Research article

Towards halving food waste: A comparative study using orange juice by-product in dairy desserts

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ABSTRACT

By-products upcycling to produce ingredients has increased in the last years. However, the perception of foods with these ingredients must be studied to find the proper way to inform the consumer. The aim of this work was to study the purchase intention and healthiness and environmental friendliness perceptions of a flan dessert, enriched with orange juice by-product fibre. The effect of different product categories (ready-to-eat, powdered form, home-made type), fibre origin claim, and the addition of a sustainability logo in the packaging were studied through an online survey carried out in Spain (n = 342) and Uruguay (n = 307). Data were analyzed by PLS and cluster analysis. Both Spanish and Uruguayan participants considered the product category the most important attribute in purchase intention and in healthiness and environmental friendliness perception, being the home-made product preferred by both. Logo presence was more important for purchase intention and perceived environmental friendliness, while information about fibre origin was more important for healthiness perception. The home-made product with a logo and the claim about fibre origin was the one that had the highest perception of being healthy and environmentally friendly in both populations. Logo presence affected positively purchase intention for both groups, but the relative importance was higher in the case of Spanish consumers. The allegation "source of fibre" also increased healthiness and environmental friendliness perceptions, although not the purchase intention in Spain. Cluster analysis identified different groups of consumers on each country, who gave different relative importance to each attribute in purchase intention.

1. Introduction

Consumers are demanding natural products due to the increasing concern over health and wellness [1]. In recent decades, people have strongly preferred natural foods, willing for fresh, natural, and minimal processed foods. However, the concept of natural food is not still clear. Surprisingly, it is more influenced by the process in which the product is obtained rather than by the content itself [2]. Moreover, external factors such as product category, healthy descriptors, and labels, also affect the concept of healthy and natural food [3].

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Melendrez et al. [4] studied the perception of differently processed pulses and found that the degree of processing of the product was the factor influencing its image the most. Raw products were perceived as natural and good for health, while the processed types (canned or ready-to-eat) were perceived as bad for health. Curutchet et al. [5] found that fibre-enriched bread and pasta were perceived as healthier than the ones without added fibre and were, therefore, more buyable.

Consumers are also becoming more interested in environmental sustainability [6]. When it comes to clothes shopping, consumers seem to be aware of the impact of its production and prefer more environmentally friendly clothes, such as organic cotton [7]. Work has been done on electronics to reduce waste, and sustainable options are being developed as eco-friendly alternative [8]. In the case of food, the effect of the packaging type of foods and drinks on environmental friendliness perception has been studied, for example, in plastic bottles [9] and active packaging [10]. However, knowledge regarding environmentally friendly food consumption is relatively low. Because of the evident impact of meat production on the environment, work has been done on the meat analogue's environmental friendliness perception [11]. Lazzarini et al. [12] studied the relationship between the perceived environmental friendliness and the life cycle assessment (LCA) of different protein products, such as meat, cheese, and plant-based products, and found that these are positively correlated. Hartmann et al. [13] found that consumers with higher knowledge of the environmental impact of foods and food production can choose more environmentally friendly menus (measured by eco points) than those with lower knowledge. To the best of our knowledge, environmental perception of other foods has not yet been assessed. It seems that, as with naturalness, one of the factors affecting mainly this perception is the way in which food is produced, rather than the food itself.

Recently, United Nations have committed themselves to halving food waste as one of the sustainable development goals. One of the ways of helping reduce food waste is by broadening what is typically considered as edible, such as peels and seeds of fruits [14]. These foods are commonly described as "upcycled foods": those that produce ingredients that would be otherwise wasted and that benefit the environment and society [15]. In this way, oranges' peels and seeds, which are typically discarded or used for animal feeding, may be upcycled to obtain dietary fibre. There is a worldwide shortage of its consumption, which could be addressed by supplementing massively consumed foods with this ingredient. However, its use must be conveniently communicated to consumers to help increase the consumption of these foods. Plasek et al., [16] found in their study that one of the main factors affecting healthy perception is the presence of an ingredient's claim. Also, Curutchet et al., [17] found that the acceptability of an apple fibre-enriched cake was higher when informing consumers about the fibre's origin. Grasso & Asioli, [18], who studied the use of defatted sunflower cake flour as an upcycled ingredient in the formulation of biscuits, found that although the knowledge of upcycled ingredients is relatively low among consumers, they would consider buying biscuits formulated with this kind of ingredients.

In this context, the main objective of the present study was to study Uruguayan and Spanish consumers' perception of healthiness and environmental friendliness of different types of dairy desserts (ready-to-eat, powdered form, home-made type) enriched with fibre obtained from an upcycled food as well as their purchase intention.

The main research questions were the following.

(1) Is the upcycled fibre perceived similarly in foods with different processing levels?
(2) How does the fibre origin information affect purchase intention?
(3) Is the logo chosen to communicate sustainability perceived as such by consumers?
(4) Is purchase intention related to perceived healthiness and environmental friendliness?

2. Materials and methods

The study evaluated the effect of information related to fibre enrichment origin and the information about sustainability, on different categories of a product. We considered that the effect of food processing might strongly influence consumer perceptions. According to Melendrez Ruiz et al. (2021), consumers' mental representation of foods depends on their processing level. Therefore, in the present study three categories related to its processing level were considered: a home-made flan, an industrial powder product to

Fig. 1. Example of product's image.

prepare at home and a ready-to-eat industrial flan. As many authors reported that brand credibility is positively related to purchase intention of food [19,20], which is even more important than sensory characteristics on consumer liking for food [19], brand effect on consumer perception was also considered. Leader brands in both countries were used.

The study was conducted through an online survey where images of each category product with different information about fibre enrichment origin and sustainability information were presented to consumers for evaluation.

2.1. Product stimuli

For the product evaluation, images of each (Fig. 1) category product were presented next to information regarding the origin of fibre enrichment (variable 1, levels 0 and 1), and a sustainability logo (variable 2, levels 0 and 1), resulting in a total of 4 images for each category product. The claim "source of fibre" was included next to the image in all cases. Table 1 shows the experimental design of the study.

2.2. Online survey

Data was collected using Qualtrics (Qualtrics, Provo, UT) between March and April 2022, both in Uruguay and Spain. Participants were recruited via social media channels. Their informed consent to participate in the study was collected before beginning the survey. They were informed that all information was being collected for investigation purposes and was confidential.

Consumer's perception of environmental friendliness, healthiness, and purchase intention of all products shown in Table 1 were assessed. The images were presented individually to participants, following Williams' Latin square design. They were asked to look at the images and to rate their perception of environmental friendliness and perceived healthiness using a 7-point scale (1: not at all friendly, 7: completely friendly; and 1: not at all healthy, and 7: completely healthy, respectively), and purchase intention using a 7-point scale (1: I would definitely not buy it, 4: maybe yes, maybe no, 7: I would definitely buy it). Also, the frequency of dairy dessert consumption was evaluated, and finally, consumers were asked about sociodemographic characteristics (age, gender, education level, income level).

G*Power version 3.1 was used to calculate the minimum sample size. According to these, a sample size of 246 participants was needed to detect a medium-sized effect (f = 0.25; power >0.95). Surveys were completed by 342 participants in Spain and 307 in Uruguay. Social demographic information is presented in Table 2.

2.3. Data analysis

Pearson correlation tests (p-value 0.05) were performed on aggregated data of each country to analyse if a correlation existed between perceived healthiness, environmental friendliness, and purchase intention.

To interpret data from the survey, part-worth utilities and the relative importance of attributes were estimated by PLS. A one-way repeated measures ANOVA with post-hoc Tukey test was applied to compare attributes in terms of their utilities. A Chi-square test was performed to compare the relative importance between populations.

Hierarchical cluster analysis of purchase intention was employed to identify clusters reflecting the participants' preferences. Kruskal Wallis Test was used for multiple data comparisons, with post-hoc Dunn - Bonferroni test to examine significant differences (p-value 0.05) between clusters in their purchase intention.

A Principal Component Analysis (PCA) was performed to study the effect of the information on healthiness and environmental friendliness perception.

Statistical analysis was performed using XLSTAT (Addinsoft 2020; New York, NY, USA).

3. Results and discussion

3.1. Relation between purchase intention and perceived healthiness and environmental friendliness

Correlation coefficients between purchase intention and participants' perceived healthiness and environmental friendliness are shown in Table 3.

Table 1
Experimental design: information presented in the label image for each category product.

Homemade flan	Ready-to-eat flan	Powder preparation
Source of fibre	Source of fibre	Source of fibre
Source of fibre	Source of fibre	Source of fibre
With orange fibre	With orange fibre	With orange fibre
Source of fibre	Source of fibre	Source of fibre
Sustainability logo	Sustainability logo	Sustainability logo
Source of fibre	Source of fibre	Source of fibre
With orange fibre	With orange fibre	With orange fibre
Sustainability logo	Sustainability logo	Sustainability logo

Table 2
Social demographic description of participants of each country.

		Frequency (%)	
		Spain	Uruguay
Sex	Feminine	53.8	66.1
	Masculine	42.4	33.6
	Prefers not to say	3.8	0.3
Age	17–29	56.4	26.1
	30–44	26.3	31.9
	45–60	14.9	25.4
	>60	2.3	16.6
Household income	Medium-low	78.7	40.1
	Medium-high	21.4	59.9
Educational level	Primary	0.6	2.9
	Secondary	15.2	5.9
	Third level (non-degree)	9.1	16.6
	Third level (degree or higher)	75.2	74.6
Dairy dessert consumption	More than once per week	48.3	28.3
	More than once per month	32.8	38.4
	Less than once per month	14.3	22.5
	Never	4.7	10.8

Purchase intention was positively correlated with healthiness in both countries. However, environmental friendliness was positively correlated with purchase intention only in Uruguay. Healthiness and environmental friendliness perceptions were positively correlated in both countries. This was also seen in Lazzarini et al. [12] study, who found a positive linear relationship between these two variables when evaluating different protein products. Curutchet et al. [21] observed that purchase intention increased when the label included a sustainability logo and description of the added ingredient (in this case, brewers spent grain) in the formulation of three different products: chocolate milk, pasta and bread.

The relationship between perceived environmental friendliness, perceived healthiness and purchase intention is represented in Fig. 2. More giant bubbles represent a higher purchase intention. The general perception of healthiness and purchase intention of these types of desserts was higher for the Uruguayan population than for the Spanish. The perception of the environmental friendliness of home-made dessert was the highest in Uruguay, as well as their perceived healthiness and purchase intention. In Spain, the trend was the same, but the difference with the other type of products was less pronounced.

Environmental friendliness is perceived as higher when information (either as the fibre origin or as logo) is provided for both Spanish and Uruguayan consumers. The same is observed in the case of healthiness perception, where in each category the highest is observed when both the logo and fibre origin are presented.

It is interesting to note that in the case of Spanish consumers, although the presence of information about fibre origin caused an increase in perceived healthiness and environmental friendliness, this did not lead to a positive impact on their purchase intention. In Uruguay, on the other hand, the higher perception of environmental friendliness and healthiness led to a higher purchase intention, as represented in Fig. 2. Few studies have been done linking the perceived environmental friendliness of products and their purchase intention, and they are primarily about organic product consumption. In these cases, one of the reasons for consumers to eat that type of product is their perceived environmental friendliness, as reported by Gundala & Singh [20] and Perito et al. [22]. Plamondon et al. [21] found that communicating information about eco-friendly and nutritious menu choices to consumers within institutional settings could be relevant to enable them to make more eco-efficient food choices.

On the other hand, some studies indeed reported that a certain "fatigue" to the presence of labels appears over time and that their effectiveness is possibly short-lived (Slapø, 2016). Similar results were reported by Koen et al. [23], who observed that providing too much information on the label may confuse consumers.

3.2. Effect of product category and information about origin and sustainability on consumer response

The part-worth utilities and mean relative importance of attributes in purchase intention, perceived healthiness and environmental friendliness are represented in Table 4. This table shows consumer preferences attached to each level of the attributes, indicating the

Table 3
Pearson correlation between purchase intention and perceived environmental friendliness and perceived healthiness.

	Purchase intention		Healthiness		Environmental friendliness	
	Spain	Uruguay	Spain	Uruguay	Spain	Uruguay
Purchase intention	1	1	0.738	0.880	0.447	0.773
Healthiness	0.738	0.880	1	1	0.618	0.809
Environmental friendliness	0.447	0.733	0.618	0.809	1	1

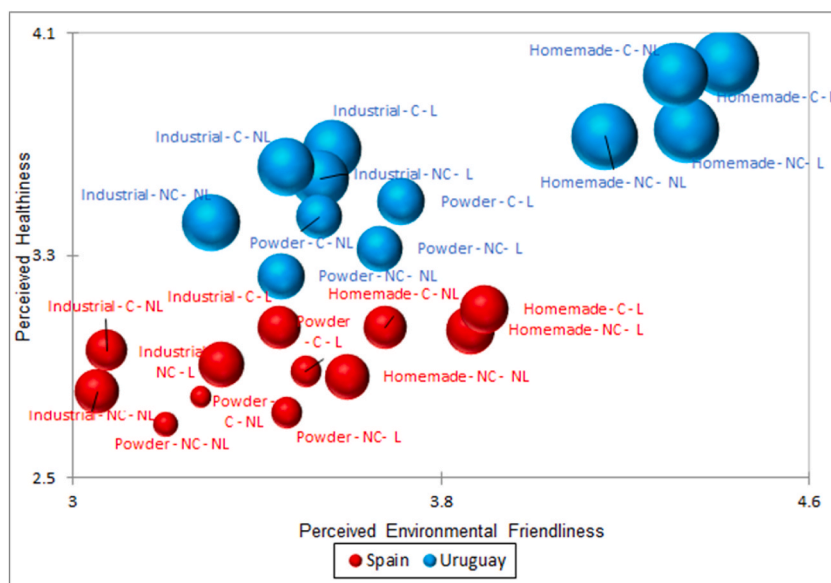Values in bold are significantly different from 0 (p < 0.05).

Fig. 2. Perceived environmental friendliness and perceived healthiness related to purchase intention of Spanish and Uruguayan consumers. Larger bubbles indicate higher purchase intention. C: fibre origin claim; NC: no fibre origin claim; L: logo presence; NL: no logo presence.

influence of each factor level on respondents' preferences for a single combination [24].

Regarding purchase intention, the product category was the attribute of the highest importance both for Spanish and Uruguayan consumers. For both populations, significant differences (p < 0.05) were observed between the three products, the powdered product being the only one with a negative part-worth utility value. The homemade dessert was preferred to the industrial type in both consumer groups.

Logo presence positively affected purchase intention for both groups, but the relative importance was higher for Spanish consumers. Bhatt et al., [25] found that the circularity of the logo increases the consumers' willingness to pay and that green colour is associated with healthfulness and environmental benefits. These researchers found that the presence of a green circular logo improves the evaluation of upcycled foods, which increases purchase intention. In this sense, products' perceived healthiness and environmental friendliness were higher when the logo was present. Furthermore, the European Union has been developing policies to achieve a more circular economy since the last decade, which has led to food companies developing solutions to address food loss [26]. It seems plausible, then, that consumers may be more willing to use upcycled products and therefore, the logo presence has a higher impact on European consumers.

The attribute with the least relative importance was fibre origin for both populations. While Uruguayan consumers did not show significant differences (p > 0.05) between the product with fibre origin claim and no claim, Spanish people preferred the absence of a claim. For perceived healthiness, product category also was the attribute that contributed the most for both populations, followed by fibre origin and logo presence. Industrial and powdered products negatively affected the perceived healthiness of Uruguayan consumers, while Spanish only found powdered products to affect this factor negatively. This is in accordance with Román et al. [2], who observed that the product considered the healthiest is the one with the least processing perceived, in this case, the homemade dessert. According to Laguna et al. [27], consumers regard those products as unhealthier the products that are ready-to-eat unhealthier compared to home-made type of products. As they explain, the reason for this is that home-made meals are considered healthier, as they do not contain additives and are not ultra-processed. Also, Rizk & Treat [28] found that consumers tend to regard as healthier those products in which there is a qualifying nutrient; the presence of the claim seems to mask the other nutrients present (the healthiness of a rich in sugar product was regarded as higher when the product also had a high fibre content). Melendrez Ruiz et al. [4] studied consumers' responses to different processing categories of pulses, finding that people prefer unprocessed products, as they consider the processed type unhealthier. Products being perceived as healthier because of a favourable NutriScore also exhibit a higher purchase intention, as found by De Temmerman et al. [29]. According to Annunziata et al. (2016), European and North American consumers pay attention to nutritional labels when buying food, being the Americans the ones who spend the most time reading nutritional labels. Song et al. (2022) studied how information about the processing of orange juice affected consumers' choice, finding that Spanish consumers were more affected by information than Danish consumers. These authors also found that the claims regarding products' benefits (such as longer shelf life or natural taste) are more important than information on processing.

Regarding environmental friendliness, the only category that positively affected its perception was the "homemade" type dessert, both for Spanish and Uruguayan consumers. This aligns with what was described by Lazzarini et al. [12], who found that processing negatively affected the perception of environmental friendliness. This variable most influenced the environmental friendliness perception, followed by logo presence and fibre origin. Regarding logo presence, Spanish consumers' relative importance was 28.30%, while in the Uruguayan case, it accounted for 13.10%. Both populations found that products with logo presence and orange fibre claim

Table 4

Part-worth utilities of each level, mean relative importance of attributes (MRI) and significant effects in a one-way repeated measures ANOVA.

Attribute	Attribute level	Purchase intention				Perceived healthiness				Perceived environmental friendliness			
		Uruguay		Spain		Uruguay		Spain		Uruguay		Spain	
		Mean part-worth utility	MRI	Mean part-worth utility	MRI	Mean part-worth utility	MRI	Mean part-worth utility	MRI	Mean part-worth utility	MRI	Mean part-worth utility	MRI
Product category	Homemade	0,325[a]	**93,30%**	0,166[a]	**78,26%**	0,255[a]	**65,90%**	0,106[a]	**53,78%**	0,517[a]	**79,80%**	0,31[a]	**65,10%**
	Industrial	0,021[b]		0,09[b]		−0,026[b]		0,024[b]		−0,321[c]		−0,224[c]	
	Powder	−0,346[c]		−0,256[c]		−0,229[c]		−0,13[c]		−0,195[b]		−0,086[b]	
Logo	With logo	0,02[a]	**5,50%**	0,048[a]	**14,74%**	0,037[a]	**9,40%**	0,046[a]	**18,97%**	0,085[a]	**13,10%**	0,135[a]	**28,30%**
	No logo	−0,02[b]		−0,048[b]		−0,037[b]		−0,046[b]		−0,085[b]		−0,135[b]	
Fibre origin	No claim	−0,005[a]	**1,20%**	0,023[a]	**7,00%**	−0,096[b]	**24,70%**	−0,066[b]	**27,25%**	−0,046[b]	7,10%	−0,031[b]	6,60%
	"Orange fibre"	0,005[a]		−0,023[b]		0,096[a]		0,066[a]		0,046[a]		0,031[a]	
	R^2	0,927		0,904		0,956		0,88		0,971		0,923	

Values within one column (and within one attribute) with different superscripts are significantly different according to Tukey's test ($p < 0.05$). Bold percentages in mean relative importance for the same attribute were significantly different among countries according to z test ($p < 0.05$).

were perceived as more environmentally friendly than those who did not have them.

3.3. Consumer segments

Respondents were separated into three clusters, for both Spanish and Uruguayan participants, based on differences in purchase intention on the product category.

3.3.1. Spain

Three different groups of consumers were identified, with different interests. Part worth utilities and mean relative importance of attributes in the purchase intention of each cluster are presented in Table 5.

Although the three groups regarded the product category as the most important factor, Cluster 1 and 3 showed higher importance for the logo presence. Still, they differ in the preferred product category. Cluster 1 prefers the industrial dessert, while cluster 3 prefers the home-made type. Conversely, cluster 2 regarded as more important the fibre origin claim. They also considered the logo presence negative, in contrast to the other groups.

Table 6 shows the demographic characteristics of each cluster. The composition of these clusters does not show considerable differences, other than the educational level of consumers in cluster 2. These people show a higher education level, which could explain the higher importance given to fibre origin.

To sanalyse for each cluster the effect of each attribute studied on perceived healthiness and environmental friendliness, a principal component analysis was approached (Figs. 3–5).

Cluster 1 regarded the home-made category as environmentally friendly and perceived the industrial and powdered products with no logo as not environmentally friendly. The industrial type was considered healthy provided either information about fibre origin or logo were present, while the powdered product was not regarded as healthy regardless of the provided information. This cluster is formed by regular consumers of dairy desserts (more than once per month) and an equal share of men and women.

Cluster 2 considered the home-made dessert with no extra information regarded environmentally friendly, while the industrial type was not. The home-made style was the healthiest, provided information was shown as logo or fibre origin claim. The powdered product was the least healthy. This group has the highest share of people with third-level education (95%), which could explain the healthiness evaluation. Also, this group is the one with the least options considered environmentally friendly, probably due to the higher education level as well.

Cluster 3 considered industrial options as not environmentally friendly, and the logo or information presence did not improve this perception. Only home-made type without logo and information was perceived as healthy, which means - adding information improved the perception of industrial and home-made products. It is interesting though, how this group perceives the industrial type as healthier than the other categories. This cluster comprises young people (18–29 years old).

3.3.2. Uruguay

In Uruguay, the three clusters regarded as the most important product category, followed by fibre origin and logo presence. Part worth utilities and mean relative importance of attributes in the purchase intention of each cluster are presented in Table 7.

Cluster 3 gave more importance to the fibre origin than the logo presence compared to cluster 2. This cluster is also the only one in which the industrial category is regarded as worse than the powder, having a negative part-worth utility.

The composition of these clusters (Table 8) did not vary significantly in terms of age, income level and gender ($p > 0.05$), but groups were significantly different in terms of educational level and frequency of consumption.

To analyse for each cluster the effect of each attribute studied on perceived healthiness and environmental friendliness, a principal component analysis was approached (Figs. 6–8).

For Cluster 1, the environmental friendliness perception was higher for the home-made type. It seems the information did not improve the perception, as the options without it were considered environmentally friendly. None of the products was considered healthy options. These people are regular consumers of dairy desserts, with 43% eating more than once per month and 28% eating more than once per week.

Table 5
Part-worth utilities of attribute levels, mean relative importance of attributes (MRI) and significant effects in a one-way repeated measures ANOVA in purchase intention for Spanish clusters.

Attribute	Attribute level	Cluster 1		Cluster 2		Cluster 3	
		Mean part-worth utility	MRI	Mean part-worth utility	MRI	Mean part-worth utility	MRI
Product category	Homemade	0.067[b]	71.58%	0.191[a]	86.88%	0.171[a]	73.09%
	Industrial	0.174[a]		0.044[b]		0.114[b]	
	Powder	−0.241[c]		−0.235[c]		−0.285[c]	
Logo	With logo	0.089[a]	26.32%	−0.001[b]	0.40%	0.089[a]	22.94%
	No logo	−0.089[b]		0.001[a]		−0.089[b]	
Fibre origin	No claim	0.007[a]	2.11%	0.034[a]	12.72%	0.015[a]	3.98%
	"Orange fibre"	−0.007[b]		−0.034[b]		−0.015[b]	

Values within one column (and within one attribute) with different superscripts are significantly different according to Dunn's-Bonferroni test ($p < 0.05$).

Table 6

Distribution of consumers (%) on Spanish clusters, according to demographic characteristics. Difference among proportions test, $\chi2$ and probability (p) values.

Frequency (%)						
Characteristic	Level	Cluster 1	Cluster 2	Cluster 3	χ^2	p
Sex	Male	49	39	44	1.9	0.389
	Female	51	58	50	2.1	0.352
	Prefers not to say	0	3	6	3.4	0.183
Age	17–29	55	52	61	2.5	0.28
	30–44	28	28	24	6.0	0.628
	45–60	17	17	12	6.0	0.488
	>60	0	3	3	1.3	0.514
Income level	Medium – Low	85	77	78	1.4	0.507
	Medium – High	15	23	22	1.4	0.507
Educational level	Primary	2	0	1	2.9	0,237
	Secondary school	21 b	5a	24 b	6.0	<0.0001
	Third level (non-degree)	15	11	5	5.4	0.066
	Third level (degree or higher)	62[a]	84[b]	70[a]	12.9	0.002
Frequency of consumption	More than once per week	66[b]	44[a]	51[ab]	9.8	0.007
	More than once per month	26	36	31	2.03	0.363
	Less than once per month	9	15	16	2.5	0.461
	Never	0a	8 b	2a	9.1	0.011

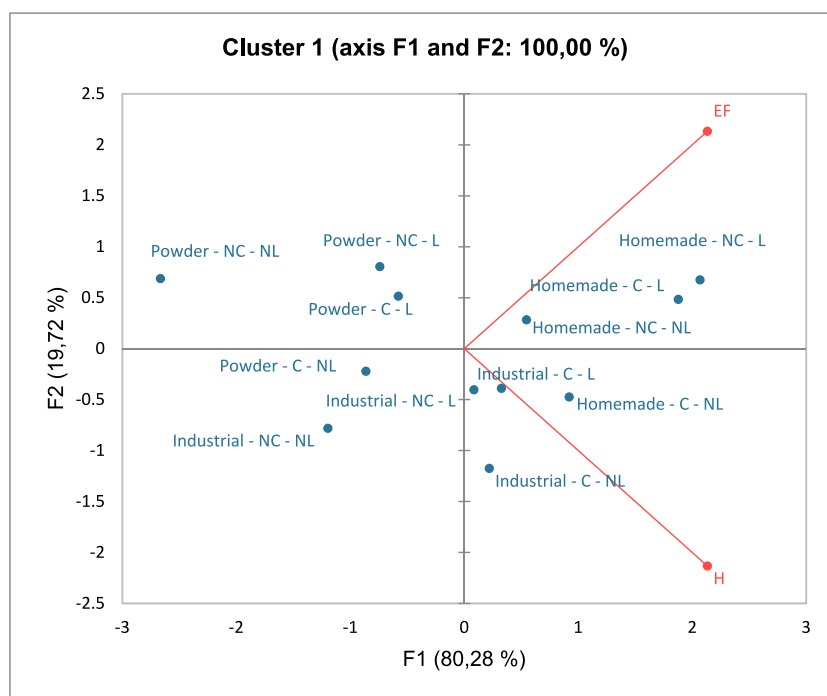Percentage values in rows followed by different letters are significantly different ($p \leq 0.05$).

Fig. 3. Principal component analysis for cluster 1. Relation between attributes and environmental friendliness and healthiness perception of Spanish consumers. C: fibre origin claim; NC: no fibre origin claim; L: logo presence; NL: no logo presence.

Cluster 2 perceived as environmentally friendly, the home-made product with logo presence, and the powdered product with logo and no information. While the three types of products with information were regarded as healthy, the industrial type without information, regardless of logo presence, was considered not healthy. This cluster is formed mainly by regular consumers of dairy desserts (55% consume more than once per week), with people aged between 45 and 60 years.

The third cluster perceived as healthier the home-made category with information. On environmental friendliness, the industrial type was the least environmentally friendly, and only the home-made options without information were considered friendly. This group is formed by rare dairy desserts consumers (30% never eat, 28% less than once per month), aged between 17 and 45 years old and with a medium-high income.
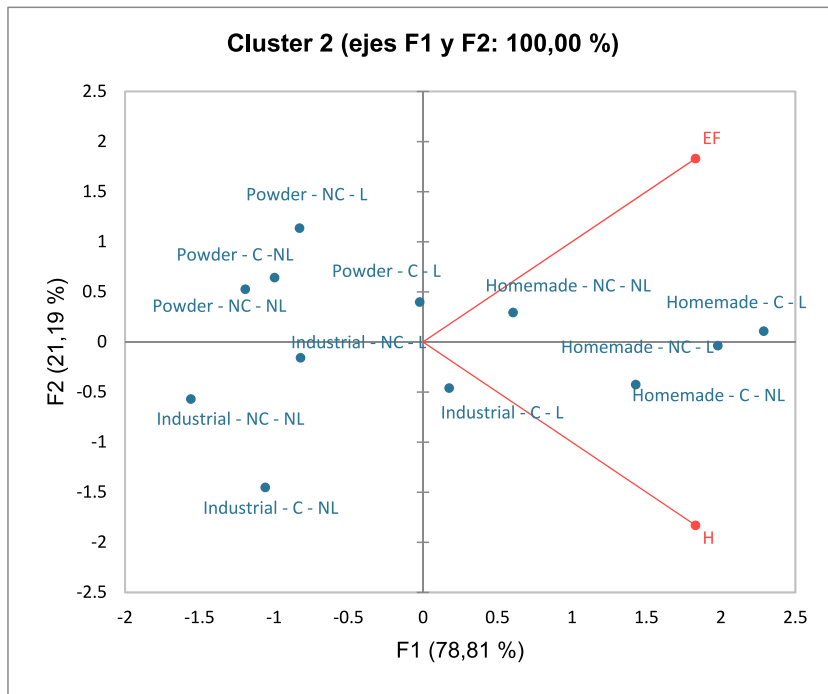
Fig. 4. Principal component analysis for cluster 2. Relation between attributes and environmental friendliness and healthiness perception of Spanish consumers. C: fibre origin claim; NC: no fibre origin claim; L: logo presence; NL: no logo presence.
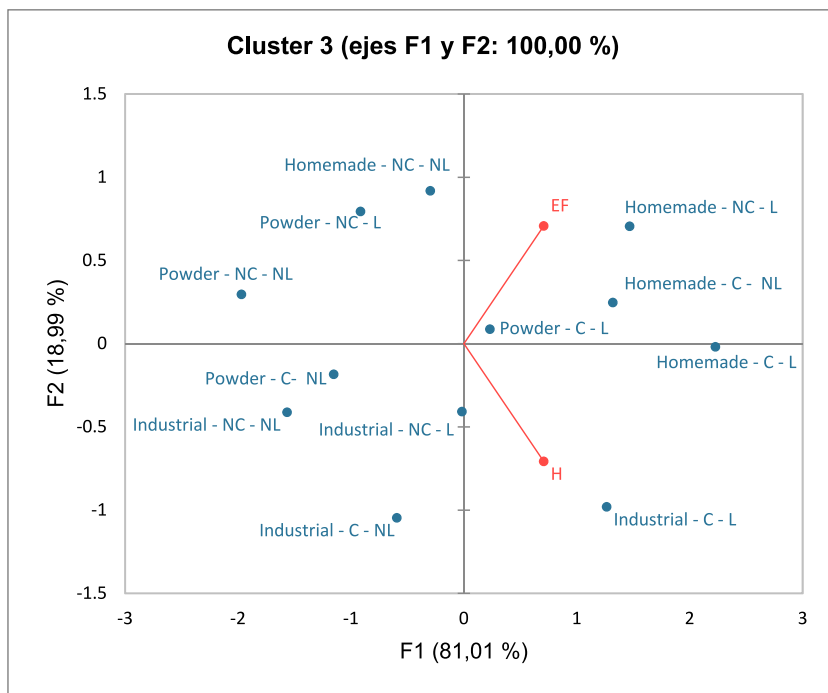

Fig. 5. Principal component analysis for cluster 3. Relation between attributes and environmental friendliness and healthiness perception of Spanish consumers. C: fibre origin claim; NC: no fibre origin claim; L: logo presence; NL: no logo presence.

Table 7

Part-worth utilities of attribute levels, mean relative importance of attributes (MRI) and significant effects in a one-way repeated measures ANOVA in purchase intention for Uruguayan clusters.

Attribute	Attribute level	Cluster 1		Cluster 2		Cluster 3	
		Mean part-worth utility	MRI	Mean part-worth utility	MRI	Mean part-worth utility	MRI
Product category	Homemade	0.326[a]	85.60%	0.147[a]	64.30%	0.394[a]	71.80%
	Industrial	0.098[b]		0.06[b]		−0.222[c]	
	Powder	−0.425[c]		−0.207[c]		−0.173[b]	
Logo	With logo	0.023[a]	4.70%	0.040[a]	12.50%	0.004[a]	0.60%
	No logo	−0.023[b]		−0.040[b]		−0.004[b]	
Fibre origin	No claim	−0.048[b]	9.70%	−0.075[b]	23.20%	−0.151[b]	27.60%
	"Orange fibre"	0.048[a]		0.075[a]		0.151[a]	

Values within one column (and within one attribute) with different superscripts are significantly different according to Dunn's-Bonferroni test ($p < 0.05$).

Table 8

Distribution of consumers (%) on Uruguayan clusters, according to demographics characteristics. Difference among proportions test, $\chi2$ and probability (p) values.

Frequency (%)						
Characteristics	Level	Cluster 1	Cluster 2	Cluster 3	χ^2	p
Sex	Male	38	31	23	5.5	0.063
	Female	62	69	77	5.9	0.053
	Prefers not to say	0	0	0	0.5	0.785
Age	17–29	25	24	30	0.6	0.738
	30–44	34	24	30	1.3	0.514
	45–60	28	28	17	3.5	0.171
	>60	13	24	24	6.0	0.054
Income level	Medium – Low	41	48	34	2.1	0.357
	Medium – High	59	52	66	2.1	0.357
Educational level	Primary	2	3	4	0.6	0.727
	Secondary school	4[a]	17[b]	7[a]	6.0	0.014
	Third level (non-degree)	19	10	13	2.4	0.308
	Third level (degree or higher)	75	69	76	0.6	0.751
Frequency of consumption	More than once per week	28[a]	55[b]	18[a]	13.8	0.001
	More than once per month	43	31	28	5.7	0.059
	Less than once per month	24[b]	7[a]	24[b]	4.5	0.107
	Never	5[a]	7[a]	30[b]	34.2	<0.0001

Percentage values in rows followed by different letters are significantly different ($p \leq 0.05$).

4. Conclusion

This investigation shows how product information may influence consumer purchase intentions in relation to healthiness and environmental friendliness perception and how it could vary between countries. In any way, food companies may use this information to drive them to develop innovative strategies for introducing new products made with by-products.

Product category was the most important attribute in purchase intention for Uruguayan and Spanish populations, being the homemade product preferred by both. Product category also affected the healthiness and environmental friendliness perception, probably due to differences in perceived processing level. The information about fibre origin positively impacted the perceived healthiness, while the logo related to sustainability impacted purchase intention and environmental friendliness perception. The home-made product with a logo was perceived as healthiest and environmentally friendliest by both populations. The allegation "orange fibre" also increased these perceptions, although not the purchase intention in Spain.

Although Spanish consumers perceived the products with fibre claim and logo as healthier and environmentally friendlier, this did not positively impact purchase intention. Purchase intention is related to healthiness in both populations, but only the Uruguayan relate it to environmental friendliness.

Cluster analysis showed three groups of Spanish consumers, two who consider more important the logo presence than the fibre origin claim. Within these two, one of the groups has a higher purchase intention in the industrial category, while the other prefers the industrial type. In the case of Uruguay, the three clusters analyzed consider the fibre origin claim more important than the logo presence.

This work's main limitation is that to reach a more profound conclusion about consumer perception of the use of by-products, further work with another product category may be necessary.

On the other hand, considering that consumer behaviour may be affected by both internal (health, and external factors, it could be interesting to know if consumer perception may change with the pass of the time. Future work may be done carrying out again the study and analysing if consumer behaviour changes over time and the reasons for these changes.
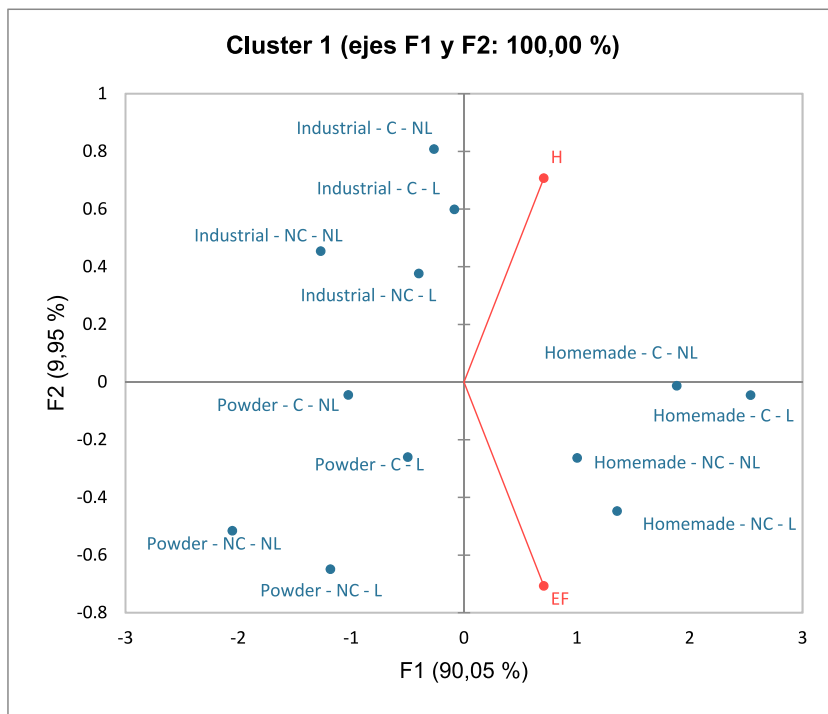
Fig. 6. Principal component analysis for cluster 1. Relation between attributes and environmental friendliness and healthiness perception of Uruguayan consumers. C: fibre origin claim; NC: no fibre origin claim; L: logo presence; NL: no logo presence.
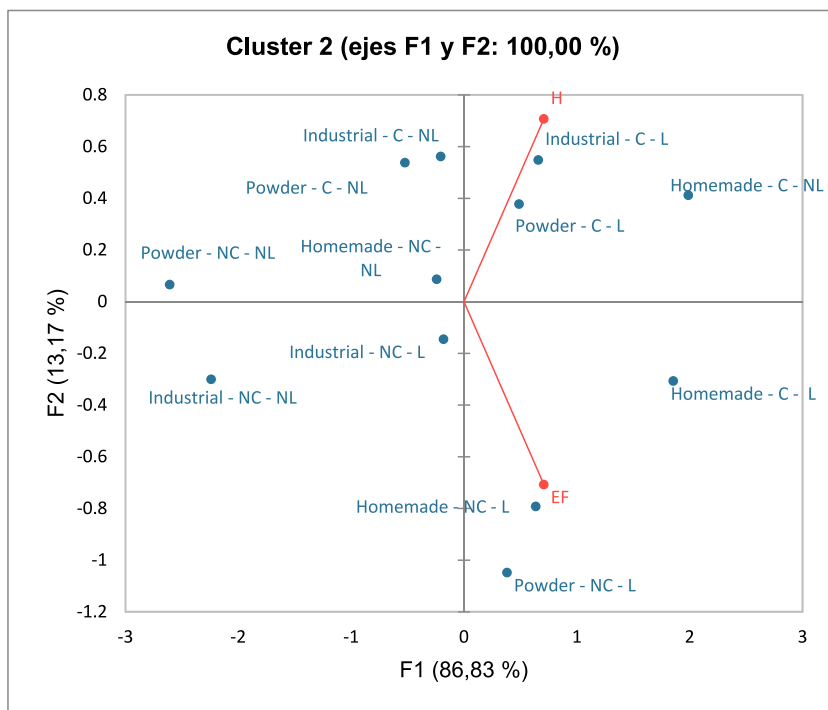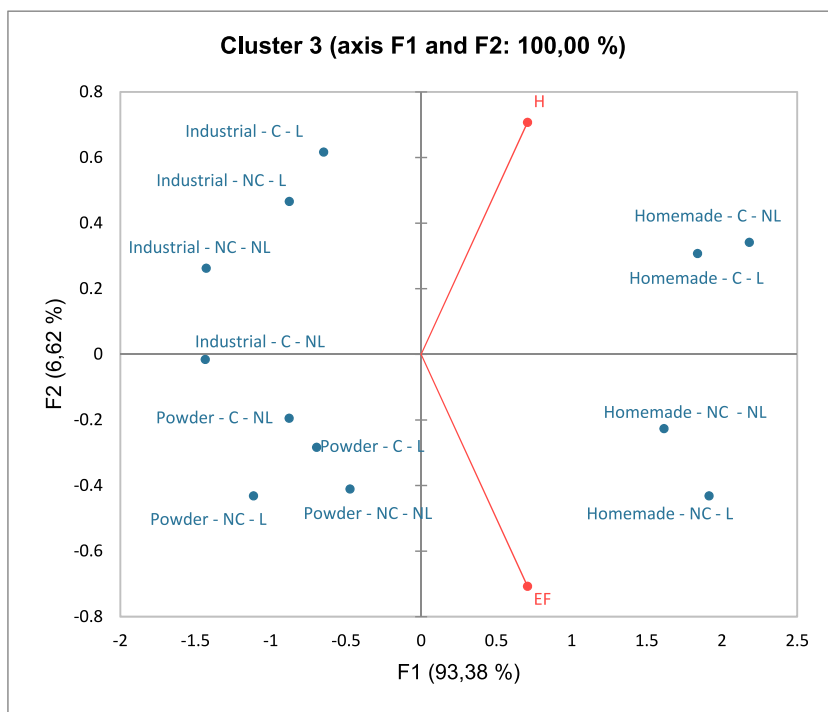

Fig. 7. Principal component analysis for cluster 2. Relation between attributes and environmental friendliness and healthiness perception of Uruguayan consumers. C: fibre origin claim; NC: no fibre origin claim; L: logo presence; NL: no logo presence.

Fig. 8. Principal component analysis for cluster 3. Relation between attributes and environmental friendliness and healthiness perception of Uruguayan consumers. C: fibre origin claim; NC: no fibre origin claim; L: logo presence; NL: no logo presence.

Author contribution statement

Claudia Perez Pirotto: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

Maria Isabel Hernando: Conceived and designed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Sonia Cozzano: Contributed reagents, materials, analysis tools or data.

Ana Curutchet, Patricia Arcia: Conceived and designed the experiments; Analyzed and interpreted the data; Wrote the paper.

Data availability statement

Data will be made available on request.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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