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**SUSTAINABLE AND HEALTH CLAIMS VS SENSORY PROPERTIES: CONSUMERS'  
OPINIONS AND CHOICES USING A VEGETABLE DIP AS EXAMPLE PRODUCT**

María Mora<sup>a</sup>, Elena Romeo-Arroyo<sup>a</sup>, Paula Torán-Pereg<sup>a</sup>, Carolina Chaya<sup>b</sup>, Laura Vázquez-Araújo<sup>a,c,\*</sup>

<sup>a</sup>BCC Innovation, Centro Tecnológico en Gastronomía, Basque Culinary Center, Donostia-San Sebastián, España

<sup>b</sup> Department of Agricultural Economics, Statistics and Business Management. Universidad Politécnica de Madrid, Escuela Técnica Superior de Ingeniería Agronómica, Alimentaria y de Biosistemas, Ciudad Universitaria s/n, 28040 Madrid, Spain

<sup>c</sup>Basque Culinary Center, Facultad de Ciencias Gastronómicas, Mondragon Unibersitate, Donostia-San Sebastián, España

(\* *Corresponding author. Email: lvazquez@bculinary.com*)

**KEYWORDS**

Sustainable, food waste, consumers, messages, food choice

**HIGHLIGHTS**

- Potential claims related to sustainability, production, and health were identified
- Different terms for a similar concept elicited different interest
- Sensory properties drove liking over healthy or sustainable claims

## **ABSTRACT**

New foods development is always challenging, and including consumers' opinion during the design process is crucial to increase a successful welcome of the product in the market. During the present study, a whole product design and development process is described, including consumers' insights collected from focus groups, a national online survey, and a final sensory consumer study of the developed vegetable dip. The aim of the study was to determine if some of the extrinsic properties of a product developed using discarded parts of fruits and vegetables had an impact on the final product acceptance, or if the intrinsic properties were the main drivers of the acceptance. The experimental design included four focus groups to study consumers' ideas about products made with sustainable ingredients and which may have health benefits. Then, a national survey was conducted to test the best messages associated to the new food. A vegetable dip was developed, using consumers' insights, and a consumer study was conducted to test the impact of three different messages associated with the product. Results of the survey showed three consumers' segments with different interests on the concepts associated with the products, being two of the clusters potential consumers of the new vegetable dip. Results of the consumer study showed that, although consumers belonged to these segments in which the extrinsic properties seemed to be important, the 3 tested messages were similarly accepted.

## 1. INTRODUCTION

It has been reported that more than 75% of new food products fail during the first year after launch (Kemp & Hort, 2015), and using consumers' insights during the product design and development phase could help increasing this success ratio (e.g.: Busse & Siebert, 2018; Talavera & Chambers, 2017). When some of the ingredients used in the new development have specific characteristics (e.g.: high vitamin content), understanding consumers' reactions to these functional or extrinsic properties could be of great interest for the developer; the information relative to the reactions of consumers to the different product-related properties could be used as a powerful communication tool to impact product acceptance (Jaeger, 2006).

According to FAO, food loss and waste have become important problems, meaning over 1.3 billion tons of edible materials per year. Most of the food loss and waste come from fruits, vegetables, roots, and tubers (FAO, 2011). Consumers' explicit interest in sustainability has increased in different countries such as Netherlands, in which 70% of consumers were either "sustainable consumers" or "concerned with sustainability" (Statista, 2018), or Spain, where a 73% of population makes consumer decisions for ethical or sustainability reasons (OCU, 2018). Therefore, using food by-products or discarded fruits and vegetables could be of great interest in order to reduce food waste, and also because the consumer niche in sustainable products is increasing. Although this idea is not new, and several studies have been conducted to determine the suitability of different food by-products as ingredients for new foods (e.g.: García, Domínguez, Galvez, Casas, & Selgas, 2002; Lee, Yeom, Ha, & Bae, 2010), investigating the impact of the associated extrinsic properties in these new foods has not been widely investigated yet.

The relationship of consumers' perception of different products with their health-related, organic, local, or production method info, has been explored in different studies. Most of these studies concluded that some specific cues can impact liking in a positive manner, such as "organic", "tradition", or "local/domestic". For example, Januszewska *et al.* (2013) proposed a scale to measure local embeddedness to the region. Results from their study showed three different consumer segments in terms of local involvement. Also, health claims were linked to positive, or not having a significant impact on liking, depending on the product category (Fernqvist & Ekelund, 2014). Although some of these concepts were linked to environmental impact (e.g.: organic, local), consumers' awareness about the impact of food waste has significantly increased in the

last decade, and few studies have been conducted related to the assessment of consumers' perception of foods made with by-products. Henchion, McCarthy, & O'Callaghan (2016), after conducting a qualitative research to determine consumers' attitudes towards meat by-product, suggested to use beef by-products as ingredients for being integrated into existing routines. During the present research, some fruits and vegetable by-products were used as ingredients for developing new products, but consumers' input was used for the whole design and development process. The aims of the research were 1) to collect information related to the opinions and reactions of consumers associated to discarded fruits and vegetable parts, 2) to determine the impact of some of the concepts on the acceptance of the new developed product.

## **2. PHASE I: CONSUMERS' INSIGHTS FOR PRODUCT DESIGN**

### **2.1. Material and methods**

The protocol and procedures used in this study (in both phases: I and II) were approved by the Basque Culinary Center scientific committee, which stated a waiver consent. All articles from the Declaration of Helsinki and the 2016/679 EU Regulation on the protection of natural persons regarding the processing of personal data and on the free movement of such data were met. The experimental procedure was explained and a written consent indicating voluntary participation was obtained from each participant prior to beginning the study.

#### *2.1.2. Focus groups*

With the aim of i) guaranteeing the greatest acceptance of the product to be designed, and ii) collecting information about consumers' attitudes and reactions to vegetable-waste ingredients, different 1.5 hours focus group (FG) were conducted with 5-8 consumers per group. A total of 24 participants, who actively participate in the groceries purchase of their home, were recruited from the BCCInnovation consumers' database. The FGs were led by a trained moderator, who introduced the discussion talking about the importance of reducing food waste and the nutrients which are yet present in the vegetable by-products. Then, the discussion was directed to determine interests of consumers related to food purchase habits (health benefits of foods, price, sensory properties, etc.). Two interventions were included during the discussion to determine the best way of communicating the properties of the new product to consumers, and also to ask them which kind of vegetable products they would like to try, independently of being or not made using by-products. The responses were recorded, transcribed, and analyzed. All terms related to the

extrinsic characteristics of the product to be developed were organized and collected in a final list. This, along with the five product categories which were detected as “interesting for consumers” in the second intervention, were later evaluated in a national survey.

### *2.1.2. National survey*

A next step on the product development phase was to evaluate the different concepts collected during the FG phase, because some of them were quite similar from a technical standpoint, but expressed using different terms/lexicon by consumers. To test if some of those terms were more liked than others, and if different segments of consumers could be identified depending on their interests, an on-line national survey was conducted using Compusense® Cloud software (Compusense Inc., Guelph, Ontario, Canada). A total of 495 respondents, recruited from the BCCInnovation consumers' database and who typically participate in the groceries purchase of their homes (32% men, 68% women; 33% from 18 to 35 years old, 47% from 36 to 55 years old, and 20% older than 56 years old), evaluated their interest in the 29 concepts which were collected during the FG phase (Table 1). In addition, consumers' interest in the 5 different hypothetical new foods which came up during one of the focus groups' interventions, was assessed during the survey. A 9-points scale was used in the survey, being 1 = non interested at all, and 9 = very interested. The same scale was used to determine consumers' interest in the potential 5 new products. Both, concepts and products, were randomly presented for each consumer in the survey.

For data analysis, one way-ANOVA was conducted to determine if the concepts elicited different interest in consumers. Post-hoc test was conducted using Tukey's HSD. Once the concepts were proven to be perceived as significantly different, to determine if some groups of consumers could be identified having different/common interests, a Hierarchical Cluster Analysis, using Euclidean distance and Ward's criterion of aggregation, was conducted on consumers' individual data. All statistical analyses were conducted using XLSTAT Version 2009.6.03 (Addinsoft, USA) (Addinsoft, 2019).

## 2.2. Results and Discussion of Phase I

### *2.1. Focus groups*

Different concepts were recorded during the focus groups phase, highlighting the ones shown in Table 1. The conversation included questions related to “health and food”, “circular economy and

food”, “production”, and also about the intrinsic and extrinsic properties that attendants considered related to those already discussed subjects. Different terms were used by respondents when talking about circular economy, such as “sustainable”, “food waste”, “subproducts”, etc., eliciting different discussions when trying to define the meaning of each term. Some other concepts were mentioned in different moments of the discussion (e.g.: km 0, with natural ingredients) and seemed to be associated to different categories by different participants (e.g.: production, sustainability or economy). When driving the conversation to “health and food”, most of the comments were associated with vitamins, minerals, and other nutrients which may be present in foods, although most of the participants stated not feeling confident with the health claims of processed foods. Results of the first intervention conducted during the FGs indicated that respondents felt more confident about food messages when transmitted by a nutritionist/dietician, or when read in technical publications; also, attendants marked “webpages” and “social networks” as the easiest way of obtaining information about food or food ingredients.

Several food examples were mentioned by participants when asked about which foods they would like to try knowing that were made using food by-products (e.g.: pumpkin or orange peels); the mentioned foods were grouped in 5 categories: vegetables/fruits/legumes dip, vegetables/fruits flour, mixed fruits and vegetables peels for infusions, dried fruits toppings, and vegetable puff pastry. Pumpkin and orange peels were some of the examples mentioned by the moderator during the discussion because of being some of the most frequent by-products of supermarkets and catering companies of the local area (data not shown in the manuscript, directly provided by the companies). These 5 food categories, together with the different concepts/ideas collected during the FG (Table 1) were used to design the national survey.

## 2.2. *National survey*

Significant differences ( $p < 0.05$ ) were found among interest ratings when studying the concepts assessment (Table 2). In general, some of the concepts elicited higher interest ratings than others (e.g.: “made with seasonal products” compared with “coming from food waste”). Consumers were clustered in 3 groups which presented different interests profiles: C1 was characterized by a general low interest in all the exposed concepts, C2 included those respondents with a higher discrimination among concepts (high interest for some, and low interest for other concepts), and C3 included those respondents with a general high interest for all the presented concepts,

including those closely related to “food waste”, “discards”, or “by-products” (Figure 1). C1 and C2 showed significantly lower interest than C3 in those concepts associated with using by-products, ugly fruits, etc., but were interested in the terms “sustainability” and “responsible with the environment”. These consumers' segments identified with the results of the national survey provided useful info about the importance of using specific terms when talking about the extrinsic properties of foods. For example, it was to note the differences among the concepts “local product”, “closeness”, and “km 0”, the three of them significantly different, although all of them referring to the geographical origin of the product. In general, all the terms related to using by-products (e.g.: “made using food by-products” or “made with ugly fruits”) were significantly less liked than general terms which could have included the same idea, such as “responsible with the environment”, “contributing to a responsible consumption” or “integral use of the fruit / vegetable”. The impact of selecting a wrong term could be more notable if trying to reach those consumers who belong to C2.

It has been reported that food choice patterns are influenced by ethics reasons, including somehow “origin” and “environmental” factors, and those were somehow included in the Food Choice Questionnaire developed by Steptoe, Pollard, & Wardle (1995). Later, different concepts associated with sustainability were added in a wider food choice questionnaire developed by Sautron, Péneau, Camilleri, Muller, Ruffieux, Hercberg, & Méjean (2015), some of them related to food waste, and some to pollution or packaging. It is important to indicate that these researchers identified that the concern about “proximity” seemed to be linked with preserving national economy more than protecting the environment; this trend had also been reported by other authors (e.g.: Chambers, Lobb, Butler, Harvey, & Traill, 2007). A study conducted by Januzewska *et al.* (2013), conducted in 15 countries, showed the impact of regional embeddedness in consumer segmentation; the specific segment “strong local supporters” was associated with holding a strong emotional bond with their region, and a tend on purchasing local food products.

Results of the survey conducted in the present study indicated that not just different concepts linked to sustainability or production elicited different interest among consumers, but also that the interest on the sentence/term used to describe the same idea was rated significantly different. This was the main reason for not grouping the different concepts in wider categories such as

“production”, “origin”, or “health claims” during phase II of the study, or even for data analysis. A deeper study to determine the different understanding of the various terms would clarify if consumers were associating some of the terms to different categories, as reported by Sautron *et al.* (2015). Also, future cross-cultural studies could expose the different perception to similar sustainability associated terms, providing cues about the best way of promoting new environmentally friendly foods in different countries.

Results of the evaluation of the interest in the 5 different products showed that the products elicited significantly different interests, highlighting a higher interest in the vegetables dip (mean = 6.62) and a lower interest in the dehydrated fruits/vegetables toppings (mean = 6.26). Vegetable and cheese-based dips are considered snack foods in Spain, which are consumed at different moments of the day and understood as convenience foods. In general, demand in the “snack food” segment is increasing; the income of this market (not including dried fruits neither meat snacks) currently represents approximately 4% of the global food market, and is forecasted to grow to almost US\$193 billion worldwide at retail selling prices by 2023 (Statista, 2019). This segment includes a wide variety of salty and savory foods such as potato chips, nuts, dried fruits, and even some meat products. In addition to the aforementioned interest for consumers in sustainability (Statista, 2018; OCU, 2018), the study highlights the potential increase in the healthy snacks market in the next years. It has been reported a great interest in dried fruits snacks, maybe due to their high content in minerals, vitamins, phytonutrients, and fiber. Increasing awareness regarding their health benefits among consumers in some European countries (e.g.: U.K., Germany, France), may encourage the demand for these products during the next years (Grand View Research, 2019). Some of the products mentioned during the focus groups phase, which were mentioned as interesting by attendants regardless of including vegetable by-products as ingredients, belonged to this snack category (e.g.: vegetables and fruits dips). Therefore, results of Phase I showed that using fruits and vegetable by-products as ingredients for designing new and healthy snacks could be an interesting option for both, industry and consumers.

For all these reasons, and because the other products mentioned during the FG phase needed some cooking/preparation phase before consumption, a vegetable dip was developed which included most of the characteristics identified as interesting by consumers, and which could be used to communicate its properties, e.g.: made with natural, seasonal, and local products (Table

2). Also, some of the ideas were actually considered for the product development: the product was 100% vegetable and no added sugar, neither palm oil, were used as ingredients.

### **3. PHASE II: PRODUCT DESIGN AND CONSUMER TEST**

#### **3.1. Material and methods**

Using the results of Phase I, a vegetable dip was developed, taking into consideration some consumers' interests (Table 2). Some of the ingredients of the vegetable dip (pumpkin and orange) were discarded fruits from groceries/catering industry, mainly because of being "ugly", or in an overripe stage which did not match the quality standards of the companies. Before using these fruits/vegetables, a drying and milling process had been conducted to obtain fruits/vegetable flours, ensuring a higher shelf life of the product. The main ingredients of the vegetable dip were: beans, the aforementioned dried pumpkin and dried orange pulp and peel, olive oil, lemon juice, and tahini; the recipe was developed by an experienced chef of Basque Culinary Center.

Because the aim of the present research was to determine the importance of the sustainable or health claim/storytelling of the product, the experimental design focused on assessing the impact of 3 different messages on the product acceptance. The concepts chosen to be tested in this phase are highlighted in Table 2. Concepts which were similarly scored were grouped together in 1 idea significantly more interesting for consumers, and 2 ideas significantly less interesting for consumers, one of them related to the nutritional aspects of the food, and the other one to production. Sample coded as "471" was presented with the message: *"this product is made by a local company, with seasonal ingredients, without additives neither added sugars. With the purchase of this product you are contributing to a responsible consumption with the environment"*. This message included some of the concepts that elicited higher interest, especially in consumers' clusters 2 and 3, and independently of the category or association that consumers could be doing of each single concept (e.g.: sustainability, supporting local economy, or health claim). Sample coded as "842" was presented with the sentence *"this product is made from the use of peels and discards of fruits and vegetables. It is a km 0 product, and 100 % vegetable"* including some of the concepts linked to production and which elicited less interest, especially in clusters 1 and 2. Sample coded as "723" was presented with the sentence: *"this product is rich in minerals, has a high fiber content, and favors a slow release of energy"*, with concepts linked to the nutritional

aspects of the food, and significantly less interesting for consumers than those used in sample 471.

A Home Use Test (HUT) consumer study (n = 117; 41% men and 59% women; mean age was 30 years old) was conducted, because researchers wanted to ensure that participants consumed the products when they considered more appropriate; HUT has been reported to be more appropriate than Central Location Tests (CLT) whenever the product consumption is expected to be contextual (Boutrolle, Delarue, Arranz, Rogeaux & Köster, 2007). Consumers were recruited from the BCCInnovation consumers' database and had not participated in the FG or the national survey.

The 3 coded samples, consisting on the same dip, but with 3 different codes (3 digit numbers randomly assigned) and messages, were shipped refrigerated to each consumer (40 g each sample), along with written instructions, and a link to complete the questionnaire using a mobile/tablet. Consumers were asked to complete the test, whenever they considered appropriate to consume the dips, and to follow the instructions of the on-line questionnaire using Compusense® Cloud software (Compusense Inc., Guelh, Ontario, Canada). Consumers were free to choose bread, *crudités*, or no carrier, to taste the different coded samples, but once selected, the use of the same vehicle for the 3 samples was mandatory. Before completing the questionnaire associated with each coded sample, a small paragraph with information about the sample (the concepts/storytelling) was presented to the consumer, and then the corresponding sample was tested and assessed by the respondent. The questionnaire included a 9-points hedonic scale for acceptance (1 = extremely dislike, 5 = neither dislike nor like, 9 = extremely like), and 9-points Just About Right (JAR) questions (1 = too much light, 5 = Just About Right, 9 = too much intense) about color, density, orange flavor, and salty taste. Although the vegetable dip was the same in the 3 samples, the aim of the research was to assess the impact of the 3 different messages on the dip perception, thus the JAR questions were added. Samples presentation was randomized in the on-line survey, guaranteeing that consumers would taste the samples in a different order. Besides asking some demographic questions (e.g.: age), the questionnaire previously used during the national survey of Phase I, was included.

Consumers were clustered depending on their interests in the different concepts using a Hierarchical Cluster Analysis, using Euclidean distance and Ward's criterion of aggregation.

Then, a 2-way ANOVA was conducted using “sample” and “cluster” as factors, and the 2-way interaction “sample\*cluster”; post hoc test was conducted using Tukey’s HSD. Data analyses were conducted using the statistical package XLSTAT Version 2009.6.03 (Addinsoft, USA).

### 3.2. Results and discussion of Phase II

The same 3 clusters that were identified in the national survey results were also found when analyzing the results of the consumer test (n = 23 for C1; n = 71 in C2; and n = 23 in C3). In general, no significant differences were detected among samples liking (mean = 6.1), but significant differences were detected among clusters ( $p < 0.01$ ): consumers belonging to C3 liked all samples more than consumers who belonged to C1 and C2. JAR data showed that all 3 samples were perceived Just About Right regarding color, density, orange flavor, and saltiness (Table 3). Cluster 3 considered the samples significantly denser than clusters C1 and C2, but the messages did not have an impact on the perception of the sensory attributes (Figure 1).

Although the national survey results indicated that some of the information linked to the samples could have an impact on samples liking, results of the consumer test conducted in the present study showed the opposite. Different authors have reported data to show how diverse information related to food products has a clear influence on products liking (Piqueras-Fiszman & Spence, 2015). For example, dietary fiber information was proven to have an impact in the perception of different sensory properties of breads and English muffins, as well as acceptance, in Chinese Malaysian and Australian consumers (Mialon, Clark, Leppard, & Cox, 2002). Also, Ekelund, Fernqvist, & Tjärnemo (2007) reported that tomatoes labelled as “organic” or “local” received higher liking scores than the same tomato labelled as coming from a different country. These are some examples of foods which liking or sensory perception was modified due to labels related with health claims, sustainability, or even the name of the food product (e.g.: Miller & Kahn, 2005). During the present study, all samples were similarly liked, despite having different labels with diverse information regarding production (e.g.: “made with seasonal products” vs “km 0”) or health related claims (“no added sugar” vs “with a high fiber content”). Independently of the information provided to consumers, and even using the claims which were less liked by all clusters (e.g.: “coming from discards”, used in sample 842), acceptance of the 3 studied samples was similar. These results agreed with the results reported by other authors whose studies indicated that sensory properties were the drivers of food choice or liking, or maybe more important than other

extrinsic properties (Vázquez-Araújo, Chambers, & Cherdchu, 2012; Brečić, Mesić & Cerjak 2017; Oliveira, Ares, & Deliza, 2017). In addition, these results could be associated with the category of the product; because snacks are generally understood as “comfort foods” in Spain, consumers might have focus on the hedonic component of the product (sensory properties) instead of its extrinsic properties (messages associated to each sample). Drivers of liking have been demonstrated to be product category dependent (Li, Jervis, & Drake, 2015), and this could be the case of snack foods in the Spanish market.

Although results should be considered tentative because of the different n of each cluster, significant differences were found among clusters. Consumers included in C3 liked all samples more than consumers who belonged to clusters 2 and 1. Also, consumers of cluster 3 perceived all samples as being “denser” than consumers of clusters 2 and 1 (Table3). C3 was characterized by higher interest scores in all the terms assessed in the survey, including those related with “food waste”, “discards” and “by-products” which were significantly less interesting for C1 and C2. Several studies have demonstrated that the perception of products can vary depending on consumers’ sensitivity to the extrinsic properties of the product. For example, Laureati, Jabes, Russo, & Pagliarini (2013) found that individuals interested in sustainability issues rated expectations and liking of products labeled as “organic” in a different manner than those who were not interested in sustainability topics. In the present research, consumers belonging to C3 liked all samples more, maybe because a vegetable dip-snack was a product which fitted better within this cluster’s interests.

Results of the present study showed an example of process for product development in which consumers are included during the different steps of the product development. Using discarded fruits/vegetables or fruits/vegetables by-products as ingredients for different foods could be an interesting way of fighting food waste, and consumers showed general positive attitudes to this idea during the focus groups phase. One of the limitations of the study was that individual terms were not assessed, and therefore some info might have been missed during the consumer study. Because of the amount of different terms detected during the focus groups phase, it was impossible to assess all of them during the consumer study. Further studies could be developed investigating the impact of using different terms with similar meaning on a variety of products acceptance. Also, additional studies should be developed to determine the interests of the

different consumer niches for healthy and sustainable snacks in Spain, and also to understand the differences with other countries, promoting the inclusion of local vegetable by-products as well-accepted ingredients.

#### **4. CONCLUSIONS**

A series of focus groups conducted with Spanish consumers allowed identifying a positive reaction towards using fruits and vegetables by-products as ingredients for different food categories. Various terms related to sustainability, production, and health claims were associated with these by-products. Three consumer clusters were identified, showing different interests in the concepts identified during the focus groups. In addition, some of the concepts were significantly more liked than others, highlighting in these results the importance of using the appropriate terms when communicating with consumers. Although a national survey indicated that general terms such as “integral use of the fruit/vegetable” or “responsible with the environment” would enhance liking of a new food, if compared with specific terms such as “Km 0” or “rich in minerals”, results of a home-use-test showed the opposite. Liking of a vegetable dip sample developed with vegetables and fruits by-products, and with different messages, liked similarly independently of the messages associated to the sample. Further studies are necessary to better understand consumers’ reactions to similar ideas expressed using different terms (e.g.: “local” vs “Km 0”) and also to understand the healthy and sustainable snacks market niche interests (sensory and rewarding vs health vs sustainability).

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Table 1. Concepts collected during the FG phase, mentioned when discussing about the food purchase interests of consumers, and later on evaluated in an on-line national survey.

Legend. Concepts have been coded as shown in the figures to facilitate reading.

Concept assessed by consumers in the national survey	
Q1. Coming from discards	Q16. 100% Vegetable
Q2. Made with ugly fruits	Q17. Made with seasonal products
Q3. Made from fruit and vegetable peels	Q18. Without palm oil
Q4. Made with food waste	Q19. Integral use of the fruit / vegetable
Q5. Made using food by-products	Q20. Traditional recipe
Q6. Sustainable	Q21. No added sugar
Q7. Responsible with the environment	Q22. With a high fiber content
Q8. From the reuse of ...	Q23. Real food
Q9. Closeness	Q24. With a short list of ingredients
Q10. Local product	Q25. Without additives
Q11. Km 0	Q26. Rich in vitamins
Q12. With natural ingredients	Q27. Rich in minerals
Q13. Natural / sustainable packaging	Q28. Slow release of energy
Q14. Ecological	Q29. With a QR (information on: traceability, raw materials, production system, etc.)
Q15. Contributing to a responsible consumption	

Table 2. One-way ANOVA results of the national survey (n = 495). Post-hoc test was conducted using Tukey's HSD. Bold indicating the concepts tested in sample 471 (expected to be more liked) and italic for those tested in sample 723 and 842 (expected to be less liked).

Legend. Interest scores not sharing the same letter were significantly different ( $p < 0.0001$ )

Concept	INTEREST SCORE	Tested in sample:
Q17 Made with <b>seasonal</b> products	7.9 a	471
Q7 <b>Responsible with the environment</b>	7.8 a	471
Q10 <b>Local</b> product	7.8 a	471
Q12 With natural ingredients	7.7 ab	-
Q25 <b>Without additives</b>	7.6 abc	471
Q21 <b>No added sugar</b>	7.6 abc	471
Q18 Without palm oil	7.5 abcd	-
Q15 Contributing to a responsible consumption	7.5 abcd	-
Q6 Sustainable	7.5 abcd	-
Q13 Natural / sustainable packaging	7.4 abcd	-
Q19 Integral use of the fruit / vegetable	7.3 bcd	-
Q9 Closeness	7.3 bcd	-
Q24 With a short list of ingredients	7.2 bcde	-
Q26 Rich in vitamins	7.2 cde	-
Q14 Ecological	7.1 def	-
Q22 <i>With a high fiber content</i>	6.9 efg	723
Q20 Traditional recipe	6.8 fgh	-
Q29 With a QR (information on e.g. traceability)	6.7 fgh	-
Q16 <i>100% Vegetable</i>	6.7 fgh	842
Q27 <i>Rich in minerals</i>	6.5 ghi	723
Q11 <i>Km 0</i>	6.4 hij	842
Q23 Real food	6.2 ij	-
Q8 <i>From the reuse of ...</i>	6.0 jk	842
Q3 <i>Made from fruit and vegetable peels</i>	5.7 kl	842
Q28 <i>Slow release of energy</i>	5.7 kl	723
Q2 Made with ugly fruits	5.3 lm	-
Q5 Made using food by-products	5.1 m	-
Q1 Coming from discards	5.1 m	842
Q4 Made with food waste	4.9 m	-

Table 3. Two-way ANOVA and Tukey HSD results of Liking and JAR data.

Legend. Liking scores not sharing the same letter were significantly different ( $p < 0.05$ )

	ANOVA			Cluster			Sample		
	Sample	Cluster	Sample* Cluster	3	2	1	471	723	842
Liking	0.790	<b>&lt; 0.0001</b>	0.527	6,66 a	5,65 b	5,93 b	6,02 a	6,16 a	6,07 a
Density	0.749	<b>0.001</b>	0.954	5,88 a	5,43 b	5,42 b	5,51 a	5,63 a	5,60 a
Orange flavor	0.824	0.641	0.966	4,99 a	4,91 a	4,74 a	4,98 a	4,80 a	4,86 a
Color	0.602	0.125	0.730	5,26 a	5,22 a	4,97 a	5,20 a	5,06 a	5,18 a
Saltiness	0.743	0.095	0.994	4,57 a	4,22 a	4,42 a	4,48 a	4,39 a	4,34 a

Figure 1. Hierarchical Cluster Analysis using Euclidean distance and Ward's criterion of aggregation. with the National Survey responses.

Legend: Q1, Q2, etc. are the assessed concepts, coded as indicated in Table1. "1", "2", and "3" are the 3 identified clusters (n = 188, 174, and 133 for C1, C2 and C3 respectively).

