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Research Paper

Are mixed meat and vegetable protein products good alternatives for reducing meat consumption? A case study with burgers

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ABSTRACT

The principal motivations for the worldwide trend towards reducing meat consumption are health, the environment and animal welfare. The present study investigated the willingness of omnivores to introduce mixed (beef-vegetable protein) and 100% vegetable protein products into their diet. The participants (n = 251) were young adult omnivores who consumed meat at least once a week. The stimuli were images of six different products representing two beef burgers, two mixed-protein burgers (50% beef and 50% seitan or soy) and two 100% vegetable protein burgers (seitan and soy). The participants were asked to write down spontaneous associations with each product (Word Association technique) and score their expected liking and purchase intention for them. In addition, they completed a questionnaire (36 statements) to evaluate their attitude towards meat reduction, considering six aspects: diet, habits, ethics, hedonism, health, and the environment. According to their response to these statements, they were classified into three attitude groups: anti- (ANTI, n = 106), intermediate- (INTERM, n = 89), and pro- (PRO, n = 56) meat reduction. All the participants expected to like the 100% beef burger most, the PRO group expected to like all six products to a similar degree and the ANTI group expected to like the mixed product significantly more than the 100% vegetable product, indicating that the introduction of mixed proteins could be a small first step towards meat reduction for those most attached to meat. The associations elicited by the different burgers were mostly the same but were mentioned with different frequencies, which also depended on the attitude group. These distinctive association patterns showed clear connections to the motives underlying each group's attitude towards meat reduction. It may be concluded that mixed products would be a reliable although timid option for consumers who are attached to meat to reduce their meat intake, while any of the products containing vegetable proteins would be an option for consumers who are more favourable towards meat reduction.

1. Introduction

Meat consumption is rooted in the culture of Western countries (Elzerman et al., 2011). However, high levels of meat consumption, particularly red and processed meat, have negative impacts on human health and the environment (McBey et al., 2019). In the last decade, a large body of research has aimed to analyse several aspects of this so-called "meat paradox". Many of these studies deal with sociological and psychological aspects of meat consumption. Some examples are studies on drivers for meat consumption (Milford et al., 2019) and factors influencing meat consumption and meat consumption reduction (such as social, temporal, and situational aspects (Horgan et al., 2019) or gender, race, ethnicity, location of residence and social class (Gossard and York, 2003)). Other studies have focused on identifying and characterizing consumer segments with varying degrees of willingness to make changes in their protein consumption in the short term (Malek et al., 2019). Regarding the efficacy of messages in reducing future meat consumption, the relevance of framing (Stea and Pickering, 2018) and the emotional vs. informational appeals (Carfora et al., 2019) have been studied. Other factors that have been investigated include those involved in encouraging behavioural change, such as attitude, perceived behavioural control, personal norms and problem-awareness (Weibel et al., 2019), consumer attitudes and behaviour towards meat consumption in relation to environmental concerns (Sanchez-Sabate and Sabaté, 2019), and the role of the dominant food retail infrastructure in favouring or not favouring meat alternatives (Gravely and Fraser, 2018). On analysing this literature, there is widespread agreement that health, the environment and concerns about animal welfare are the main motivations for people to reduce their meat consumption.

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In the field of Food Science, a number of studies and patents regarding meat substitute development are found (not shown), not to mention the plethora of studies dealing with meat extenders (from both animal and vegetable sources). Less research has focused on consumer perceptions and attitudes towards the consumption of real meat products and reducing their intake. Such studies have principally dealt with preferences and attitudes towards specific meat substitutes such as micro-algae (Weinrich and Elshiewy, 2019), soy (Siegrist and Hartmann, 2019), cultured meat or insects (Lupton and Turner, 2018; Alexander et al., 2017). It is not easy to discover from these studies whether the consumers were confronted with the product itself (real or an image) or just with the abstract idea of the meat substitute.

Vegetarianism and its relationships with meat consumption have also received some attention in the literature. According to Rosenfeld (2018), definitions of vegetarianism vary and so do people's motives for following a vegetarian diet. The most common vegetarian motivations

Fig. 1. Sample codes, protein sources and images of the six burger pack samples used in the study.

include concerns about animals, health, the environment and religion (Ruby, 2012). Except for religion, all the other motives for following a vegetarian diet are the same as people who follow a conventional omnivorous diet have for reducing their meat consumption. Increasing numbers of omnivores across a range of nations are reducing their meat intake, citing these reasons, but omnivores exhibit more positive attitudes towards meat than do vegetarians (Ruby, 2012). A report from AESAN (The Spanish Agency for Food Safety and Nutrition) (AESAN, 2011) stated that 80% of the protein intake is from animal sources. No official figures on the number of vegetarians or vegans in Spain are available. In 2017, some sources identified about 7.2% of the Spanish population as flexitarian (with a preference for vegetable products) (Lantern, 2019) but only 0.2% as vegan and 1.3% as vegetarian. A 24% growth rate in flexitarians over the past two years has been reported by the same source (Lantern, 2019).

For this reason, the consumers targeted in the present study were young adult omnivores. The study hypothesis was that mixed beef and plant protein (seitan or soy) products instead of 100% plant protein options could be a first step towards reducing meat consumption in omnivores.

The present study aimed to investigate 1) the free, spontaneous associations elicited among omnivores when presented with images of 100% beef, 50% beef/50% plant protein and 100% plant protein burgers, and 2) their expected liking and purchase intention for these products. When analysing the results, taking into account that the omnivore participants showed different attitudes towards meat consumption, they were classified into three groups: PRO, INTERM and ANTI (pro meat reduction, intermediate and ANTI meat reduction, respectively).

2. Materials and methods

2.1. Participants

The participants were recruited in Valencia (Spain) and its surroundings. The inclusion criteria were omnivore consumers who declared that they consumed red meat at least once a week and were aged between 18 and 35. People following any restrictive diet (reduced-calorie or any kind of food or nutrient avoidance) were excluded. Participation was entirely voluntary. Those that met the inclusion criteria numbered 251 (51% men). They received a gift for taking part. The participants completed the questionnaire in the Sensory Room at IATA using tablets.

2.2. Samples

Six images of burger packages were used (Fig. 1). Two were of commercial seitan and soy burgers (100% vegetable protein), another two of commercial beef burgers (100% meat), and the other two images were created ad hoc, based on commercial packages, to show 50/50% vegetable protein/beef (seitan/beef and soy/beef) burgers.

2.3. Evaluation

The participants were not given any information about the purpose of the study. They were presented with the images (10 × 15 cm) of the six products (one at a time) coded with 3-digit numbers. The order of presentation was balanced to avoid an order effect. The consumers completed three tasks and were then asked how frequently they consumed meat.

2.3.1. Word association (WA) task

The participants were given the image in printed form and were asked to write down the first four words (sensations, thoughts, associations) that came into their minds when they looked at that image, entering them into the four text boxes shown on the screen. The WA task was completed for each of the six images before passing on to the second part of the questionnaire. The words obtained were first "cleansed" of conjunctions (and, or), articles (*the, a*). The remaining relevant words were analysed by three researchers working separately; these researchers were familiar with the Word Association technique. The words with similar meanings were grouped together and a consensus was reached about the words retained.

2.3.2. Expected liking and purchase intention

In the second part of the questionnaire, the participants were asked to score their expected liking for each image (*How much do you think you would like this burger?*) on a 9-point hedonic scale (from "Dislike extremely" to "Like extremely") and their purchase intention (*Would you buy this burger?*) on a 5-point scale (from "Definitely wouldn't buy it" to "Definitely would buy it").

2.3.3. Questionnaire about attitudes towards reducing meat consumption

A questionnaire was developed to assess the attitude of the participants towards meat consumption and reducing their meat consumption. This questionnaire comprised a total of 36 statements. Most of these statements were adapted from two previous questionnaires: the Meat Attachment Questionnaire and the Moral Disengagement in Meat Questionnaire ((Graça et al., 2014, 2016) respectively), and some new ones were added to cover six aspects (Diet, Habits, Ethics, Hedonism, Health and Environment) (Table 1). The participants were asked to indicate their level of agreement or disagreement with each statement using a 7-point Likert scale (1 = Entirely disagree, 2 = Mostly disagree, 3 = Somewhat disagree, 4 = Neither disagree nor agree, 5 = Somewhat agree, 6 = Mostly agree, 7 = Entirely agree). The order of the statements in the questionnaires presented to the consumers was varied following a balanced design. Based on their scoring of these statements, the participants were divided into PRO- and ANTI-meat reduction and intermediate (INTERM-) groups.

2.4. Data analysis

Although the questions about the participants' attitudes towards meat consumption and reducing their meat consumption were performed after the WA and expected liking and purchase intention scoring tasks, they were analysed first. Before analysing the data from the attitude questionnaire the numerical scoring scale for reverse questions (Table 1) was reversed in the opposite direction; so, "Entirely disagree" had score of 7, "Mostly disagree" had a score of 6, "Somewhat disagree" became 5, "Neither disagree nor agree" still equalled 4, "Somewhat agree" became 3, "Mostly agree" became 2 and "Strongly agree" became 1. A mean score for each participant was calculated from all 36 statements and three groups were formed: PRO (consumers who were willing to reduce their meat consumption, mean scores between 4.5 and 7), ANTI (consumers who were not willing to reduce their meat consumption, mean scores between 1 and 3.5), and INTERM (an intermediate attitude between PRO and ANTI, mean scores between 3.5 and 4.5).

Factor analysis with Varimax rotation was used to analyse the variation in consumer responses to the 36 statements and to determine the different dimensions. For each dimension, Cronbach's alpha was calculated as the measure of internal consistency of the scale. For each FA dimension, the mean score of agreement with the statements was calculated to study how it differed among the attitude groups (PRO, ANTI, and INTERM), using a single ANOVA and applying a post hoc Tukey test.

A 2-factor (sample and attitude group, and their interaction) ANOVA coupled with a Tukey post hoc test was applied to the liking expectation scores.

The percentages of participants who would not buy the product (sum of "definitely would not buy" and "probably would not buy"), would buy the product (sum of "definitely would buy" and "probably would buy") and were undecided ("I could buy it or not") were calculated from the purchase intention data.

Table 1
Aspects and statements used for measuring attitudes towards reducing meat consumption.

Aspects	Code	Item
Diet	Diet-1	If I couldn't eat meat I would feel weak (R)
	Diet-2	All things considered, meat is necessary in the human diet (R)
	Diet-3	Eating meat is important for a complete diet (R).
	Diet-4	I need to eat meat to have enough energy (R)
	Diet-5	Eating meat is part of a balanced lifestyle (R).
	Diet-6	Meat is irreplaceable in my diet (R)
	Diet-7	It is possible to have an adequate diet without eating meat
Habits	Habit-1	I would feel fine with a meatless diet
	Habit-2	I don't picture myself without eating meat regularly (R)
	Habit-3	It is easy to have a meat-free diet
	Habit-4	Nowadays there are good alternatives to meat consumption
	Habit-5	I will consider changing my habits only if other also change theirs (R)
Ethics	Eth-1	When I think about eating meat I feel guilty
	Eth-2	I feel bad when I think about eating meat because of the animal suffering
	Eth-3	Eating meat reminds me of the death and suffering of the animals
	Eth-4	If I saw an animal being killed, I would have no problems eating it (R)
	Eth-5	If I had to kill the animals myself, I would probably stop eating meat
	Eth-6	It would be difficult for me to watch an animal being killed for food purposes
Hedonism	Hed-1	I love eating meat very much (R)
	Hed-2	I love meals with meat (R)
	Hed-3	I am a big fan of meat (R)
	Hed-4	Eating meat is one of the good pleasures in life (R)
	Hed-5	Nothing can compare with a good steak (R)
	Hed-6	Meat disgusts me
	Hed-7	I do not like the taste of meat
	Hed-8	If I was forced to stop eating meat I would feel sad (R)
Health	Health-1	A diet with lots of meat can be harmful to health
	Health-2	Eating meat in excess has a negative impact on health
	Health-3	Eating meat frequently is not bad for your health (R)
	Health-4	If I ate less meat, my health would improve
	Health-5	Eating less meat is good for my health
Environment	Env-1	Eating meat has a negative impact on the environment
	Env-2	To eat meat is disrespectful towards life and the environment
	Env-3	By eating meat, I'm also responsible for the problems associated with its production
	Env-4	By eating meat I support an industry which is responsible for environmental damage
	Env-5	Even if I stopped eating meat it wouldn't solve the environmental problem (R)

(R) Reverse-scored statements.

A Multiple Factor Analysis (MFA) was applied to the three matrices (one for each group) containing the data on frequency of elicitation of each word for each sample as active variables and the expected liking scores of each group as supplementary variables.

All the statistical analyses were performed with XLSTAT version 2019.1.3.

3. Results

3.1. Classification of the participants according to their attitude towards meat consumption reduction

A factor analysis (FA) was performed on the participants' scores (degree of agreement) for the 36 statements (Table 1). The results indicated that the variation in responses to the different statements was represented by seven dimensions which did not fit the aspects originally proposed exactly. Four statements were discarded because they were not correlated with any of these 7 dimensions; these statements were “Nowadays there are good alternatives to meat consumption”, “I will consider changing my habits only if other also change theirs”, “If I was forced to stop eating meat I would feel sad”, and “Even if I stopped eating meat it wouldn't solve the environmental problem”. The final seven dimensions, identified according to the meaning of the statements, were D1-Diet/habits, D2-Ethics (animal suffering), D3-Hedonics, D4-Health (excess/damage), D5-Ethics (animal killing), D6-Environment, and D7-Health (reduction/benefit).

Cronbach's α values (Table 2) were higher than 0.6 for all these 7 dimensions, indicating the statements' good reliability for measuring the consumers' attitudes regarding each specific aspect related to reducing meat consumption.

As explained above, the participants were classified as ANTI, PRO or INTERM according to their attitude towards meat consumption and its reduction. Fifty-six participants (22.3%) were classified as being in favour of reducing their meat consumption (PRO), 106 participants (42.3%) were classified as being against reducing their meat consumption (ANTI), and 89 participants (35.5%) were classified as intermediate (INTERM). The effect of attitude group on the 7 dimensions of the FA was analysed by one-way ANOVA of the mean scores (Fig. 2). As expected, the results clearly show that the mean degree of agreement with the statements corresponding to each of the 7 dimensions varied significantly between groups.

Significant differences between the mean values corresponding to the participants in each attitude group (ANTI, PRO and INTERM) were found for all seven dimensions considered (Fig. 2). In general, for the five dimensions showing reasons for reducing meat consumption (D2, D4, D5, D6 and D7), the degree of agreement was higher for the PRO group than for the ANTI group. Excessive meat consumption and the corresponding health concern (D4) was the most potent reason for willingly reducing meat consumption in all three groups (mean degree of agreement values from 5.1 to 6.0). Ethics - killing animals (D5) was the reason with which the PRO group agreed most (6.2) but the ANTI group showed little or no agreement (3.5). These results indicate that, in general, all the participants were worried about the health problems caused by high meat consumption but the animal welfare aspects were only important for the PRO group.

Regarding the dimensions related to attachment to meat (D1 and D3), Hedonics (D3) was the main reason for reluctance to reduce meat consumption in the ANTI and INTERM groups (mean degree of agreement 6.1 and 5.2, respectively). Dietary habits (D1) was also an important reason for the ANTI group but not for the INTERM and PRO groups.

Table 2
Cronbach's α for the seven factor-analysis dimensions and correlation between these dimensions and each statement of the questionnaire.

FA dimension (Cronbach's α)	Items of each FA dimension	FA dimension						
		D1	D2	D3	D4	D5	D6	D7
D1	Diet 1	0.84	0.15	0.16	0.18	0.01	−0.06	−0.09
Diet/habits	Diet 2	0.80	0.09	0.16	−0.05	0.12	0.18	0.13
(α = 0.918)	Diet 3	0.79	0.05	0.20	−0.08	0.14	0.19	0.17
	Diet 4	0.78	0.11	0.20	0.17	0.02	−0.05	−0.06
	Diet 5	0.76	−0.02	0.22	−0.13	0.15	0.18	0.24
	Diet 6	0.63	0.21	0.38	0.17	0.19	0.02	0.03
	Hab 1	0.60	0.29	0.30	0.10	0.16	0.15	0.17
	Diet 7	0.58	0.09	−0.01	0.08	0.03	0.13	0.14
	Hab 2	0.53	0.27	0.41	0.12	0.04	0.04	−0.02
	Hab 3	0.37	0.02	0.28	0.03	−0.13	−0.01	0.09
D2	Eth 1	0.14	0.65	0.23	0.04	0.24	0.20	0.10
Ethics (animal suffering)	Eth 2	0.29	0.65	0.18	0.08	0.39	0.13	0.17
(α = 0.852)	Eth 3	0.33	0.58	0.30	0.00	0.29	0.19	0.05
D3	Hed 1	0.19	0.10	0.85	0.07	0.12	0.07	0.00
Hedonics	Hed 2	0.26	0.03	0.81	0.00	0.14	0.07	0.06
(α = 0.893)	Hed 3	0.34	0.11	0.73	0.03	0.19	−0.06	0.00
	Hed 4	0.27	0.06	0.61	0.12	0.14	0.05	0.07
	Hed 5	0.34	0.23	0.58	0.04	0.23	0.09	−0.04
	Hed 6	0.16	0.36	0.57	−0.12	0.04	0.26	0.07
	Hed 7	0.00	0.30	0.56	0.00	0.05	0.05	−0.03
D4	Health 1	0.09	0.01	0.04	0.72	0.12	0.06	0.20
Health (excess/damage)	Health 2	0.08	0.09	0.06	0.62	0.13	0.08	0.06
(α = 0.626)	Health 3	0.21	−0.05	0.16	0.31	0.09	0.07	0.16
D5	Eth 4	0.12	0.18	0.21	0.04	0.73	0.10	0.01
Ethics (animal killing)	Eth 5	0.21	0.17	0.23	0.11	0.72	0.10	0.06
(α = 0.820)	Eth 6	0.05	0.30	0.19	0.14	0.60	0.13	−0.01
D6	Env 1	0.36	0.20	0.14	0.15	0.29	0.53	0.17
Environment	Env 2	0.33	0.17	0.26	0.01	0.23	0.45	0.18
(α = 0.755)	Env 3	0.10	0.23	0.14	0.15	0.13	0.53	−0.07
	Env 4	0.14	0.21	0.02	0.02	0.12	0.62	−0.07
D7	Heath 4	0.22	0.16	0.00	0.23	0.08	0.01	0.65
Health (reduction/benefit)	Health 5	0.24	0.18	0.07	0.27	0.00	0.01	0.53
(α = 0.701)								

3.2. Expected liking

An ANOVA applied to the expected liking scores of all the participants showed that the effects of sample ($F = 42.074$, $p < 0.0001$), attitude group ($F = 18.383$, $p < 0.0001$) and their interaction ($F = 10.158$, $p < 0.0001$) were significant, indicating that the expected liking score strongly depended on the participant's opinions about reducing meat consumption.

Fig. 3 shows the mean expected liking values for each product and their statistical differences within each attitude group. The individual ANOVAs of the expected liking scores of each attitude group, conducted to study the effect of sample, indicated that this effect was significant for all three groups (PRO: $F = 2.830$, $p = 0.016$; INTERM: $F = 14.440$, $p < 0,0001$; ANTI: $F = 45.106$, $p < 0,0001$).

Interestingly, BEEF-Tray was the sample with significantly the highest expected liking in all three groups. It is also remarkable that BEEF-Bag presented significantly less expectation of liking than BEEF-Tray in all three groups.

The different groups mainly varied in their response towards the products with vegetable proteins.

For the PRO reduction participants, their expected liking for the SEI burger (100% seitan) did not differ significantly from that of the BEEF-Tray burger (100% beef) and was significantly higher than for the other beef burger (BEEF-Bag) (Fig. 3). The rest of the burgers with vegetable proteins (both SOY and the two mixed burgers) showed intermediate values of expected liking (without significant differences between them). The range of mean expected liking scores of the PRO group was quite narrow, between 5.3 and 6.4.

A different pattern was found for the ANTI group, in which beef burgers could be expected to be the most liked. A clear gradation of mean liking scores was found: SEI and SO, 100% vegetable < BEEF-SEI and BEEF-SOY, 50/50% < BEEF-Bag, 100% beef < BEEF-Tray, 100% beef (Fig. 3). The ANTI group had the greatest range of mean liking scores, with values between 4.3 and 7.5. Expectations of liking for the mixed burgers were higher than for 100% vegetable burgers.

Finally, within the INTERM group, the expected liking scores showed no significant differences between the four burgers containing vegetable protein (both 100% and mixed), and were lower than those of the PRO group and higher than those of the ANTI group. The range of mean expected liking scores for the INTERM group was between 5.5 and 7.3.

3.3. Purchase intention

Purchase intention is shown as the percentages of participants in each attitude group that would buy the product (the sum of those that "Definitely would buy it" and "Would buy it") in Fig. 4. The highest percentage of participants that declared their intention to buy the product corresponded to the BEEF-Tray sample within the ANTI meat consumption reduction group, which coherently showed little interest in purchasing the mixed burgers (samples BEEF-SEI and BEEF-SOY, at 34% and 29% respectively), and even less interest in purchasing 100% vegetable burgers (samples SEI and SOY, at 19% and 16%, respectively).

At the other extreme, the PRO meat consumption reduction group showed high percentages of participants that would buy the 100% vegetable burgers, SEI and SOY (68 and 53%, respectively). These percentages were higher or similar to the percentage of participants (52%) that would buy the meat sample with the highest expected liking (BEEF-Tray). A little less willingness to purchase mixed burgers BEEF-SEI and BEEF-SOY (43% and 32%, respectively) was found within the PRO group.

In the INTERM group, most participants (79%) would buy the BEEF-Tray sample, while the percentage of participants that would buy burgers with vegetable proteins was much lower (values near 37% for both the 100% vegetable burgers and the mixed ones).

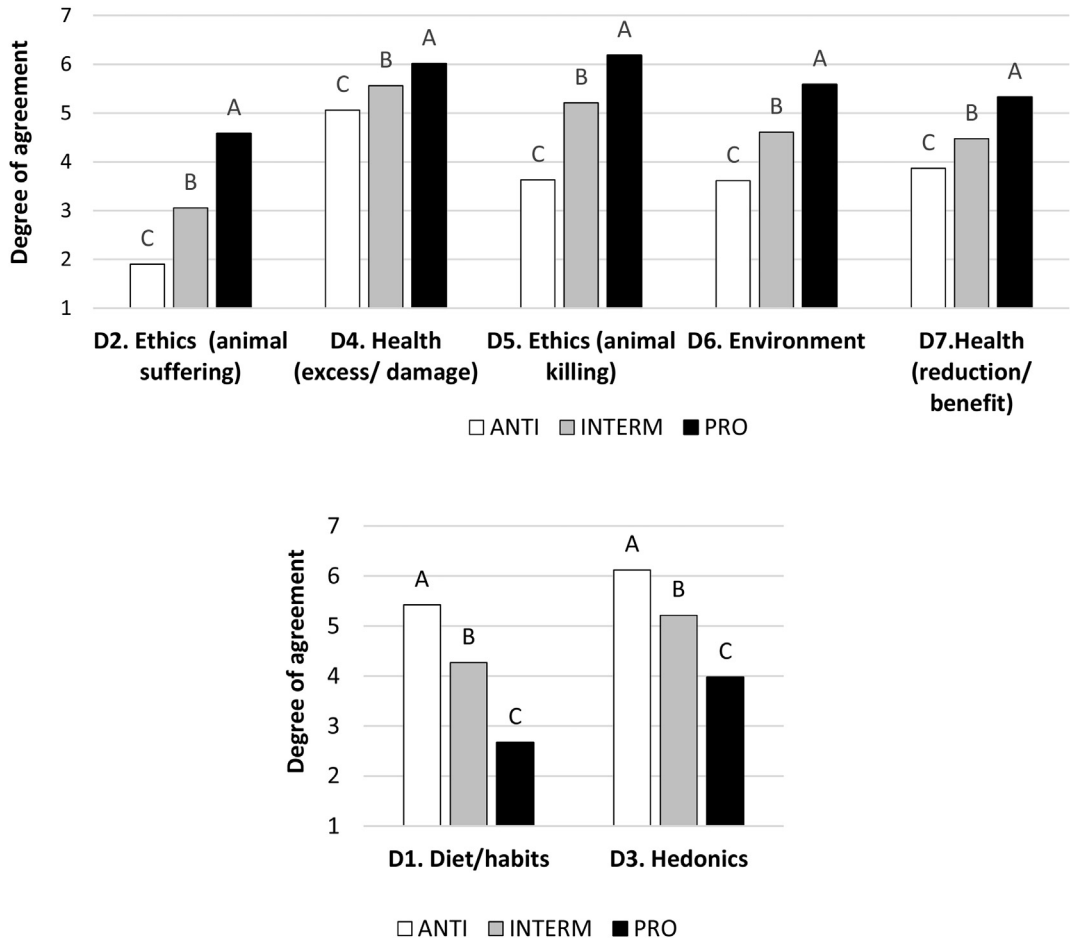

Fig. 2. Mean degree of agreement with the seven dimensions of the factor analysis for the PRO, INTERM (intermediate) and ANTI meat-reduction attitude groups. Lower mean scores mean less agreement. (Above): dimensions related to reasons for meat reduction; (Below): dimensions related to reasons for not reducing meat consumption. Different letters within the same dimension indicate significant differences between attitude groups according to Tukey's test (α = 0.05).

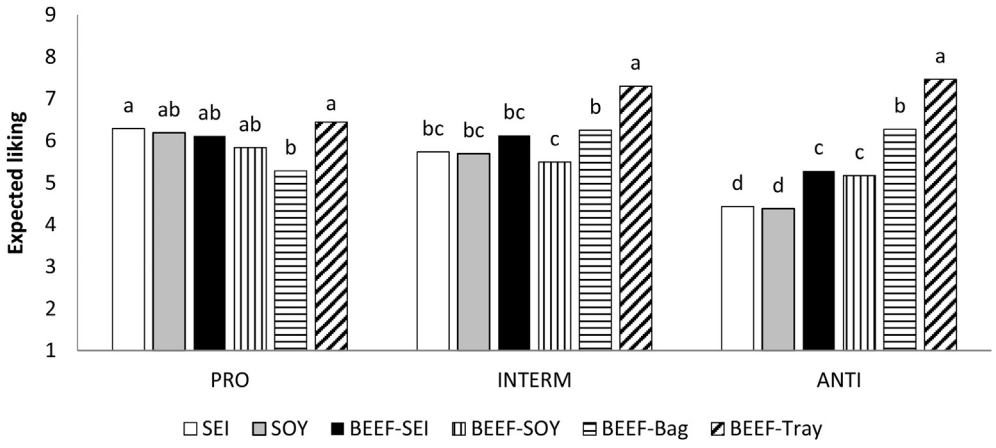

Fig. 3. Mean expected liking scores for each sample in the PRO, INTERM (intermediate) and ANTI meat-reduction attitude groups. Different letters within the same attitude group indicate significant differences between samples according to Tukey's test (α = 0.05).

3.4. Word association task

A total of 6024 mentions were collected. After treatment of the terms by three researchers, the frequency of mention of the terms for each sample within each of the three attitude groups (PRO, INTERM, and ANTI) was obtained. The 29 most-mentioned terms (at least 5% of the total mentions within the same attitude group) were included in the MFA. The most-mentioned terms were given by the participants in all three groups (marked with three asterisks in Table 3), while only a few were mentioned by only two groups (two asterisks) or one group (one asterisk).

The two first factors of the MFA plot (Fig. 5) explained 77.22% of the variability (first factor 61.37%, second factor 15.85%). The expected liking values of each group were projected onto the plot to show their relation to the burger descriptions.

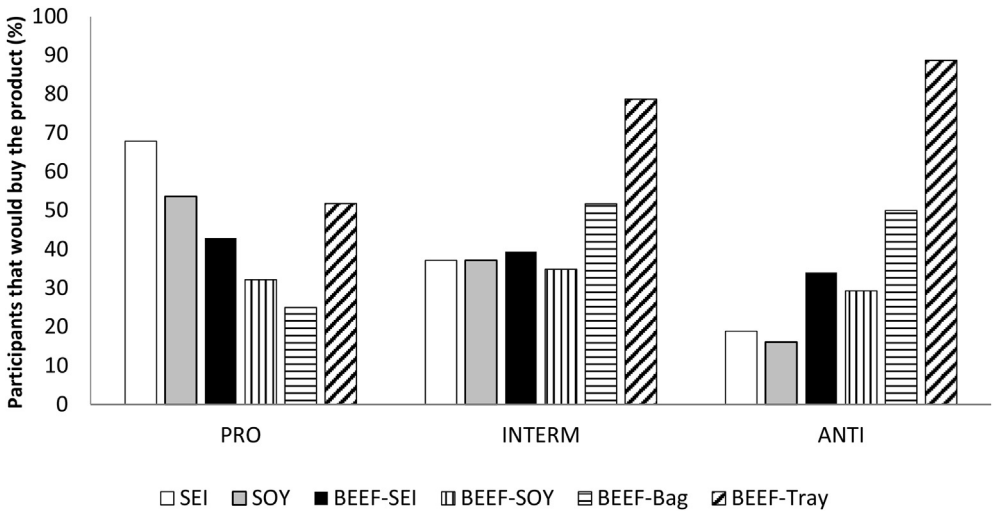

Fig. 4. Proportion (percentage) of PRO, INTERM (intermediate) and ANTI meat-reduction attitude group participants that would buy each sample. Samples: SEI (100% seitan burger), SOY (100% soy protein burger), BEEF-SEI (50% beef/50% seitan burger), BEEF-SOY (50% beef/50% soy protein burger), BEEF-Tray and BEEF-Bag (100% beef burgers).

The first factor clearly separated the 100% BEEF samples (both placed in positive values of the first factor) from those containing vegetable proteins (negative values). The beef burgers were associated with *Yummy, Animal, Meat, Juicy, Fat, Burgers, Burger chain.*

The second factor clearly separated BEEF-Tray (positive values of Factor 2), associated with Natural, Good quality, Traditional and Protein, from BEEF-Bag (negative values), related to *Processed, Unhealthy* and *Heavy*. The expected liking vectors for both the INTERM and ANTI groups appeared in the positive values of the first factor between the two 100% BEEF burgers, but nearer to BEEF-Tray and opposite the samples containing vegetable protein (Fig. 5).

In the negative values of the first factor, the second factor slightly separated the 100% vegetable protein samples SEI and SOY (both placed in the positive values) from the 50% vegetable protein burgers BEEF-SEI and BEEF-SOY (negative values) although this separation was not as marked as that of the 100% beef samples. The four burgers containing vegetable proteins were associated with *Healthy, Vegetable, Vegetarian, Green,* and *Nutritious*, but also with *Curiosity, Different, Novelty, Tasteless*

Table 3
List of terms and frequency of mention for each sample from the Word Association task. Only frequently-mentioned terms (>5% within each attitude group) are listed.

Term	Sample						Total
	SEI	SOY	BEEF-SEI	BEEF-SOY	BEEF-Tray	BEEF-Bag	
Healthy[a]	136	180	102	126	14	13	571
Yummy[a]	29	41	56	45	111	100	382
Vegetable[a]	92	103	47	60	2	24	328
Vegetarian[a]	114	116	30	33	0	0	293
Ecological[a]	154	27	77	29	2	1	290
Processed[a]	28	43	28	44	36	104	283
Good[a]	29	26	40	32	51	50	228
Meat[a]	7	6	33	27	65	46	184
Animal[a]	2	1	25	13	99	40	180
Different[a]	21	24	59	45	0	12	161
Burger[b]	13	16	18	18	34	22	121
Fat[a]	0	4	11	5	32	55	107
Curiosity[a]	21	21	28	22	1	8	101
Expensive[a]	23	14	23	19	17	3	99
Natural[a]	13	17	8	7	36	9	90
Good quality[b]	4	2	3	4	69	6	88
Tasteless[b]	18	27	17	18	1	2	83
Nutritious[b]	11	27	19	17	2	5	81
Unhealthy[b]	4	5	6	4	12	45	76
Protein[b]	17	1	7	28	13	4	70
Green[c]	25	23	7	9	0	3	67
Good appearance[c]	7	7	10	8	8	26	66
Traditional[c]	2	5	5	5	35	14	66
Heavy[c]	2	2	5	3	19	30	61
Novelty[c]	8	9	19	18	0	4	58
Juicy[c]	2	3	6	8	16	13	48
Disgusting[c]	14	10	6	9	2	5	46
Animal suffering[c]	0	1	3	1	24	6	35
Burger chain[c]	0	3	1	3	9	15	31
TOTAL							4294

[a] Term mentioned in all three attitude groups.
[b] Term mentioned in two attitude groups.
[c] Term mentioned in only one attitude group.

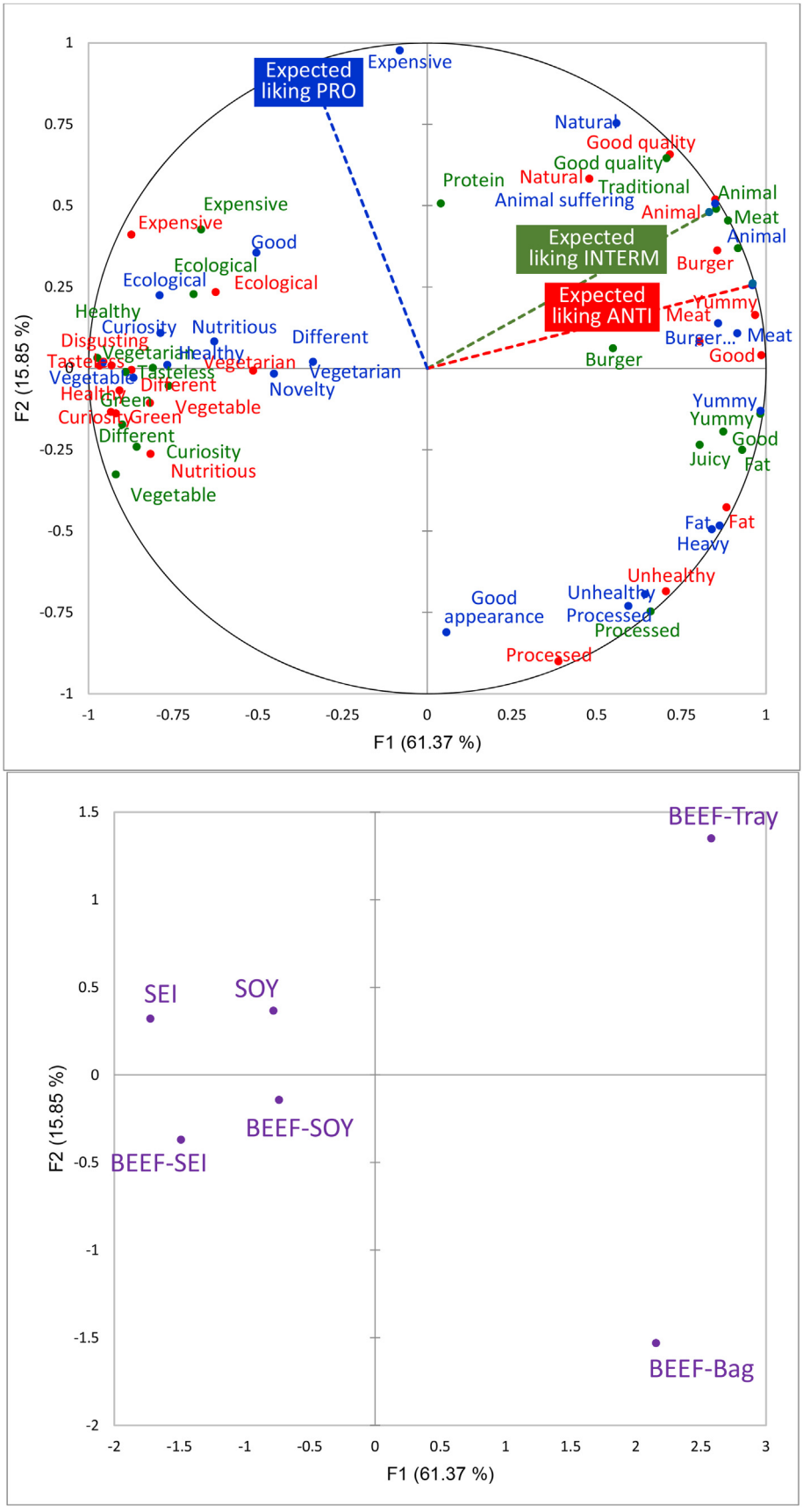

Fig. 5. MFA two-dimensional plots showing (above): the terms generated in the word association task and the projection of mean expected liking scores for the three meat reduction attitude groups: ANTI (red), INTERM (green) and PRO (blue); (below): samples: SEI (100% seitan burger), SOY (100% soy protein burger), BEEF-SEI (50% beef/50% seitan burger), BEEF-SOY (50% beef/50% soy protein burger), BEEF-Tray and BEEF-Bag (100% beef burgers).

and *Disgusting*. SEI and SOY in particular were nearer to *Ecological* and *Expensive* than the mixed burgers. The expected liking vector for the PRO participants appeared in the positive values of Factor 2 and slightly above the negative values of Factor 1 of the plot (Fig. 5), between BEEF-Tray and the burgers with vegetable proteins and opposite the BEEF-bag burger.

4. Discussion

In the present study, images of burger packs were presented, although the branding, images on the picture or marketing slogans could be expected to exert some kind of modulation in the participants' responses. Real products offer a realistic picture that contain all the congruent cues, instead of incongruent or evidently false images of burger packs with no brand, no images, no slogans, no nutritional info, etc., which could also modulate the responses. Visual stimuli for assessing consumers' expected liking and purchase intention for food products have been used in a number of previous studies. Some examples are photographs of dishes prepared with spirulina (Grahl et al., 2018), photographs of commercial Maroilles cheese packs (Nacef et al., 2019) or photographs of commercial hazelnut spread packs (Spinelli et al., 2015).

4.1. Reasons for being PRO or ANTI reduction in meat consumption

Individual attitudes towards reducing meat consumption can be described through five favourable dimensions and two unfavourable dimensions. The three principal arguments that guided the PRO group participants were related to health, animal welfare and the environment. Among these, the Ethics (animal killing) and Health (excess/damage) dimensions stood out because of their higher degree of agreement in the PRO group (Fig. 2). They were found to be the strongest motivations for a personal willingness to reduce meat consumption. These results are in accordance with previous reports of consumer awareness of the negative impacts of meat consumption on animal welfare, the environment and health (Horgan et al., 2019). Regarding the Ethics issues (both animal killing and animal suffering), it is evident (and logical) that nobody is comfortable with the idea of inflicting violence on animals. However, a large body of research has stated that when confronted with this idea, people who are reluctant to reduce their meat consumption use several moral disengagement mechanisms (Graça et al., 2016) to maintain such harmful but cherished practices.

Regarding the Health issues (both excess/damage and reduction/benefit), it seems evident that the participants are aware of the long-standing association between mortality caused by heart failures and animal-based diets (AESAN, 2011). Along the same lines, Graça, Calheiros, and Oliveira (Graça et al., 2014) found that a higher risk of suffering ischemic heart disease persists in individuals with conventional western diets even when controlled for factors such as social class, smoking or body mass.

Finally, Hedonics was the main reason for not giving up eating meat, followed by Dietary habits (Fig. 2). These results are in line with the *Meat Attachment* construct, which can be broadly defined as the positive bond with meat consumption shown by some people. According to Graça, Calheiros, and Oliveira (Graça et al., 2016), this concept comprises four principal dimensions: meat as a source of pleasure (hedonism), affinity towards meat consumption, feelings of dependence on meat consumption, and feelings of entitlement towards meat consumption.

4.2. Linking expected liking and purchase intention to consumers' spontaneous perceptions

4.2.1. Meat-only burgers

The BEEF-Tray sample obtained the highest expected liking scores in all three attitude groups, which is, up to a point, a logical result in an omnivore population. Also, a high general percentage of participants in all three attitude groups was willing to purchase this burger. BEEF-Bag showed less expectation of liking than BEEF-Tray in all three groups. The difference in expected liking between these two samples should be analysed in relation to the images of the samples (Fig. 1) shown to the participants. "Beef burger" can be read in both images, but the BEEF-Tray image shows a tray where the burgers can be seen through a transparent film, whereas the BEEF-Bag image shows a bag that is not transparent, so the burgers cannot be seen. A tray covered with transparent film is the most common way to present burgers in Spanish supermarkets, so the differences in expected liking were probably due to the confidence inspired by seeing the "real thing" and a familiar image. According to Simmonds, Woods, and Spence (Simmonds et al., 2018), a product that can showcase itself as being fresh or of good quality would be likely to perform better in the marketplace within transparent packaging.

4.2.2. Mixed and 100% vegetable protein burgers

Among the PRO participants, the range of expected liking scores for the products containing vegetable protein was narrow. It was also similar to those for meat burgers (Fig. 3). This result could mean that the products with vegetable proteins elicited positive expectations (similar to those for 100% meat burgers) in the PRO participants' minds. In addition, more than 50% of PRO participants would buy 100% vegetable burgers, while a distinctly lower number of participants would buy mixed burgers (Fig. 4). These results can be explained because although PRO participants expected to like the four products as much as the 100% beef burger they were more willing to buy the 100% vegetable products than the mixed ones, reaffirming their commitment to reducing their meat intake.

For the INTERM group, the expected liking scores for the 100% vegetable and mixed burgers were similar to those of the PRO group but significantly lower than for the BEEF-Tray burger, indicating a firm preference for burgers containing only meat rather than for those with vegetable proteins. In the same way, no gradation in purchase intention between 100% vegetable and mixed burgers was observed within this group (around 37% of participants would buy any of them), but it was also much lower than the purchase intention for BEEF-Tray (79%) (Fig. 4). Combining the expected liking and purchase intention results of the INTERM group, it could be inferred that these participants have a more tepid commitment to meat reduction than the PRO consumers, finding no difference between any of the proportions of vegetable protein in the burgers.

In the ANTI group, a significant increase in expected liking was found from SEI and SOY to mixed burgers (Fig. 3) and the expected liking score range was wider, indicating a firm attachment to the preference for meat burgers. In the same way, a gradation in purchase intention was also found within the ANTI group (Fig. 4), where only around 20% of participants would buy 100% vegetable protein burgers, 32% would buy mixed burgers and more than 50% would buy a 100% beef burger (more than 90% for BEEF-Tray). For the ANTI group, the expectations of liking and purchase intention were both higher for the mixed burgers, indicating that these samples were considered a better option than 100% vegetable ones, although these participants clearly preferred the 100% beef burgers.

According to van der Weele, Feindt, van der Goot, van Mierlo, and van Boekel (van der Weele et al., 2019), some meat alternatives are often found only outside the traditional food sector, so these products seem strange and are perceived as novel. These results are in line with previous research suggesting that individuals tend to maintain coherence between beliefs, past food choices and future intentions (Vainio et al., 2018).

To summarize, within the ANTI group the preference for mixed options over 100% vegetable ones would indicate that mixed burgers could be an option as a first (although small) step towards reducing meat consumption. In the PRO and INTERM groups, higher values of expected liking for 100% vegetable and mixed options were obtained than in the ANTI group, but no clear preferences were detected. This result could be interpreted as meaning that for these participants who are already somewhat favourable towards reducing animal protein, both options would be equally valid, although the PRO group showed the highest purchase intention for the 100% vegetable burgers.

4.3. Linking spontaneous response to the burgers and expected liking

It is worth noting that most of the terms in the Word Association task were mentioned by participants from all three attitude groups, although their frequency of mention was (logically) different for the different burgers (Table 3). The MFA plot (Fig. 5) shows these differences and also takes into account the membership of each attitude group (shown in different colours), and relates the associations to the expected liking of each attitude group (as vectors of different colours in Fig. 5).

4.3.1. Only meat burgers

The 100% beef burgers were associated with *Yummy, Meat, Good* and *Fat,* mentioned by the three groups (Fig. 5), indicating that all the participants had positive hedonic expectations although they thought that meat burgers are fatty. Terms such as *Animal* and *Natural* (mentioned also by the three groups) *and Good Quality, Traditional,* and *Burger chain* were closer to BEEF-Tray, whereas BEEF-Bag was associated with *Processed* (mentioned by all three groups) *Unhealthy* and *Heavy*. The differences between the two all-meat burgers could also be attributed, as mentioned above, to the possibility of seeing the colour and appearance of the burgers in the BEEF-Tray sample image. This, in turn, could be the source of this sample's higher expected liking (and purchase intention) compared to BEEF-Bag, in which the burgers were not visible, giving rise to negative associations. In fact, the ANTI and INTERM groups' expected liking values, projected onto the plot, were both close to BEEF-Tray. This proximity of the ANTI and INTERM expected liking vectors reflects their similar preference patterns, as also shown by Fig. 3. In spite of their similar hedonic expectations, the purchase intention of the PRO consumers was higher for the 100% vegetable burgers than for the mixed ones.

On the other hand, the visibility of the meat would also elicit the association with *Animal suffering,* which was located close to BEEF-Tray and was mentioned only by participants in the PRO group.

4.3.2. Vegetable protein-containing burgers

The mixed and 100% vegetable protein burgers, placed very close to each other in the MFA plot, were associated with *Vegetable*, *Vegetarian*, *Healthy* by the participants in all three attitude groups and with *Nutritious* (Fig. 5), which would seem to show a general agreement relating vegetable protein to health and good nutritional value. However, for the participants classified as ANTI and INTERM these burgers elicited terms such as *Tasteless* and *Disgusting.* McBey, Watts and Johnstone (McBey et al., 2019) found that people who consumed or had tried meat alternatives before described them as tasty and palatable, whereas those who had not done so viewed them as bland in texture and taste and unpalatable.

Interestingly, terms like *Curiosity, Different* (mentioned by the three groups), and *Novelty* were also associated with the samples containing vegetable protein, which would indicate some degree of unfamiliarity or little knowledge about them, but at the same time a certain degree of interest in trying them.

SEI and SOY, the 100% vegetable protein samples, were placed slightly towards the positive values of Factor 2 of the plot (Fig. 5). They were particularly near to *Ecological* and *Expensive,* mentioned by the three groups of consumers, who seemed to identify the positive ecological impact of 100% plant-protein based alternatives, as recognized by the FAO (Tubiello et al., 2015). This term could be considered to have been suggested by the Spanish term for organic farming ("Agricultura ecológica") on the SEI sample (Fig. 1). Regarding the association with *Expensive*, Apostolidis and McLeay (Apostolidis and McLeay, 2016) also found that, among other reasons, a low level of acceptance of meat substitutes has been associated with higher prices in comparison to meat.

The expected liking vector for the PRO attitude group was located between the options with vegetable proteins and BEEF-Tray (the most highly-valued sample). This result would indicate that the PRO participants would be favourable towards considering the vegetable alternatives good, with similar liking expectations to those for the 100%-meat sample BEEF-Tray (which is not surprising as they are meat eaters). Among the PRO consumers, the fact that their purchase intention for the 100% vegetable protein burgers was higher than for the BEEF-Tray burger indicates that these would be good alternatives for consumers who are concerned not only with their health but also with animal welfare and environmental sustainability.

Previous studies have indicated that the taste and texture of meat are highly valued by meat consumers, and it has been stated that in general, non-vegetarian consumers consider the overall sensory quality of meat substitutes to be lower than that of meat (Hoek et al., 2013).

It has been reported that not only the meat substitute itself but also its context (alone or part of a meal) is important for evaluating the expected liking for meat substitutes (Elzerman et al., 2011). This could be especially important for the ANTI group, which is reluctant to reduce meat consumption because it provides pleasure and is part of their diet and habits. The common consumption context of a burger is on a plate or in a bun. In both cases, the burger with partial or total meat replacement is not masked, so it needs to have a similar taste and texture to a beef burger. It would seem that the ANTI group were not confident of this similarity in the mixed or 100% vegetable protein burgers.

In line with the expected liking results, a clearly graded tendency towards "the more vegetable protein the less intention to purchase" was found in the ANTI group. For these participants, the mixed meat-vegetable protein burger concept is a better alternative than the 100% vegetable burger, but the expectation of liking is low compared to 100% meat products. In a recent study (Neville et al., 2017), hybrid products (burgers and sausages) were developed and were evaluated under blind conditions by meat-eating consumers. Some of the prototypes (mixed meat and vegetable proteins) reached high expected liking scores that did not significantly differ from the 100% meat products, indicating that mixed products with similar sensory appeal to 100% meat products can be developed. According to these latter results, consumers need to be made aware (through tasting) of the potential similarity of mixed products to 100% meat. In this way, mixed options could be a valid step in the replacement of animal protein for participants who are more attached to meat but may be especially interested in meat reduction, mainly for health reasons.

5. Conclusions

Regarding the motives for meat reduction in young adult omnivores, the results of the present study are in line with others previously reported, showing that the motives of people who are favourable towards reducing their meat consumption (22.3% of these participants) are based on ethics and health issues, while people who are very attached to meat consumption (42%) allude to enjoyment and dietary habits.

Regarding burgers with partial and total replacement of meat with vegetable protein, on the one hand the PRO participants were willing to purchase and expected to like them at the same level as 100% beef burgers. On the other hand, although the ANTI participants obviously expected to like the burgers with the greatest percentage of beef more, the mixed burgers obtained higher expected liking and purchase intention levels than the 100% vegetable versions, indicating that the mixed products could be an interesting option for consumers who are more strongly attached to meat to begin to reduce their consumption. Since attachment to meat is the most common position among the young adult omnivore participants, the present results could pave the way for the industry to develop mixed products to attract this consumer niche. At the other extreme, the PRO participants, those who already had a positive attitude towards reducing their meat intake, preferred the vegetable, mixed or beef-only options almost equally, although the vegetable-only options showed a higher purchase intention than the beef-only burgers.

Declaration of Competing Interest

None declared.

CRediT authorship contribution statement

Amparo Tarrega: Conceptualization, Writing - review & editing. **Arantxa Rizo:** Data curation, Formal analysis, Writing - original draft. **Ana Murciano:** Data curation, Formal analysis, Writing - original draft. **Laura Laguna:** Data curation, Formal analysis, Writing - original draft. **Susana Fiszman:** Conceptualization, Writing - review & editing.

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References

Alexander, P., Brown, C., Arneth, A., Dias, C., Finnigan, J., Moran, D., Rounsevell, M.D.A., 2017. Could consumption of insects, cultured meat or imitation meat reduce global agricultural land use? Glob. Food Sec. 15, 22–32. https://doi.org/10.1016/j.gfs.2017.04.001.

AESAN, 2011. http://www.cibr.es/ka/apps/cibr/docs/estudio-enide-1.pdf. (Accessed 4 May 2019).

Apostolidis, C., McLeay, F., 2016. Should we stop meating like this? Reducing meat consumption through substitution. Food Pol. 65, 74–89. https://doi.org/10.1016/j.foodpol.2016.11.002.

Carfora, V., Bertolotti, M., Catellani, P., 2019. Informational and emotional daily messages to reduce red and processed meat consumption. Appetite 141, 104331. https://doi.org/10.1016/j.appet.2019.104331.

Elzerman, J.E., Hoek, A.C., van Boekel, M.A.J.S., Luning, P.A., 2011. Consumer acceptance and appropriateness of meat substitutes in a meal context. Food Qual. Prefer. 22, 233–240. https://doi.org/10.1016/j.foodqual.2010.10.006.

Gossard, M.H., York, R., 2003. Social structural influences on meat consumption. Hum. Ecol. Rev. 10, 1–9.

Grahl, S., Strack, M., Weinrich, R., Mörlein, D., 2018. Consumer-oriented product development: the conceptualization of novel food products based on Spirulina (Arthrospira platensis) and resulting consumer expectations. J. Food Qual. 11. https://doi.org/10.1155/2018/1919482, 1919482.

Gravely, E., Fraser, E., 2018. Transitions on the shopping floor: investigating the role of Canadian supermarkets in alternative protein consumption. Appetite 130, 146–156. https://doi.org/10.1016/j.appet.2018.08.018.

Graça, J., Calheiros, M.M., Oliveira, A., 2014. Moral disengagement in harmful but cherished food practices? An exploration into the case of meat. J. Agric. Environ. Ethics 27, 749–765. https://doi.org/10.1007/s10806-014-9488-9.

Graça, J., Calheiros, M.M., Oliveira, A., 2016. Situating moral disengagement: motivated reasoning in meat consumption and substitution. Pers. Indiv. Differ. 90, 353–364. https://doi.org/10.1016/j.paid.2015.11.042.

Hoek, A.C., Elzerman, J.E., Hageman, R., Kok, F.J., Luning, P.A., de Graaf, C., 2013. Are meat substitutes liked better over time? A repeated in-home use test with meat substitutes or meat in meals. Food Qual. Prefer. 28, 253–263. https://doi.org/10.1016/j.foodqual.2012.07.002.

Horgan, G.W., Scalco, A., Craig, T., Whybrow, S., Macdiarmid, J.I., 2019. Social, temporal and situational influences on meat consumption in the UK population. Appetite 138, 1–9. https://doi.org/10.1016/j.appet.2019.03.007.

Lantern, 2019. http://www.lantern.es/papers/the-green-revolution-2019. (Accessed 4 May 2019).

Lupton, D., Turner, B., 2018. Food of the future? Consumer responses to the idea of 3D-printed meat and insect-based foods. Food Foodw. 26, 269–289. https://doi.org/10.1080/07409710.2018.1531213.

Malek, L., Umberger, W.J., Goddard, E., 2019. Committed vs. uncommitted meat eaters: understanding willingness to change protein consumption. Appetite 138, 115–126. https://doi.org/10.1016/j.appet.2019.03.024.

McBey, D., Watts, D., Johnstone, A.M., 2019. Nudging, formulating new products, and the lifecourse: a qualitative assessment of the viability of three methods for reducing Scottish meat consumption for health, ethical, and environmental reasons. Appetite 142, 104349. https://doi.org/10.1016/j.appet.2019.104349.

Milford, A.B., Le Mouël, C., Bodirsky, B.L., Rolinski, S., 2019. Drivers of meat consumption. Appetite 141, 104313. https://doi.org/10.1016/j.appet.2019.06.005.

Nacef, M., Lelièvre-Desmas, M., Symoneaux, R., Jombart, L., Flahaut, C., Chollet, S., 2019. Consumers' expectation and liking for cheese: can familiarity effects resulting from regional differences be highlighted within a country? Food Qual. Prefer. 72, 188–197. https://doi.org/10.1016/j.foodqual.2018.10.004.

Neville, M., Tarrega, A., Hewson, L., Foster, T., 2017. Consumer-orientated development of hybrid beef burger and sausage analogues. Food Sci. Nutr. 5, 852–864. https://doi.org/10.1002/fsn3.466.

Rosenfeld, D.L., 2018. The psychology of vegetarianism: recent advances and future directions. Appetite 131, 125–138. https://doi.org/10.1016/j.appet.2018.09.011.

Ruby, M.B., 2012. Vegetarianism. A blossoming field of study. Appetite 58, 141–150. https://doi.org/10.1016/j.appet.2011.09.019.

Sanchez-Sabate, R., Sabaté, J., 2019. Consumer attitudes towards environmental concerns of meat consumption: a systematic review. Int. J. Environ. Res. Publ. Health 16, 1220. https://doi.org/10.3390/ijerph16071220.

Siegrist, M., Hartmann, C., 2019. Impact of sustainability perception on consumption of organic meat and meat substitutes. Appetite 132, 196–202. https://doi.org/10.1016/j.appet.2018.09.016.

Simmonds, G., Woods, A.T., Spence, C., 2018. 'Show me the goods': assessing the effectiveness of transparent packaging vs. product imagery on product evaluation. Food Qual. Prefer. 63, 18–27. https://doi.org/10.1016/j.foodqual.2017.07.015.

Spinelli, S., Masi, C., Zoboli, G.P., Prescott, J., Monteleone, E., 2015. Emotional responses to branded and unbranded foods. Food Qual. Prefer. 42, 1–11. https://doi.org/10.1016/j.foodqual.2014.12.009.

Stea, S., Pickering, G.J., 2018. Optimizing messaging to reduce red meat consumption. Environ. Commun. 13, 633–648. https://doi.org/10.1080/17524032.2017.1412994.

Tubiello, F.N., Salvatore, M., Ferrara, A.F., House, J., Federici, S., Rossi, S., Biancalani, R., Condor Golec, R.D., Jacobs, H., Flammini, A., Prosperi, P., Cardenas-Galindo, P., Schmidhuber, J., Sanz Sanchez, M.J., Srivastava, N., Smith, P., 2015. The contribution of Agriculture, Forestry and other land use activities to global warming, 1990-2012. Global Change Biol. 21, 2655–2660. https://doi.org/10.1111/gcb.12865.

Vainio, A., Irz, X., Hartikainen, H., 2018. How effective are messages and their characteristics in changing behavioural intentions to substitute plant-based foods for red meat? The mediating role of prior beliefs. Appetite 125, 217–224. https://doi.org/10.1016/j.appet.2018.02.002.

van der Weele, C., Feindt, P., Jan van der Goot, A., van Mierlo, B., van Boekel, M., 2019. Meat alternatives: an integrative comparison. Trends Food Sci. Technol. 88, 505–512. https://doi.org/10.1016/j.tifs.2019.04.018.

Weibel, C., Ohnmacht, T., Schaffner, D., Kossmann, K., 2019. Reducing individual meat consumption: an integrated phase model approach. Food Qual. Prefer. 73, 8–18. https://doi.org/10.1016/j.foodqual.2018.11.011.

Weinrich, R., Elshiewy, O., 2019. Preference and willingness to pay for meat substitutes based on micro-algae. Appetite 142, 104353. https://doi.org/10.1016/j.appet.2019.104353.