

# **Environmental values and self-identity as a basis for identifying seaweed consumer segments in the UK.**

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## **Abstract**

**Purpose :** This study aimed to identify and profile segments of seaweed consumers in the United Kingdom.

**Design/methodology/approach:** Hierarchical k-means cluster analysis was used to identify consumer segments based on consumers' self-identity and environmental values. In addition, the study used subjective knowledge, intentions, and consumption in profiling different consumer segments. Data were collected in 2022 through a consumer survey with a representative sample from the United Kingdom (n = 1110).

**Findings:** Cluster analysis segmented consumers into three groups: progressive (39%), conservative (33%), and egoistic (28%). The progressive segment was most likely to consume seaweed food products. Consumers in the progressive segment identify themselves as food innovative and healthy; they also highly value the environment and their pleasure. Conservative and egoistic consumers were significantly less likely to consume seaweed food products.

**Practical implications:** The results suggest that public policy officers and marketers promote seaweed food products by emphasizing biospheric values for innovative (younger) consumers, as well as seaweed's good taste and nutritional/health qualities.

**Originality/value:** This study identifies and examines the profiles and characteristics of seaweed consumers based on their values and self-identity. Through this research, we have discovered how environmental, values and identity can effectively group consumers into homogeneous segments. Moreover, we have identified the specific consumer group in the UK that is more likely to consume seaweed food products.

**Keywords:** *Seaweed consumption, food innovativeness, environmental values, cluster analysis, novel food, consumer behavior.*

## 1. Introduction

Seaweed is a natural source of nutrients such as antioxidants, minerals, proteins, vitamins, and omega-3 fatty acids. Seaweed culture is also sustainable as it does not require fertilizers, heating, or watering (Pereira, 2016). In the context of increasing demand from consumers for environmental and healthy food sources, the food industry has shown renewed interest in using seaweed in food products (Birch, Skallerud, & Paul, 2019; Vincent, Stanley, & Ring, 2020). Few studies have focused on seaweed consumers and the variables influencing seaweed consumption (Birch et al., 2019; Govaerts & Olsen, 2022; Palmieri & Forleo, 2022). For example, Govaerts and Olsen (2022) considered seaweed consumption to be driven by health awareness, environmental considerations, and food innovativeness. Birch et al. (2019) revealed that, in Australia, early seaweed food product adopters have higher educational levels, are health conscious, and consider seaweed food consumption as an expression of their personality.

This study contributes to the existing seaweed literature by describing consumers based on their shared and distinct individual characteristics to determine the optimal number of subgroups within a population. The advantage of sorting consumers into homogeneous clusters based on individual differences in their beliefs, values, norms, identities, and personalities is that these differences are integrated within the individuals (Donnellan & Robins, 2010). Hence, instead of studying the effect of determining variables on behavior, this study aimed to understand seaweed consumers' underlying motivational drivers and consequences (e.g., consumption).

Within the consumer segmentation approach, this study contributes to identifying segments based on the importance of consumer values and self-identity. Values are frequently used to segment consumers in consumer food research (Grunert, 2019). For example, Brunsø et al. (2021) used Schwartz's (1992) universal core values to profile consumer segments. This study extends the literature on international segmentation in the food domain (Grunert, 2019) by combining personal and environmental value theory (Schwartz, 2012; Steg et al., 2014; Stern, 2000) and self-identity (Stryker & Burke, 2000) in the context of consumer food research. The combination of using personal environmental values and identity is scarce in general consumer studies (Trudel, 2018), but there is a growing tendency to integrate value and identity theories in, for example, sustainable behavior (Bouman, van der Werff, Perlaviciute, & Steg, 2021; Wang & Mangmeechai, 2021; Zeiske, Venhoeven, Steg, & van der Werff,

2021). However, to our knowledge, no study has combined values and self-identity to segment consumers in the context of (sea)food or seaweed.

Segmentation studies typically use several additional profiling constructs and variables to further enrich consumer characteristics and profiles when clusters or segments are identified. Profiling variables vary across studies but mostly include individual differences in attitudes, goals, involvement, behavior, demographics, and consumer situations (Nie & Zepeda, 2011; Witzling & Shaw, 2019). Our study focuses on the relationship between the identified consumer segments and their knowledge, intentions, socio-demographic characteristics, and consumption of seaweed food products. These constructs have previously been used in consumer studies of seaweed (Birch et al., 2019; Govaerts & Olsen, 2022, 2023; Palmieri & Forleo, 2020, 2022; Wendin & Undeland, 2020).

Finally, to our knowledge, this study is the first to focus on seaweed consumer behavior in the United Kingdom (UK). The UK is one of the leading countries in the introduction of new food products and is considered a highly relevant market for seaweed food consumption. In 2019, the UK was the first European importer of seaweed for human consumption (CBI Ministry of Foreign Affairs, 2022). Despite growing consumer demand, growing interest, and development of the seaweed industry in the UK, there is limited knowledge about seaweed food product consumers in the UK and their psychological and demographic profiles. This study contributes to filling this knowledge gap. The current results are based on a nationally representative sample of 1110 UK consumers. Thus, the external validity of the cluster solution using representative samples is more valuable for the purposes of the seaweed industry, for example, in realistically estimating the size of different segments.

In the following sections, the theoretical framework introduces the constructs used as bases for identifying segments, and the constructs and variables used to further profile the segments.

## **2. Theoretical framework**

The segmentation approach involves grouping consumers based on their individual differences and similarities in character traits, values, identity, habits, and other psychological and personal characteristics (Grunert, 2019). In consumer research, this is a popular approach, as it allows marketers to identify homogeneous groups of consumers sharing the same motivations (Wedel & Kamakura, 2000). The selection of variables on which to segment

consumers is essential for defining the groups. Previous studies have used various segmentation bases; for example, Legendre (2021) used consumer value as a segmenting axis regarding insect consumption in the USA. Different lifestyles associated with food, health, and ways of shopping are frequently used in food science literature ( e.g., Nie & Zepeda, 2011; Witzling & Shaw, 2019). Similarly, in a more general context, Brunsø et al. (2021), segmented consumer food choice based on core values (Schwartz, 1992), food involvement, food innovativeness, and food responsibility. Finally, in the context of seaweed food consumption, Palmieri and Forleo (2020) based their groupings of Italian consumers on food habits and attitudes towards food. This study contributes to the existing literature by using some facets of food-related self-identity (innovative and health) and some relevant facets of environmental values (egoistic, hedonistic, and biospheric) (De Groot & Steg, 2007; Steg, Perlaviciute, van der Werff, & Lurvink, 2014) to explore segments of seaweed consumers in the UK. The choice of these facets is based on previous studies suggesting that seaweed is novel in Western countries (Birch et al., 2019), as well as healthy (Chapman, Stévant, & Larssen, 2015; Pereira, 2016) and sustainable (Govaerts & Olsen, 2022; Sondak & Chung, 2015). This decision is additionally supported by research suggesting a positive, albeit slightly distinct correlation between consumers' knowledge, intention, and consumption of seaweed (Govaerts & Olsen, 2022, 2023; Wendin & Undeland, 2020; Young, Paul, Birch, & Swanepoel, 2022).

## 2.1. Environmental and individualistic values

Values refer to “desirable trans-situational goals varying in importance, which serve as a guiding principle in the life of a person or other social entity” (Schwartz, 1992, p. 21). Schwartz's definition encompasses three fundamental value characteristics: abstractness, desirable goals, and stability over time and situations. A total of 56 values have been validated as universal beliefs guiding people's behavior, which can be grouped into two dimensions (openness to change versus conservatism and self-enhancement versus self-transcendence) (Schwartz, 1992). Based on Schwartz's inventory, (Steg et al., 2014; Stern, 2000) three values have been suggested that are particularly relevant to pro-environmental food consumption : egoism, hedonism, and biospherism. While the first two types of values (hedonism and egoism) are classified as individualistic values, the latter is considered collectivistic (Steg et al., 2014; Stern, 2000). Seaweed production has a positive impact on the environment because

it does not need freshwater, fertilizers, or pesticides (Duarte, Wu, Xiao, Bruhn, & Krause-Jensen, 2017). Previous studies suggest that consumers perceive seaweed as sustainable (Blikra et al., 2021; Govaerts & Olsen, 2022, 2023; Palmieri & Forleo, 2022; Young et al., 2022) and found positive associations between pro-environmental values and seaweed attitudes and consumption (Govaerts & Olsen, 2023).

Hence, consumers with hedonistic values seek pleasure or sensuous gratification (Schwartz, 2012). Pro-environmental behavior often requires effort or reduces comfort (Steg et al., 2014). Nevertheless, food is associated with pleasure (Aertsens, Verbeke, Mondelaers, & van Huylenbroeck, 2009; Bryła, 2016); therefore, consumers with high hedonistic values are positive towards unique and novel food experiences (Govaerts & Olsen, 2023).

Egoistic value reflects concern for one's own resources (Steg et al., 2014). Sustainable products are often associated with egoistic benefits such as better health. Seaweed food provides many health benefits as it is rich in minerals, vitamins, antioxidants, and proteins. Govaerts and Olsen (2022) showed that consumers are motivated to eat seaweed by its perceived positive health consequences. Therefore, we believe it is possible to segment consumers based on their egoistic value.

Biospheric value reflects concerns about the quality of nature and the environment for its own sake (De Groot & Steg, 2008). Biospheric values are positively correlated with pro-environmental behavior. Seaweed products are often promoted as sustainable food because they do not use fertilizers, freshwater, or soil. Hence, consumer groups characterized by their concern for preserving the environment may consume seaweed as a pro-environmental contribution.

2.2. Consumers' self-identity is associated with food innovativeness and healthy lifestyle.

More recently, the value-identity-personal norm theory underlined the significant role of self-identity in understanding consumer norms and behavior (Ruepert et al., 2016). Self-identity is the label people use to describe themselves (Cook, Kerr, & Moore, 2002). Consumers can have many different and sometimes conflicting identities, which can be salient, depending on the context (Stryker & Burke, 2000). For instance, food innovative self-identity, referring to how much people see themselves as a person who likes to try new food, is an especially salient factor in the context of novel food consumption (Bouman et al., 2021). Indeed, food

innovativeness is positively related to consuming novel foods (Huotilainen, Pirttilä-Backman, & Tuorila, 2006), such as seaweed (Govaerts & Olsen, 2022), functional food products (Nystrand & Olsen, 2021), and organic food products (Bartels & Reinders, 2010).

Health identity is another relevant construct in the context of seaweed food product consumption. Health identity is a construct that deals with the degree to which individuals see themselves as someone who has a healthy lifestyle (Quaye, Mokgethi, & Ameyibor, 2021). Seaweed is evaluated as healthy because it is rich in minerals and vitamins, low in calories, and contains dietary fiber (Blikra et al., 2021; Stévant, Rebours, & Chapman, 2017). Previous studies have underlined the importance of consumer health motives in the consumption of organic food (Kushwah, Dhir, Sagar, & Gupta, 2019). Govaerts and Olsen (2022) found a positive relationship between consumers' knowledge of seaweed's health benefits and their intentions to consume these products. We believe that consumer groups characterized by a higher self-perception of having a healthy lifestyle are more likely to consume seaweed food products.

We are not aware of any previous studies that have used self-identity as a basis for consumer segmentation (Grunert, 2019). Thus, the current study contributes to the food consumer literature by examining whether food innovativeness and health identities are appropriate as a basis for identifying and profiling consumer segments in a food context.

### 2.3. Profiling consumers based on knowledge, intentions and consumption of seaweed.

Previous research showed that several factors affect consumers' seaweed consumption, such as personal norms (Govaerts & Olsen, 2022), values, health and environmental beliefs (Govaerts & Olsen, 2023), food neophobia (Palmieri & Forleo, 2022), as well as attitudes (Govaerts & Olsen, 2023) and intention (Govaerts & Olsen, 2022), which are among the most influential ones. Thus, this study examines the differences between consumer groups in knowledge, intentions, and behavior towards seaweed food products. These variables are all considered important in the context of seafood consumption behavior (Govzman et al., 2021; Olsen, 2004).

In Asia (for example, China, Japan, and Korea), the taste and health qualities of seaweed make it very popular in Asian food culture and traditions. In Europe, consumers remain unfamiliar with seaweed. The level of knowledge about a product is a critical factor in

consumers' adoption of a new product, as consumers evaluate product attributes based on their knowledge before purchasing (Fu & Elliott, 2013). Product knowledge refers to “the amount of accurate information held in memory (objective knowledge) and self-perceptions of product knowledge (subjective knowledge)” (Rao & Sieben, 1992, p. 258). This study uses self-rated (subjective) knowledge as an indicator of consumer's product knowledge. As seaweed food products remain unfamiliar, consumers should have relatively little knowledge of seaweed. Despite the low familiarity, we believe that the level of knowledge will vary between groups or segments.

Behavioral intention refers to a person's specific aim to engage in a particular behavior (Fishbein & Ajzen, 2010). This study included consumers' intention to eat seaweed in the next month as a profiling variable. Behavioral intention is a strong predictor of an individual's behavior across contexts (Fishbein & Ajzen, 2010), including food behavior (Carfora, Cavallo, Catellani, Giudice, & Cicia, 2021), seafood consumption (Olsen, 2004), and seaweed consumption (Govaerts & Olsen, 2022). In this study, seaweed consumption refers to the frequency with which people have eaten a product containing seaweed over the past year.

### **3. Materials and methods**

#### **3.1. Sample and procedure**

The sample consisted of 1110 adult consumers from the UK and was representative of gender, age, and region (See Table 1). The participants were aged 18 years old and above, of whom 48% were male. Most respondents were well-educated (university or university college) (47%), with middle income (36%).

YouGov conducted the recruitment online in September 2022. Respondents were required to answer all the questions to complete the survey. The questionnaire required approximately 8–15 min to complete. It consisted of segmentation variables (food innovative identity, health identity, egoistic, biospheric and hedonistic values) and the profiling variables (subjective knowledge, intention and consumption), together with some other constructs not reported in this study.

The survey initially included a small introduction, which contained the following text: “Seaweed is a form of algae that grows in the sea. There are various species of edible seaweeds, the color range of which varies from red to green to brown. Seaweed helps capture



CO2. Seaweed is a good source of nutrients such as proteins, vitamins, minerals, and dietary fiber.”

Table 1 Socio-demographic characteristics (N = 1110)

Variables	Percent
<i>Gender</i>	
Male	48
Female	52
<i>Age</i>	
18-29	18
30-39	18
40-49	17
50-59	13
60-69	19
70+	15
<i>Income</i>	
Lower income	25
Middle income	36
Higher income	14
Prefer not to say/ Don't know	25
<i>Education</i>	
Low	15
Medium	38
High	47

### 3.2. Measurement of the constructs

The following section presents five segmentation and three profiling variables. All variables, except *consumption*, are composed of multiple items and are listed in Tables 2 and 3 with their reliability (internal consistency) coefficients.

#### 3.2.1. Segmentation variables

*Food innovative identity* was adapted based on a recent study on consumer identity (Chan, Pong, & Tam, 2020) and adapted to food innovativeness. The three items were “Trying new and different food is an important part of who I am,” “I am the type of person who takes pleasure in trying new foods,” and “I see myself as a person who likes to try new food.”

Participants were asked to respond to each item on a 7-point Likert scale ranging from totally disagree to totally agree.

*Health identity* was measured using three items adapted from past studies (Chan et al., 2020), the items were “Having a healthy lifestyle is an important part of who I am,” “I am the type of person who takes pleasure in having a healthy lifestyle,” “I see myself as a healthy person.” All items were rated on a 7-point Likert scale.

*Three environmental values* were measured using a scale developed by Steg et al. (2014): a total of 10 items measuring *egoistic* (4 items), *biospheric* (4 items), and *hedonistic* values (2 items). Following Schwartz (1992), respondents were asked to rate the importance of each item on a scale from 1 (“opposed to my principles”) to 9 (“extremely important”). See Table 2.

### 3.2.2. Profiling variables

*Subjective knowledge (about seaweed food products)* was adapted based on Fu and Elliott (2013). We used four items on a scale ranging from 1 (“very un knowledgeable”) to 7 (“very knowledgeable”). The following items were used: “How knowledgeable a person are you about seaweed consumption?”; “Rate your knowledge of seaweed consumption compared to the average consumer”; “How familiar are you with seaweed consumption?”; “Rate your knowledge of seaweed consumption compared to your knowledge of other food products that you buy.”

*Intention to consume seaweed food* was measured by rating four items on a scale from 1 to 7 (extremely unlikely/extremely likely). The items were adapted from past studies (Honkanen, Olsen, & Verplanken, 2005; Menozzi, Sogari, Veneziani, Simoni, & Mora, 2017). The four items used to assess behavioral intention were: “I intend to eat products containing seaweed in the next month,” “I expect to eat products containing seaweed in the next month,” “I plan to eat products containing seaweed in the next month,” and “I will try to eat products containing seaweed in the next month.”

To measure *consumption* of seaweed food products, respondents were asked to answer the following question: “Over the past year, how many times have you eaten a product containing seaweed?” The question was assessed on a scale from 1 (less often/never) to 9 (3+ times per week).

### 3.3. Analytical procedures

First, we conducted an exploratory factor analysis (EFA) using principal factor analysis (PFA) with varimax rotation. Subsequently, a maximum likelihood confirmatory factor analysis (CFA) with maximum likelihood estimation was conducted. The convergent and discriminant validity of the constructs were assessed using Fornell and Larcker's (1981) methodology. The convergent validity of the constructs was established when the estimation of the average variance extracted (AVE) was  $> 0.5$ , and discriminant validity was found when the AVE value of a latent construct was larger than the squared correlation (SC) of any other latent construct in the model. Cronbach's alpha was used to measure internal consistency. In the analysis, Cronbach's Alpha values should not fall below 0.6, as recommended by Hair, Anderson, Babin, and Black (2010).

Multiple indicators were used to evaluate the goodness of fit:  $\chi^2$  (chi-square), comparative fit index (CFI), Tucker–Lewis index (TLI), root mean square error of approximation (RMSEA), and SRMR (standardized root mean residual). Model fit is good when CFI and TLI indices are  $> 0.90$ , and RMSEA and SRMR are  $< 0.08$  (Brown, 2015).

A hierarchical cluster analysis was based on Ward's method to identify the appropriate number of clusters. The Calinski-Harabasz analysis stopping rule was used to determine the number of clusters. A stopping rule was computed for each cluster solution. Larger values of the Calinski-Harasz pseudo-F index indicate more distinct clustering (Calinski & Harabasz, 1974). One-way analysis of variance (ANOVA) was performed to compare differences between clusters in terms of the segmentation variables (identity and values) and profiling variables (i.e., subjective knowledge, intention, and consumption). All analyses were performed using Stata software (17).

## 4. Results

### 4.1 Factor analysis

We ran EFA separately for the segmentation variables. The EFA revealed five factors. However, the rotated component matrix indicated cross-loadings. Hence, the following modification was made: one of the three items measuring hedonistic value (self-indulgence) was omitted because of its cross-loading with egoistic value.

Finally, we performed CFA for the segmentation and profiling variables. CFA confirmed the validity of the structure of the latent variables, with a total of 16 indicators for the segmentation variables (see Table 2). Regarding the profiling variables, CFA indicated that one item used to capture subjective knowledge (“Please rate your knowledge of seaweed products compared to the average consumer you know”) had a low factor loading (<0.5) and was then omitted. CFA confirmed the validity of the structure of the two profiling latent variables with a total of 7 indicators (see Table 3). Thus, the results of CFA indicated a good data fit for the segmentation variables ( $\chi^2 (109) = 623.03, p < 0.001, RMSEA = 0.06, CFI = 0.96, TLI = 0.96, SRMR = 0.06$ ). In addition, for the segmentation variables, the final results of the CFA indicated good data fit ( $\chi^2 (113) = 499.31, p < 0.001, RMSEA = 0.05, CFI = 0.97, TLI = 0.97, SRMR = 0.03$ ).

Moreover, for both the segmentation and profiling variables, CFA indicated convergent and discriminant validity between the latent variables with  $AVE > 0.5$  and  $AVE > SC$ , respectively (Fornell & Larcker, 1981). Cronbach’s alpha scores were greater than 0.6, indicating good construct reliability (Hair et al., 2010).

The results (Table 5) indicate that the participants had, on average, low knowledge of seaweed. Participants’ level of intention to eat seaweed food products and actual consumption was low.

Table 2 Confirmatory factor analysis of the segmentation variables

Construct and item	Factor loading	Cronbach’s $\alpha$	Average variance extracted
<i>Food innovative identity</i>		0.95	0.86
Trying new and different foods is an important part of who I am	0.86		
I am the type of person who takes pleasure in trying new foods	0.95		
I see myself as a person who likes to try new foods.	0.95		
<i>Health identity</i>		0.91	0.79
Having a healthy lifestyle is an important part of who I am	0.80		
I am the type of person who takes pleasure in having a healthy lifestyle	0.83		
I see myself as a healthy person	0.78		

<i>Egoistic value</i>		0.80	0.52
Social power: control over others, dominance	0.69		
Wealth: material possessions, money	0.58		
Authority: the right to lead or command	0.88		
Influential: having an impact on people and events	0.71		
		0.87	0.78
<i>Hedonistic value</i>			
Pleasure	0.83		
Enjoying life	0.92		
		0.95	0.83
<i>Biospheric value</i>			
Preventing pollution: protecting natural resources	0.87		
Respecting the earth. Harmony with other species	0.93		
Unity with nature. Fitting into nature	0.91		
Protecting the environment: preserving nature.	0.93		

Table 3 Confirmatory factor analysis of the profile variables

Construct and item	Factor loading	Cronbach's $\alpha$	Average variance extracted
<i>Subjective knowledge about seaweed</i>		0.87	0.70
How knowledgeable about seaweed food products	0.79		
How familiar are you with seaweed food products	0.90		
Please rate your knowledge of seaweed food products compared to your knowledge of other food products that you buy	0.80		
<i>Intentions</i>		0.96	0.86
I intend to eat products containing seaweed in the next month	0.93		
I expect to eat products containing seaweed in the next month	0.94		
I plan to eat products containing seaweed in the next month	0.96		
I will try to eat products containing seaweed in the next month	0.89		

#### 4.2. Consumer segmentation

A hierarchical Ward's linkage cluster procedure was applied to the five identified factors (food innovation identity, health identity, egoistic, hedonistic, and biospheric values) to identify homogenous respondent groups within the survey sample. The Calinsky-Harabsz pseudo- $F$  stopping rule limits the number of clusters to two. The Calinski-Harabasz pseudo- $F$  value dropped from 315.21 for the solution with three clusters to 222.53 for the solution with three clusters and decreased monotonically to 117.96 for the solution with 15 clusters. Thus, the three-cluster solution was retained as the most internally consistent grouping.

The first group (39% of the sample) was characterized by higher mean scores on innovative identity, health identity, biospheric value, and hedonistic value higher than the respective sample means of these factors. This group was called progressive, as they had higher food innovative identity, health identity, and biospheric value than consumers in the other two segments. The second segment (33% of the sample) demonstrated a high level of biospheric value and an average level of hedonistic value; however, they had the lowest scores on food innovation, health identity, and egoistic value. Thus, this group was labelled conservative. The final and smallest group (28% of the sample) was called the egoistic group because they have the highest score on egoistic value and the lowest score on biospheric (collectivistic) value. The egoistic group are close to the conservative group in their health identity and relatively close in their innovativeness. They had the lowest scores for hedonistic values of all segments.

Table 4 Differences in segmentation variables across segments

Variable	Overall Mean (SD)	Progressive Mean (SD)	Conservative Mean (SD)	Egoistic Mean (SD)	$F$	Sig.
	n = 1110	n = 437 (39%)	n = 364 (33%)	n = 309 (28%)		
<i>Food innovative identity</i>	4.27 (1.64)	5.63 (1.03) <sup>a</sup>	3.17 (1.28) <sup>c</sup>	3.63 (1.46) <sup>b</sup>	440.41	<0.001
<i>Health identity</i>	4.20 (1.46)	4.99 (1.28) <sup>a</sup>	3.64 (1.44) <sup>b</sup>	3.74 (1.21) <sup>b</sup>	128.74	<0.001
<i>Egoistic value</i>	4.22 (1.47)	4.33 (1.53) <sup>a</sup>	3.94 (1.30) <sup>b</sup>	4.40 (1.53) <sup>a</sup>	10.08	<0.001
<i>Hedonic value</i>	7.07 (1.55)	7.83 (1.03) <sup>a</sup>	7.67 (1.16) <sup>b</sup>	5.96 (1.61) <sup>c</sup>	173.89	<0.001
<i>Biospheric value</i>	7.03 (1.73)	7.95 (1.08) <sup>a</sup>	7.11 (1.44) <sup>b</sup>	5.00 (1.35) <sup>c</sup>	633.17	<0.001

Note: Different superscripts (a, b, and c) indicate significant differences in means between segments found by the Bonferroni post hoc test.

#### 4.3. Profiling the segments

Following segment definition and naming, a one-way ANOVA with Bonferroni multiple comparison tests was performed to test the differences in consumers' knowledge about seaweed food products, intention to eat seaweed food products, and behavior (seaweed food consumption) across segments. Significant differences between the groups were observed for all five variables analyzed (Table 4).

The progressive and egoistic consumers showed significantly better knowledge about seaweed food products than conservative consumers. The results also indicated that the egoistic cluster had significantly higher mean knowledge than the conservative cluster (Table 5). Moreover, progressive respondents showed significantly more intentions, and a higher consumption of seaweed food products in the three groups (Table 5). Finally, the conservative and egoistic groups did not differ in their knowledge, intentions, and seaweed food product consumption.

Table 5 Profiling consumer segments based on seaweed food consumption behavior

Variable	Overall Mean (SD)	Progressive Mean (SD)	Conservative Mean (SD)	Egoistic Mean (SD)	<i>F</i>	Sig.
<i>Subjective knowledge</i>	2.15 (1.31)	2.40 (1.43) <sup>a</sup>	1.79 (1.06) <sup>b</sup>	2.22 (1.30) <sup>a</sup>	22.70	<0.001
<i>Intentions</i>	2.42 (1.76)	2.98 (1.92) <sup>a</sup>	1.95 (1.49) <sup>b</sup>	2.17 (1.60) <sup>b</sup>	40.34	<0.001
<i>Consumption</i>	2.36 (2.00)	2.81 (2.09) <sup>a</sup>	2.03 (2.03) <sup>b</sup>	2.13 (1.92) <sup>b</sup>	18.27	<0.001

Note: Different superscripts <sup>(a, b, and c)</sup> indicate significant differences in means between segments found by the Bonferroni post hoc tests.

#### 4.4. Socio-demographic characteristics

The three segments were further compared based on their sociodemographic characteristics. The results of the one-way ANOVA with Bonferroni multiple comparison tests indicated that the characteristics differed significantly between clusters (Table 6); the egoistic segment was composed of more males than the other two segments (Table 6). On average, the conservative segment was older than the progressive and egoistic segments (Table 6). Finally, the progressive segment showed higher education levels than the other two segments (Table 6).

Table 6 Socio-demographic characteristics of the segments

Variable	Overall Mean (SD)	Progressive Mean (SD)	Conservative Mean (SD)	Egoistic Mean (SD)	<i>F</i>	Sig.
<i>Sex</i>	1.52 (0.49)	1.55 (0.49) <sup>a</sup>	1.57 (0.49) <sup>a</sup>	1.41 (0.49) <sup>b</sup>	11.03	<0.001
<i>Age</i>	3.24 (1.34)	3.24 (1.31) <sup>n.s</sup>	3.37 (1.31) <sup>n.s</sup>	3.09 (1.41) <sup>n.s</sup>	3.54	<0.001
<i>Income</i>	2.38 (0.33)	2.36 (1.08) <sup>n.s</sup>	2.39 (1.14) <sup>n.s</sup>	2.39 (1.12) <sup>n.s</sup>	0.09	>0.05
<i>Education</i>	2.22 (0.04)	2.35 (0.03) <sup>a</sup>	2.19 (0.04) <sup>b</sup>	2.06 (0.05) <sup>b</sup>	10.52	<0.001

Note: Different superscripts <sup>(a, b, and c)</sup> indicate significant differences in means between segments found by the Bonferroni post hoc tests; n.s., not significant.

## 5. Discussion

This study aimed to extend the established literature on seaweed food consumers by segmenting them based on their environmental values and self-identity. A combination of five variables, including food innovative identity, health identity, and three environmental values (egoistic, hedonistic, and biospheric), successfully identified three clusters among the 1110 respondents. The three groups resulting from the cluster analysis were called progressive, conservative, and egoistic. The clusters varied in size. The largest group was progressive (39% of the sample), followed by the conservative (33% of the sample) and egoistic groups (28% of the sample).

Table 7 Summary characteristics of U.K. consumers segments

	Progressive (39%)	Conservative (33%)	Egoistic (28%)
Self-identity	Identifies as <ul style="list-style-type: none"> <li>• being food innovative</li> <li>• Having a healthy lifestyle</li> </ul>	Does not identify as <ul style="list-style-type: none"> <li>• being food innovative</li> <li>• having a healthy lifestyle</li> </ul>	Does not identify as <ul style="list-style-type: none"> <li>• being food innovative</li> <li>• having a healthy lifestyle</li> </ul>
Environmental values	Values <ul style="list-style-type: none"> <li>• the environment</li> <li>• pleasure</li> <li>• egoistic</li> </ul>	Values <ul style="list-style-type: none"> <li>• the environment</li> <li>• pleasure</li> </ul>	Values <ul style="list-style-type: none"> <li>• Egoistic</li> </ul>
Subjective knowledge	Have the highest knowledge about seaweed	Have the lowest knowledge about seaweed	Have low knowledge about seaweed



Intention	Have the highest intention to eat seaweed	Have the lowest intention to eat seaweed	Have low intention to eat seaweed
Seaweed consumption	Have the highest seaweed consumption	Have the lowest seaweed consumption	Have low seaweed consumption
Demographics	<ul style="list-style-type: none"> <li>• Mostly women</li> <li>• High level of education</li> </ul>	<ul style="list-style-type: none"> <li>• Mostly women</li> <li>• Oldest segment</li> </ul>	<ul style="list-style-type: none"> <li>• Mostly men</li> <li>• Youngest segment</li> <li>• Lowest level of education</li> </ul>

Greater food innovativeness and health identity characterized the progressive cluster. In terms of values, progressive consumers consider protecting the environment essential but also highly value pleasure. The second cluster, called conservative, differentiates from the first because they have the lowest self-perception of being food innovative and having a healthy lifestyle. The conservative group gave the least importance to egoistic values. However, similar to progressive consumers, the conservative segment highly values the environment and pleasure. Finally, we called the last group egoistic because their values were the most self-centered (Table 6). They placed the lowest importance on preserving the environment, indicating low collective and high individualistic values. However, both the progressive and conservative scores are relatively higher than the egoistic group on hedonistic values, indicating that egoistic and hedonistic values are somewhat different individual values as a basis for the segmentation of consumers, even though both are highly individualistic (Schwartz, 1992). Thus, our results contribute to the literature on environmental values by considering individual differences in hedonistic and egoistic values (Steg et al., 2014).

It is difficult to compare our segmentation findings with those of other studies because of our novel choice of segmentation basis. However, the groups that emerged after segmentation were relatively similar to those usually found in previous studies segmenting Western food consumers (e.g., Brečić, Mesić, & Cerjak, 2017; Brunsø et al., 2021; Palmieri & Forleo, 2020). Hence, the results confirm the presence of a progressive consumer segment (also referred to as adventurous or non-phobic and open) (Brunsø et al., 2021; Palmieri & Forleo, 2020). In contrast to the more progressive segment, the food-conservative segment has also been reported in the literature (Brunsø et al., 2021). The segment that we call egoistic shares similarities with segments referred to as self-centered and indifferent (Brečić et al., 2017; Brunsø et al., 2021; Nystrand & Olsen, 2021) because this segment highly values themselves and places little importance on other values, health, and food innovativeness.

Regarding seaweed food products, one segment distinguishes itself from the others, as it scores significantly higher on knowledge, intentions, and consumption. From the results, we first observe that the group with the highest food innovative and healthy identity scores (the progressive) had the best knowledge. Conversely, the conservative group, who identified as the least innovative and did not feel that they had a healthy lifestyle, had the lowest knowledge about seaweed. Thus, a high level of food innovativeness seems to be related to higher knowledge about seaweed. Innovative consumers may be more curious and have a higher level of interest, and thus, may have heard or better remember information about seaweed. These results contribute to earlier findings indicating that innovative consumers engage more in ongoing information searches and have weaker perceptions of risk; thus, they have better product knowledge than low-innovative consumers (Zhang & Hou, 2017).

Progressive consumers were positive towards eating seaweed, whereas egoistic consumer segments were the most negative. Again, we indicate that a combination of seaweed's environmental, health, and hedonistic characteristics positively influenced consumers' perceptions of seaweed food products. Moreover, this result is in line with Govaerts and Olsen (2023), who showed a positive relationship between biospheric and hedonistic values and motivation and consumers' attitudes towards eating seaweed. However, consumer egoistic values stood out as being negatively related to attitudes towards eating seaweed. This finding is consistent with previous studies that indicate a negative relationship between egoistic values and pro-environmental food consumption (Qian, Yu, & Gao, 2019; Steg et al., 2014). In addition, the progressive group intended to eat and actually consumed the most seaweed food products, while the conservative group had the lowest intention and consumption. This confirms that higher intentions to eat seaweed are followed by higher consumption (Govaerts & Olsen, 2022, 2023).

The results reveal that progressive consumers, identified by their pronounced food innovativeness and environmental consciousness, possess a deeper understanding of seaweed. This underscores the pivotal role of consumer knowledge when introducing novel products. Huy Tuu and Ottar Olsen (2009) previously highlighted the mediating role of knowledge in the acceptance of new and unfamiliar foods. Similarly, Govaerts and Olsen (2022) concluded that a higher degree of knowledge typically corresponds to an increased sense of obligation and intent to consume seaweed.

Furthermore, this study also highlights the influence of value orientations and identity on sustainable and novel food consumption. This confirms the crucial role of values, such as

environmental, hedonistic, and egoistic values, and the role of self-identity in determining food preferences. Such values and beliefs influence an individual's inclination towards new sustainable foods, such as seaweed products (Govaerts & Olsen, 2022, 2023). Identifying these driving factors allows stakeholders - from policymakers and marketers to food producers - to adapt their communication and strategies to better align with consumers' values and identities, thereby facilitating the adoption of seaweed food products.

Differences in age, sex, and education were observed between the clusters. Hence, on average, the conservative group was older than the progressive and egoistic groups. This result is in accordance with that of Birch et al. (2019), who identified young consumers as the demographic most likely to eat seaweed in Western countries. The egoistic group contrasted with the two other groups, being mainly composed of men, and the youngest and less educated (Table 6). The progressive group was the most educated. Similar to previous studies (Birch et al., 2019; Palmieri & Forleo, 2020), we also found that the more favorable segment towards seaweed food products is also the most educated. It is also worth noting that the most favorable group (progressive) towards seaweed food products was also the largest (39%).

Finally, from a practical perspective, this study shows that progressive consumers should be reached by stimulating their biospheric and hedonistic values, food innovativeness, and health self-identity. Marketers will encounter more substantial motivational adoption barriers from conservative and egoistic segments. In addition, this segment is estimated to cover almost 40% of UK consumers. Both conservative and egoistic segments are less likely to consume seaweed, as they are not interested in eating new or unfamiliar foods such as seaweed. Moreover, the conservative and egoistic groups do not identify as having a healthy lifestyle, which means, at first glance, they may be less sensitive to seaweed's health qualities. To target the conservative segment, marketers should emphasize that it is sustainable because its culture does not require fertilizers, heating, or watering (Pereira, 2016). Seaweed food producers should also propose a variety of exciting snacks containing seaweed to introduce seaweed to (younger) consumers. Healthy, high-value snacks are food products highly associated with pleasure, and as they are eaten in small amounts between meals, consumers are likely to try novel snacks containing seaweed (Palmieri & Forleo, 2020).

Regarding the egoistic segment, marketers should promote seaweed to maximize individual benefits. Hence, marketers should target interest in superfoods by promoting seaweed as beneficial, especially for well-being.

Finally, as consumers have little knowledge about seaweed, especially its preparation and culinary uses, different strategies could be used to educate consumers about seaweed- for example, partnerships with influencers, particularly those who resonate with the progressive consumer segment. Influencers can effectively communicate with social media the appeal and benefits of seaweed products to their followers. Blogs, posts or videos easily accessible to all consumers could explain the nutritional benefits, recipes, and cooking techniques for seaweed. Moreover, seaweed marketers should collaborate with restaurants and chefs to create unique seaweed-based dishes. This collaboration can not only introduce seaweed to consumers but also promote the culinary qualities of seaweed.

## **6. Limitations**

This study had several limitations. First, the focus of this study was limited to a representative sample of consumers from the UK. Future research in other potentially important Western markets (e.g., the USA, France, and Germany) is recommended. It would also be interesting to compare consumer segments in, for example, Asia with those in Europe. Previous research on seaweed food consumption has focused on Western consumers (Birch et al., 2019; Lucas, Gouin, & Lesueur, 2019; Palmieri & Forleo, 2020; Young et al., 2022) and lacks consideration of cross-cultural differences between Asian and Western cultures. Therefore, future studies should explore cross-cultural consumer perceptions and cognitive associations with seaweed. This study provides an extensive overview of the seaweed food market by focusing on consumer behavior towards seaweed food products as a general category of food products. Future research should examine consumer segments of specific seaweed food products.

This study only explores a limited number of facets related to environmental values and self-identity. However, there is room for future studies to broaden the scope by incorporating additional aspects and dimensions of both values and self-identity (Brieger, 2019; Schwartz, 1992; Van der Werff, Steg, & Keizer, 2013). Moreover, this study did not compare consumption intentions and consumption of other food products (e.g., organic foods and seafood) with consumption of seaweed. Future studies could include these issues as profiling together with other relevant profiling variables (e.g., ways of shopping, cooking habits, and convenience orientation).

## 7. Conclusion and practical implications

The insights of this study are of great importance to the emerging seaweed food sector. By providing a better understanding of market segments, marketers can use their limited resources more efficiently, by focusing on consumers who are more likely to eat seaweed in the future. These early consumers could open the market and positively influence their social networks. Such an effect could potentially increase the social acceptance of consuming seaweed products in the UK. In the long run, this change could lead to the emergence of a seaweed consumption culture that can grow in the UK and spread to Europe, generating market demand and growth. To encourage conservative and egoistic segments to consume seaweed, the seaweed industry should increase their exposure to the public by focusing on promotional campaigns in the media and social media. Promotional materials should emphasize the nutritional, environmental, and sensory qualities of seaweeds to satisfy consumers' interest in the environment or their own personal benefits, respectively.

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