Almost 60 % of respondents in Australia are Food Enthusiasts, while in the UK the proportion of Food Enthusiasts is only 22 %. In Croatia, 40.8 % of respondents are Food Enthusiasts. This segment has a higher level of food innovativeness and food involvement in all three countries. The food neophobia of respondents in Cluster 1 is lower in all countries surveyed than in Cluster 2. The health consciousness of Food Enthusiasts is also higher in all three countries, although only in the UK is there a statistical difference between Cluster 1 and Cluster 2. The sense of food responsibility is also higher among the Food Enthusiasts, but in Croatia the difference between Cluster 1 and Cluster 2 in terms of food responsibility is not significant. The symbolic value is higher in this segment in the UK, while it is lower in Australia and Croatia. (see Table 4).

The results of the chi-square tests indicated that clusters were found to be statistically significantly different with respect to socio-demographic characteristics, eating and dietary style, past behaviour in seaweed consumption and future intention to eat seaweed.

In this consumer segment, there is a higher proportion of vegetarians, pescatarians and consumers who prefer fish but also eat other animal proteins. Food Enthusiasts in all three countries are younger and have a high level of education.

In terms of previous seaweed consumption behaviour, the proportion of Food Enthusiasts who have already tried seaweed is higher, while in Australia there is no statistical difference between Cluster 1 and Cluster 2 in terms of previous experience of seaweed consumption. In addition, this

consumer segment in all three countries have eaten seaweed more frequently in the last 12 months, although the difference between the two clusters in Australia is not statistically significant.

Table 4. Consumer segments

	Australia			UK			Croatia		
	Food Enthusiasts n=312 59.9%	Food Conservatives n=209 40.1%	p	Food Enthusiasts n=114 22.0%	Food Conservatives n=405 78.0%	p	Food Enthusiasts n=234, 40.8%	Food Conservatives n=340, 59.2%	p
Food neophobia	3.32(1.26)	4.13(1.12)	<0.01	2.62(1.07)	3.81(1.20)	<0.01	2.43(0.81)	4.03(1.11)	<0.01
Food Innovativeness	4.81(1.30)	4.51(1.11)	<0.01	5.64(0.78)	4.61(1.15)	<0.01	5.18(0.80)	4.17(1.00)	<0.01
Health consciousness	4.83(1.24)	4.68(1.24)	>0.05	5.37(1.12)	4.69(1.07)	<0.01	5.36(0.98)	5.32(1.13)	>0.05
Symbolic Value	4.03(1.45)	4.40(1.18)	<0.05	5.44(0.71)	3.86(1.21)	<0.01	3.96(1.59)	4.11(1.38)	>0.05
Food Involvement	5.74(0.97)	4.47(1.18)	<0.01	6.24(0.67)	5.16(1.12)	<0.01	5.90 (0.94)	5.23(1.28)	<0.01
Food Responsibility	4.91(1.23)	4.64(1.24)	<0.05	5.42(1.22)	4.61(1.36)	<0.01	5.30 (1.08)	5.29(1.27)	>0.05

Note: 1 strongly disagree, 7 strongly agree, ANOVA test, $p < 0.05$

4.3.2. Cluster 2 the 'Food Conservatives'

This segment comprises 78 % of all respondents in the United Kingdom, while in Australia the proportion of Food Conservatives is only 40.1 %. In Croatia, 59.2 % of respondents are Food Conservatives. Compared to Cluster 1, respondents in this segment exhibit a higher level of food neophobia. In all countries surveyed, the Food Conservatives have a lower level of food innovativeness and food involvement. Respondents in this cluster have a lower level of health consciousness (in Australia and Croatia there is no statistically significant difference between Cluster 1 and Cluster 2). Their sense of food responsibility is also lower compared to the Food Enthusiasts, although this is not significant in Croatia. The results presented in Table 4 show that the symbolic value of UK respondents in this segment is lower, while the symbolic value of Australian and Croatian Food Conservatives is higher.

Food Conservatives are older, and the proportion of respondents in this segment who prefer to eat red meat, pork or chicken rather than fish or seafood is higher in the UK and Croatia.

Looking at past consumption patterns of seaweed, Conservative food consumers have less experience of eating seaweed (the proportion of respondents who have tried seaweed is lower). However, in Australia, there is no statistical difference between Cluster 1 and Cluster 2 in terms of previous experience with seaweed consumption. In addition, respondents in this segment were less likely to have eaten seaweed in the last 12 months in all countries surveyed, but again the difference between the two clusters in Australia was not statistically significant (see Table 5).

Table 5. Differences between segments regarding socio-demographics and seaweed consumption

Australia					UK			Croatia		
		Food Enthusiasts %	Food Conservatives %	p	Food Enthusiasts %	Food Conservatives %	p	Food Enthusiasts %	Food Conservatives %	p
Gender	Male	43.1	35.9	>0.05	31.6	31.6	>0.05	33.3	39.7	>0.05
	Female	56.0	63.5		68.4	68.4		66.7	59.4	
	Prefer not to say	1.0	0.6		0.0	0.0		0.0	0.9	
Age	<30 years	29.7	19.9	<0.01	26.3	22.7	>0.05	21.8	12.4	<0.01
	30-44 years	32.5	27.2		52.6	44.9		40.2	37.9	
	45-59 years	22.5	28.2		17.5	25.9		28.6	33.5	
	60+ years	15.3	24.7		3.5	6.4		9.4	16.2	
Highest educational level	Primary School	0.5	0.3	<0.05	0.0	1.2	<0.01	0.0	1.2	<0.05
	Secondary School	36.8	25.6		20.2	40.2		20.9	30.3	
	Trade or Technical certificate	26.8	36.9		22.8	23.7		17.5	13.2	
	Undergraduate degree	22.0	25.6		36.8	25.4		35.9	34.4	
	Postgraduate degree	13.9	11.5		20.2	9.4		25.6	20.9	
Have you ever eaten or tasted seaweed?	Yes	68.4	72.8	>0.05	82.5	64.4	<0.01	70.9	40.9	<0.01
	No	26.3	24.7		12.3	30.9		20.5	47.1	
	Not sure	5.3	2.6		5.3	4.7		8.5	12.1	
How often have you eaten seaweed products in the past 12 months?	Daily	1.4	0.0	>0.05	0.0	0.7	<0.01	1.7	2.4	<0.01
	More than once each week but not daily	8.6	7.4		4.4	2.7		6.0	5.0	
	About once each fortnight	12.4	15.4		3.5	4.4		7.7	3.5	
	About once each month	12.4	16.3		9.6	8.4		7.7	2.9	
	About once in the past 3 months	9.1	8.7		15.8	9.4		13.2	5.0	
	About once in the past 6 months	9.6	6.1		18.4	8.9		9.0	5.0	
	About once in the past 12 months	4.3	7.4		14.0	7.9		12.0	7.9	
	Less than once in the past 12 months	12.9	13.1		15.8	23.7		18.8	15.6	
	I have never eaten seaweed products	18.7	17.3		10.5	25.2		23.9	52.6	

	I don't know if I have eaten seaweed or not	10.5	8.3		7.9	8.6		0.0	0.0	
Eating and dietary style	Vegan (no animal products at all)	4.3	0.0	<0.01	4.4	2.5	<0.05	3.4	5.9	<0.05
	Vegetarian (I do not eat meat or fish, but I will eat eggs and dairy)	6.7	3.5		6.1	4.4		4.3	4.1	
	Pescetarian (I only eat fish/seafood)	2.4	1.3		5.3	3.0		4.3	2.1	
	I prefer to eat fish, but I will eat other animal proteins such as red meat, pork or chicken	13.4	9.9		13.2	12.6		17.5	12.4	
	I eat red meat, fish/seafood, eggs and dairy	48.8	63.5		53.5	43.0		55.6	50.3	
	I prefer to eat red meat, pork and or chicken rather than fish or seafood	24.4	21.8		17.5	34.6		15.0	25.3	

Note: Chi-square test, $p < 0.05$

A chi-square analysis was then performed to examine the differences in intention to consume seaweed products between Food Enthusiasts and Food Conservatives. The results show that there is a statistically significant difference between the two clusters in terms of their intention to consume seaweed products in the next 12 months. As expected, in all three countries Food Enthusiasts have a higher intention to eat seaweed in the next 12 months (see Table 6).

Table 6. Segments according to intention to eat seaweed products in the next 12 months

		Australia			UK			Croatia		
		Food Enthusiasts %	Food Conservatives %	p	Food Enthusiasts %	Food Conservatives %	p	Food Enthusiasts %	Food Conservatives %	p
How likely is that you will eat seaweed products in the next 12 months?	Not at all likely	19.0	23.0	<0.05	8.8	24.9	<0.01	8.1	18.8	<0.01
	Very unlikely	7.4	4.8		5.3	9.9		6.4	10.0	
	Unlikely	3.5	7.7		5.3	6.9		23.9	34.7	
	Neither likely nor unlikely	15.2	15.8		22.8	19.5		13.7	7.9	
	Likely	15.5	22.0		24.6	20.0		14.5	11.2	
	Very likely	16.1	13.4		14.9	10.4		10.7	5.3	
	Highly likely	23.2	13.4		18.4	8.4		22.6	12.1	

Note: Chi-square test, $p < 0.05$

5. Discussion

This study investigated consumer behaviour in relation to the consumption of seaweed. It classified and described consumers into groups to understand the specific needs of the seaweed market in three Western countries with different eating habits and levels of development in the seaweed industry. Psychological factors were used in the segmentation of consumers. Results of the study are of great value for understanding consumer behaviour in seaweed consumption on a multinational level.

In this study, we found that the proportion of seaweed consumers (those who already consumed seaweed and those who have consumed seaweed more frequently in the last 12 months) is higher in Australia than in the UK and Croatia. These results can be linked to the fact that commercial seaweed farming is growing rapidly in Australia (Australian Seaweed Institute, 2020). The Australian seaweed industry has ambitious plans to build a 1.5-billion-dollar industry by 2040. In the UK, the seaweed industry is still relatively young but has developed over the last 10 years with a new wave of interest in seaweed aquaculture from government bodies such as Defra (Capuzzo, 2022a) and organisations such as The Crown Estate and WWF UK (Site, 2023). The main target for seaweed products in the UK is the food and drink industry, with a third of companies focused on this sector (Capuzzo, 2022b) and 450 different algae-containing products available in the UK (Redway & Combet, 2023). The lowest proportion of regular seaweed consumers was found in Croatia. Although Croatia has great potential for algae production, there are currently no commercial algae producers or

data on algae consumption. In order to educate all those who want to start producing seaweed in Croatia, educational material was published at the national level in cooperation with the Ministry of Agriculture: “Guide to Innovativeness and Sustainability in Aquaculture – Growing Algae” (2023).

In Croatia, seaweed products such as sushi are becoming increasingly popular (Report, 2023), so we can assume that Croatia is an emerging market for seaweed products.

5.1. Consumer segments

In this study we employed six scales — Food Innovativeness, Food Neophobia, Food Involvement, Food Responsibility, Health Consciousness, and Symbolic Value — to segment consumers. Additionally, we developed four new items for the Food Neophobia scale to update previous versions. Our results have important implications for understanding consumer segmentation and behaviour in relation to seaweed consumption and, more generally, towards consumer behaviour around novel foods.

First, by validating and incorporating these theoretical concepts into our discussion, we provide a more comprehensive understanding of the factors influencing consumer behaviour towards seaweed consumption. This not only strengthens the theoretical framework of our study but also offers practical implications for policymakers and marketers aiming to promote sustainable and health-conscious food choices.

Second, the high reliability and validity of the scales across different countries suggest that these constructs can be effectively used in future research to examine consumer attitudes and behaviours. Updating the Food Neophobia Scale (FNS) was particularly important, as it reflects current socio-cultural and dietary trends, ensuring that the scale remains relevant and accurate for contemporary research.

The segmentation analysis revealed two distinct groups: ‘Food Enthusiasts’ and ‘Food Conservatives’. In the food industry, where it is necessary to react quickly to changes in consumer preferences, the twocluster model enables clear segmentation and the development of targeted strategies without unnecessary complexity. This makes a twocluster solution the ideal choice for maximizing efficiency and success in the industry.

The highest number of respondents in the United Kingdom and Croatia belong to the Food Conservatives segment. Food Conservatives in all three countries have higher food neophobia compared to Food Enthusiasts. Food neophobia is related to eating the same products and not trying new products (Henriques et al., 2009). For seaweed in particular, previous studies have found food neophobia a key barrier to consumer acceptance (e.g. Palmieri & Forleo, 2022; Losada-Lopez et al., 2021; Birch et al., 2019b). Food neophobia negatively affects diet quality or variety (Jacobi et al., 2003) because neophobes prefer to eat only familiar foods. Previous studies found that children with food neophobia eat less fruits, vegetables, and protein-rich foods than their more adventurous peers (Cooke et al., 2006). Therefore, it is important to find out how to reduce food neophobia. There is a large body of literature suggesting that educational programmes and food-related activities that increase familiarity and exposure to foods can reduce food neophobia and create positive attitudes towards novel foods (Karaağaç and Bellikci-Koyu, 2023; Wardle et al., 2003; Birch & Marlin, 1982).

Bloch (1986) noted that an enthusiast is likely to be highly innovative, which is confirmed in this study (Food Enthusiasts have higher innovativeness level). On the other side, Food Conservatives have a lower level of food innovativeness, meaning they have a low tendency to try new food products. Similarly, Brunsø et al. (2021) found that conservatives score low on innovativeness. According to a recent study by Li et al. (2021) consumer knowledge is the most important mediator of the relationship between consumer innovativeness and organic food adoption (organic food is innovative compared to traditional food). Zheng et al. (2024) found that consumers' knowledge of seaweed positively affects their intentions to try a new product flavoured with seaweed. Therefore, it is important to increase public knowledge about seaweed-based food products by highlighting their health benefits and environmental impact, which may help conservative consumers to accept novel foods like seaweed.

Respondents in the 'Food Conservatives' cluster have a lower level of health consciousness (in Australia and Croatia there is no statistically significant difference between Cluster 1 and Cluster 2). Govaerts and Olsen (2024) support the assumption that Food Conservatives are less health-conscious while having a low self-perception of having a healthy lifestyle. They are less likely to prioritise health in their food choices and more likely to stick to habitual eating patterns. This cluster also shares some similarities with the "conservative" and the "uninvolved" segments of Stancu et al. (2022), who were the least willing to try new aquaculture fish or fish products compared to the other segments. Food Enthusiasts have higher health consciousness in all countries, although in Australia and Croatia there is no statistical difference between the two segments. According to Birch et al. (2019b), more health-conscious consumers are a primary market for seaweed products, which means that new seaweed product development and marketing must emphasize the significant health and nutritional benefits that can result from seaweed consumption.

Food responsibility level among Food Conservatives is also lower compared to Food Enthusiasts, although the difference between the two segments is not significant in Croatia. Similarly, Brunsø et al. (2021) found that Food Conservatives have lower food responsibility. However, it is suggested to promote seaweed as a sustainable food, especially nowadays when we need to incorporate new (more sustainable) sources of protein into Western diets (Van den Burg et al., 2021). Food Enthusiasts have higher food responsibility. These findings are consistent with an earlier study by Thøgersen (2017) which found that "food enthusiastic food consumers" are the most sustainability-oriented food consumers.

Although seaweed is considered a "fancy" or "trendy" food (Birch et al., 2019a), and consumption of trendy foods may serve as a means to build image and social status (Perrea et al., 2017) the results are not consistent across surveyed countries. Symbolic value of UK respondents is lower in the Food Conservatives segment, while the symbolic value of Australian and Croatian is lower among Food Enthusiasts. Therefore, it is important to promote seaweed as a trendy food, but marketers should first explore cultural differences to make sure their messaging is correct for the audience.

Roininen et al. (2001) noted that individuals with low food involvement are less likely to engage in activities related to food preparation, exploration, or learning about nutrition. This aligns with the

present study's finding that Food Conservatives exhibit lower food involvement. Tohidi et al. (2023) applied neobehaviouristic theory and machine learning to segment the organic food market and highlighted certain consumer segments, including food conservatives, are less aware of, and have less access to organic food markets, showing lower involvement and innovativeness. Low food involvement among Food Conservatives suggests they may be less responsive to marketing campaigns promoting new food products like seaweed and less likely to seek out information on healthy eating. Food Enthusiasts have a higher food involvement. Previous studies have shown that higher food involvement is related to new food experiences and a greater interest in the sensory properties of food (Bell & Marshall, 2003), which are characteristics of Food Enthusiasts.

Next, the Food Conservatives have less experience of eating seaweed and a lower intention to eat seaweed in the future. These results are in line with previous studies (e.g. Ryan et al., 2004) which found that conservative consumers prefer familiar food products, and they are uninterested to try new foods. As expected, Food Enthusiasts have higher intention to consume seaweed in the future and they have eaten seaweed more often in the past. Moreo et al. (2022) explained that food novelty seeking is one dimension of the food enthusiast with valuing novel and authentic foods as a way to engage in novel experiences.

Food Conservatives are older, which is consistent with earlier studies (Stancu et al., 2022; Wycherley et al., 2008). The food environment today is more diverse and includes a much larger number of foreign, ethnic and unusual foods than 20 years ago, which can be a reason why older people are less open to trying new foods. Food Enthusiasts are younger and have a higher level of education. These findings are consistent with previous research which has shown that young consumers are more willing to try new products (Merlino et al., 2021). According to Zheng et al. (2024) the seaweed consumer group had higher education levels than the nonconsumer group. The results of the present study suggest that Food Conservatives in the UK and Croatia prefer to eat red meat, pork or chicken rather than fish or seafood. Building on the findings of Stancu et al. (2022), this study supports the notion that Food Conservatives tend to consume significantly lower amounts of fish. This observed behaviour could possibly be related to certain sensory characteristics of fish, such as taste and texture, which could be challenging for Food Conservatives.

5.2. Managerial implications

The results obtained are consistent with previous studies and suggest that some classic socio-demographic variables are important in seaweed market segmentation. Marketers interested in increasing seaweed consumption in Australia, the UK and Croatia should consider targeting younger, highly educated consumers, paying particular attention to dietary preferences. In addition, seaweed marketers should investigate specific local preferences and cultural influences. Considering Food Enthusiasts (those who have higher food innovativeness, food involvement, health consciousness and food responsibility) are more likely to consume seaweed in the future, while Food Conservatives (consumers with higher food neophobia) are less likely to consume seaweed, there are several managerial implications for companies and marketers looking to target consumers and promote seaweed products, including:

- i. Communication on health benefits, emphasizing the health and nutritional benefits of seaweed products;
- ii. Collaboration with healthcare professionals, nutritionists, and dietitians is essential to confirm and promote the health benefits of seaweed. This can also add a level of credibility and expertise to the marketing message, reinforcing the positive health impact of incorporating seaweed into one's diet;
- iii. Addressing food neophobic consumers, taking into account the potential resistance of neophobic consumers to seaweed consumption (Young et al., 2022). The development of targeted strategies to gradually introduce seaweed products to this segment should be encouraged, emphasizing familiarity and addressing any concerns related to taste or texture. Also, organisations should consider offering smaller sample-sized products or educational materials to ease the introduction of seaweed into their diet;
- iv. Certifications and quality assurance, whereby relevant regulatory bodies should provide transparent information on the quality and origin of seaweed products.
- v. Health-conscious consumers often prioritize products with organic, sustainable, and environmentally friendly attributes. Also, certifications can enhance credibility and trust in the brand;
- vi. Convenience and accessibility, whereby the convenience factor should be taken into account in the product range. Work needs to be done to develop convenient and easy-to-use seaweed products that fit seamlessly into the lifestyle of the busy and healthconscious consumer. This might include grab-and-go options or pre-packaged snacks.

In practical terms, this study confirms the important role of psychological variables in the acceptance of novel foods (seaweed). Related to the results of the research, by incorporating these managerial implications into their strategies, businesses can quite effectively tap into the Food Enthusiasts segment, as they are more willing to consume seaweed products in the future. Since repeated exposure can improve willingness to accept new foods, Food Conservatives consumers should be exposed to different kinds of seaweed products.

5.3. Limitations and future research

Whilst this study contributes to the existing seaweed literature on consumer segmentation and further understanding of the psychological determinants of seaweed consumption in western countries it does have some limitations. Firstly, results are based on self-reported behavioural measures, hence this study is prone to potential biases such as social desirability bias. Secondly, respondents were recruited from online market panels, hence there is the potential for selection bias. Thirdly, the quality of data from online questionnaires can be subject to a number of factors, including item response mode and scales, cognitive ability, distractions in the environment, and satisficing behaviour (Jaeger & Cardello, 2022). Further research undertaken via different methodologies is suggested to validate this study's findings. Fourthly, only 63.8 % (n = 1030) of all consumers in the sample (Australia: n = 370 (71.0 %); UK: n = 355 (68.4 %); Croatia: n = 305 (53.1 %)) stated they had eaten or tasted seaweed previously, hence measures of future intention are based on perceptions and beliefs rather than actual experience. It would be interesting to explore if these may change after trying seaweed products. Fifthly, whilst Likert-type scales are often used

in cross-cultural research, there have been concerns with regards their validity and reliability due to cultural differences in response style (Ares, 2018).

Future studies could use other methods such as ranking (Harzing et al., 2009) or best-worst scaling (Louviere et al., 2015) to try and help overcome any limitations associated with scale measures. Finally, this study asks about seaweed consumption in general rather than specifying the consumption of any particular seaweed food product(s). It may be that greater insight could be gained from focusing on different seaweed products and consumer responses to them rather than taking an 'umbrella' approach.

Future studies could focus on other westernised countries to determine the generalisability of the scale measures and consumer segments found in the current research. Furthermore, the inclusion of other methodologies such as qualitative interviews or focus groups may help gain valuable insights of consumer perceptions and emotional responses to unfamiliar/novel foods and their acceptance of such products guided by the determinants identified in this study. Such findings could further help inform consumer marketing strategies and food product development.

6. Conclusions

There are a limited number of studies applying psychological segmentation in seaweed related research. Based on the level of food innovativeness, food neophobia, food involvement, food responsibility, health consciousness, and symbolic value, consumers were divided into "Food Enthusiasts" and "Food Conservatives" segments. The results suggest that the UK sample have a higher share of Food Conservatives compared to Australia and Croatia.

Respondents in the Food Enthusiasts segment have lower food neophobia and higher food innovativeness and food involvement in all three surveyed countries. Health consciousness and food responsibility is also higher in this segment but the difference between Food Enthusiasts and Food Conservatives is not significant in all countries. Food Enthusiasts have higher intention to eat seaweed in the future and they have greater previous experience with seaweed consumption. Food Enthusiasts are significantly younger, more educated and have a higher share of vegetarians, pescatarians and those who prefer to eat fish rather than meat.

On the other side, Food Conservatives have higher food neophobia, while food innovativeness and food involvement are lower. Their intention to consume seaweed in the future, as with previous experience in seaweed consumption is lower. Food Conservatives are older, and in the UK and Croatia there is higher share of those who prefer to eat meat rather than fish or seafood in this segment.

Ethical statement

Participants gave informed consent via the statement "I am aware that my responses are confidential, and I agree to participate in this survey" where an affirmative reply was required to enter the survey. They were able to withdraw from the survey at any time without giving a reason.

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