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Stated Preferences for Plant-Based and Cultured Meat: A Choice Experiment Study of Spanish Consumers

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Abstract: Meat production and consumption have been claimed to have negative impacts on the environment, and even on the consumer's health. In this sense, alternative sources of protein, mainly meat substitutes and cultured meat, have emerged due to those perceived negative effects. Our paper carries out a choice experiment to analyze the preferences of 444 Spanish consumers and their willingness to pay for plant-based and cultured meats, as compared to conventional meat. Spain was considered of interest for this study due to its significant gastronomic culture, with high-quality meat products that make a great contribution to the economy, meaning that this could be a suitable and also challenging market in which to test alternative sources of protein. The findings show that consumers' motivations and their interactions with these products are complex. Additionally, a cluster analysis allowed us to identify three types of consumers in terms of preference for these products: price-sensitive millennials, conscious/concerned consumers, and indifferent consumers. Only one group showed some level of acceptance of these alternative products meats.

Keywords: consumers' preferences; meat; plant-based; cultured; choice experiment

1. Introduction

1.1. The Background to the Rise in Meat Substitutes

In the last decade, various negative consequences have been associated with meat consumption and production. From the environmental point of view, livestock production systems have been associated with a number of environmental impacts, such as greenhouse gas (GHG) emissions and, accordingly, climate change [1]. In addition, consumers' health, and ethical issues such as animal welfare, are feeding the controversy associated with meat consumption. However, not all consumers in Western countries are willing to reduce their meat consumption [2–5].

According to [6], consumers are being driven towards alternative products in order to counteract the drawbacks of meat, and are pushing the food industry to develop novel foods that bring potential benefits in line with the abovementioned points. Thus, "meat substitutes" (made from alternative protein sources, e.g., vegetables, algae, insects, mycobacteria, etc.) and "lab-grown or cultured meat" have emerged, which attempt to offer alternatives to a range of consumer preferences. Meat substitutes are foods that attempt to replace meat in people's diets via their high protein contents. Amongst them, plant-based meat (which is produced purely from vegetal ingredients) is the most technologically complex, as it endeavors to recreate the sensory traits of meat (including appearance and flavor). Cultured meat is another interesting alternative to farm-grown meat. It is produced

with use of an emerging technology derived from regenerative medicine, wherein muscle-specific stem cells are taken from animals and then grown in large numbers through tissue culturing in a controlled factory or laboratory environment (in contrast to traditional whole-animal livestock systems) until muscle tissues are formed, which can then be considered edible meat [7–10].

It should be noted that plant-based meat substitutes are already commercially available in supermarkets and restaurant chains, whilst cultured meat has not yet become available to the market for different reasons, such as the need to adjust the manufacturing process (increase the technical knowledge and the efficiency of processes, and reach economy of scale), ethical concerns, and regulations, among others. However, several producers are aiming to sell cultured meat in the coming years [11,12]. As a consequence, this has also become a popular topic in the scientific literature [13–17], with these new products attracting much attention in the media. Both start-ups and well-known meat companies have been investing considerable amounts of financial resources in the area [18,19], exceeding USD 16 billion since 2009 [20].

1.2. Literature Review on Consumer Preferences for Plant-Based and Cultured Meats

Consumer acceptance of meat substitutes has been the subject of several studies in recent years. Thus, Hartmann and Siegrist [21] recently explored this as part of a systematic review of quantitative studies, offering valuable information to complement other studies (e.g., [22–25]). In another seminal paper, Bryant and Barnett [26] carried out a systematic review of 14 empirical studies on cultured meat, concluding that whilst consumers readily perceive the benefits to animal welfare and the environment, these issues are unlikely to be central to their buying decisions. The concepts of naturalness, sensory quality, and safety seem to be the most important. Below, the authors carry out a brief review that summarizes the complexity of this topic, as well as the existing knowledge on the main drivers for, barriers to, and perceptions of plant-based and cultured meats, which will help the reader to understand the later outcomes of the present study.

1.2.1. Climate Change and the Environment

It has been claimed that some meat substitutes, including plant-based meat, are potentially more sustainable than conventional meat, due to the inefficient production of the latter (first producing the livestock and finally producing the meat) [8,27]. However, there are major uncertainties regarding the resources, such as energy, that would be required to maintain the controlled manufacturing environment used to produce meat substitutes, which replaces some of necessary biological functions of the animals [28] and has potential impact on the climate [29].

In order to fill this gap, Lynch and Pierrehumbert [29] performed a rigorous comparison of the potential climate impacts of cultured meat and cattle production, concluding that, in some scenarios, CO_2-based warming resulting from cultured meat production will persist and accumulate even with reduced consumption, overtaking the output of cattle production. These contradictory arguments are also reaching consumers through different platforms (e.g., influencers, government officials, animal advocates), and are definitely influencing their perceptions.

Another issue concerns the role of livestock in agrobiodiversity, as the maintenance of agroecosystems (ecosystem services) is possible when animals are properly integrated into the ecosystem. In fact, livestock are part of such ecosystems. However, consumers have also been exposed to images and messages about the negative impacts of livestock farming on the environment. In this sense, Fiddes [30] identified concerns about environmental quality and agricultural heritage, such as those related to landscapes and tradition.

1.2.2. Animal Welfare

The added value of cultured meat comes from the fact that animals are not used to grow it, and therefore it could even be an option for some vegetarians. However,

vegetarians' and vegans' reactions to plant-based food are very different from those to cultured meat. The former represents an alternative for these customers, while the second seems not to match their preferences. Thus, Wilks and Phillips [24] found that vegetarians and vegans had more positive perceptions of some aspects of cultured meat, although they do not seem to be the major consumers of these products. Accordingly, Verbeke et al. [22] reported that consumers eating mostly vegetarian meals were less convinced that cultured meat might be healthy, suggesting that vegetarians may not be the ideal primary target group for this novel meat substitute.

1.2.3. Nutrition

From a nutritional point of view, cultured meat has no drawbacks (it is, after all, muscle cell), although the same cannot be said about plant-based meat. In the case of cultured meat, messages reach consumers that may shape their willingness to consume it: cultured meat advocates state its nature as a healthier meat (e.g., less fat), while meat producers highlight that meat consists not only of protein, but also of amino acids, iron, B vitamins, etc. Consumers' reactions towards these messages strongly depend on their profile (e.g., environmentally or animal welfare-concerned vs. meat lovers). According to Gomez-Luciano et al. [31], perceived healthiness and nutritional benefits are important predictors of willingness to pay for cultured meat between countries.

1.2.4. Food Safety

Food safety is a broad concept, and one of the most influential factors in consumers' behavior towards food [32]. When it comes to the consumption of foods of animal origin, antibiotics residues are of paramount importance, and in this case, the absence of risk of plant-based and cultured meats is an important message that is reaching consumers and shaping their attitudes. However, it must be mentioned that this risk varies significantly between countries, due to the diverse regulations in place restricting the use of antibiotics in animal production. According to Gomez-Luciano et al. [31], perceived safety is an important predictor of willingness to pay for cultured meat between countries.

Regulation and labeling must also be mentioned, as numerous consumers show a lack of trust regarding the food industry and its regulations, citing the possibility of consuming cultured meat without knowing it [22,33]. Verbeke and Marcu et al. [22], Hocquette et al. [34], and Laestadius and Caldwell [33] reported that consumers generally thought that cultured meat would be less healthy than conventional meat, despite its lower fat content. Tucker [35] pointed out that although some participants said cultured meat was likely to be unhealthy, this was not a key reason for rejection, while Verbeke and Sans et al. [36] and Wilks and Phillips [24] indicated that there is an overall uncertainty as to the healthiness of cultured meat.

However, positive consumer perceptions have also been identified, given the link of cultured meat with reductions in zoonoses, such as BSE [22,24,25,36].

1.2.5. Naturalness

The objective of firms producing meat substitutes is to obtain products that are as similar as possible to meat, in terms of taste, texture, and color. This means, especially for plant-based meat, that they are required to use complex food technology processes and add various additives, which can make these products less acceptable from a health and nutritional point of view than the conventional meat they are trying to replace. In addition, and within current food trends, a movement has emerged that is gaining strength, namely, authentic foods, which advocates for a reduction in ultra-processed food consumption (including plant-based meats, on account of the reasons indicated above) [37,38].

Cultured meat has also been perceived as unnatural, which influences consumers' perceptions [39]. Consumers who place importance on naturalness are less likely to consider cultured meat as natural, and to consume it [40]. The perception of cultured

meat as unnatural can be observed in the different names that consumers have given to it: "fake" [41], "vile", "freakish", "weird" [22], "lab-meat", and "test-tube" [33].

Within this framework, Siegrist and Sütterlin [23] demonstrated that perceived naturalness mediated respondents' acceptance of the health risks associated with conventional vs. cultured meat. Laestadius [42] explained how the unnaturalness of cultured meat fell into two categories: (i) practical concerns about the technology causing unpredictable, tangible harm to human health or the environment; (ii) a more fundamental conceptualization of unnaturalness as inherently unethical.

1.2.6. Sensory Quality

One of the main pre-requisites currently challenging the shift from meat to meat substitute consumption is its resemblance to meat, especially in terms of texture, taste, and flavor. In this sense, [43] found that acceptance of cultured meat was increased by a simulated taste test of a cultured meat burger. In the case of cultured meat, since most of the population has not tried it, the anticipated taste/texture/appearance is an important and common objection [26], with many consumers anticipating inferior taste [22], texture, or appearance compared to conventional meat. In this sense, Tucker [35] argued that the lack of sensory appeal was the main reason underpinning the rejection of cultured meat.

1.2.7. Sustainability

Critics have raised questions regarding the impact of meat substitutes on rural economies and populations, with consumers showing concern for this issue [24,41,44], although it was also found that those living in an urban area have a more positive perception of cultured meat. Additionally, concerns related to the end of traditional animal farming have been reported [26], as well as concerns regarding the impact on the culture surrounding meat [22].

1.2.8. Emotional Reactions and Food Neophobia

Food neophobia is a common reaction that appears when new technologies are applied and/or when food challenges consumers' food/gastronomic culture. This reaction was identified by Bryant and Barnett [44] and Bryant and Dillard [45] regarding cultured meat. The authors also found that the information provided about cultured meat production, how this information is conveyed, and how cultured meat is named (cultured meat, animal-free meat, lab-grown meat, artificial meat, in vitro meat, etc.) all play a significant role in consumers' perceptions [46]. Some consumers even perceived that this technology "violates norms", and that it is not ethical, which caused moral concerns, disgust, and rejection [47].

As such, acceptance can be modified by providing positive information [48], such as that concerning environmental benefits or animal welfare. For example, Verbeke et al. [22] reported that the provision of additional information about the environmental benefits of cultured meat compared to traditional meat resulted in 43% of the participants showing willingness to try this novel food, while another 51% would "maybe" do so. Siegrist, Sütterlin, and Hartmann [49] found a higher rate of acceptance when non-technical information was given, given how this affects perceived naturalness.

All in all, there is a gap in the knowledge of how consumers from areas with a strong gastronomic culture (e.g., the Mediterranean diet) and with high-quality meat products (e.g., Spanish Iberian dry cured ham) perceive these alternatives to meat products. Therefore, the objective of the present study is to analyze Spanish consumer preferences for plant-based and cultured meats, as compared to conventional meats, on the basis of five main attributes: type of meat, sustainable production practices, reduced carbon footprint, the origin of production, and product price. The paper is structured as follows: First of all, the following section details the data collection procedure and the methodology applied in this research. Subsequently, Section 3 presents the main findings, which are later discussed in Section 4 in light of previous papers on the topic. Finally, Section 5 highlights the main

conclusions of the study, also outlining its limitations together with guidelines to improve future research.

1.3. Hypothesis of the Study

Within this context, the authors' hypotheses are as follows:

Hypothesis 1 (H1): *the preferences of Spanish consumers may lead to a greater reluctance to accept and adopt meat substitutes.*

Hypothesis 2 (H2): *the consumer subcategories with heterogeneous preferences for meat substitutes can be identified.*

Hypothesis 3 (H3): *the willingness to pay for meat substitutes is lower than the willingness to pay for conventional meat.*

This study could help both farmers and the meat industry, as it will help to identify target customers, develop products, and define marketing strategies that are aligned with the factors that contribute to a positive valuation of these alternatives to conventional meat. This may open up opportunities for these producers to modify their production strategies (e.g., taking into account environmental and consumer health concerns), as well as their communication strategies, informing consumers of the benefits that are also linked to conventional meats.

2. Materials and Methods

2.1. Methodological Procedure and Data Collection

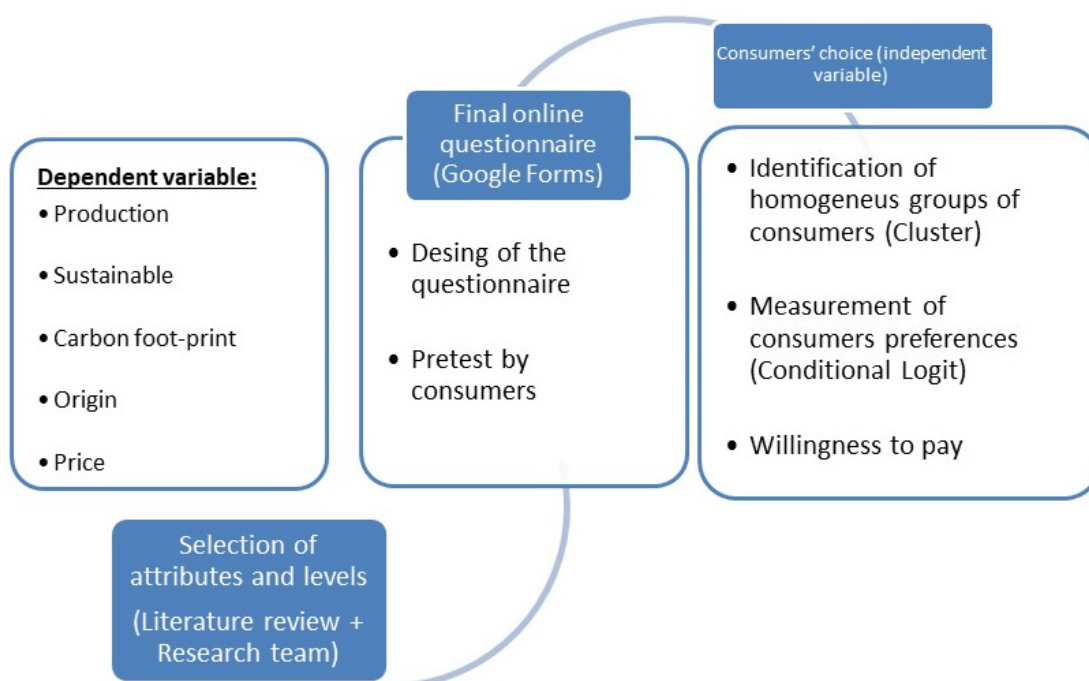Figure 1 presents the methodological procedure of this research.

Figure 1. Methodological procedure.

Data were collected by means of a questionnaire delivered in November 2019. The questionnaire was designed using Google Forms (www.docs.google.com, accessed on 18 May 2021). Participants were recruited via e-mail, using research databases created out of

previous consumer studies. The widespread use of the internet has allowed researchers to reach more segments of society, and has thus led to an increase in the use of online surveying in agri-food marketing studies [50–53]. A pilot questionnaire was carried out with 10 respondents (not included in the final sample), in order to ensure the validity and comprehensibility of the questions. Although a random sample of 496 surveys was collected, the final sample consisted of 444 Spanish consumers whose answers were complete and adhered to the conditions of analysis. Since the main purpose of the study was to analyze alternatives to meat consumption, the target population (meat consumers in Spain) could not be determined a priori, and therefore a fully representative sample could not be obtained. Regarding the socio-demographic characteristics of the sample, there was a greater prevalence of female, younger, and higher-educated respondents, which is a common situation in online studies [54–56].

2.2. Choice Experiment

Among the different tools that can be used to study consumers' preferences [57], stated preference techniques are frequently used in the agri-food sector, with choice experiments (CEs) being a commonly applied technique due to their ability to simulate real market situations, which improves participants' response rates.

In the present study, a choice experiment was performed to analyze preferences for the meats produced via the various production systems. This approach is widely used within the agri-food sector, and more specifically in the meat sector, to analyze consumer preferences [46,58–61]. The choice experiment methodology is based on the idea that goods and services can be described as the sum of their various attributes, and consequently, consumers can make purchasing decisions based on their preferences for each attribute. Each attribute presents itself at various levels, and in a choice experiment, individuals are asked to select their preferences amongst several hypothetical products, wherein each product is a combination of the various levels of the selected attributes.

Despite their potential, the use of choice experiments involves some limitations, one of the best known of which is the risk of hypothetical bias. Hypothetical bias occurs when respondents make different decisions during the study (hypothetical situation) than they would in a real purchase situation. The risk of hypothetical bias in a study increases when attributes that are socially desirable are focused on (for example, in this study, carbon footprint or sustainable production labeling). In such cases, the willingness to pay exhibited in the CE is often greater than it would be in a real situation, as respondents try to improve their image, and may give a response that they feel is more accepted by society [62,63].

In this study, and in order to correct hypothetical bias (ensuring external validity), cheap talk was used. Thus, and in accordance with other studies, a text explaining hypothetical bias and its significance for the validity of the study was attached to an information card provided before the choice experiment. Finally, the participants were asked to try to respond without bias to the choice experiment by attempting to put themselves as actively as possible into a real shopping situation (Figure 1). Regarding internal validity, the design of the experiment was tested by applying a dominance test between pairs of choices.

Thus, the first task in the development of a choice experiment is to select the relevant attributes, and to identify their levels that contribute to shaping consumer preferences [64].

The selection of the attributes was initially based on a review of the available literature on consumer preferences for meat and alternative meats. Specifically, the type of production was selected, due to the main objective of this paper, i.e., to compare different alternatives to meat. This is in line with [39,60].

Growing consumer concern about sustainability and the effects of food production on the environment—which is especially relevant in the case of meat production—suggests that this could be a key factor in the acceptance of meat substitutes, as has been highlighted in previous studies [22,36]. Since carbon footprint is a key instrument for assessing the sustainability of a product, it was deemed essential to determine the importance of this attribute for the consumer. Previous studies have indicated that the use of eco-friendly

labeling schemes, e.g., addressing carbon footprint or sustainable production practices, minimizes uncertainties related to the environmental impacts of meat products, allowing consumers to make sustainable purchasing decisions [65]. Although it is often used in research on preferences for meat substitutes [66–68], we decided not to incorporate a quantification of CO_2 emissions, as we considered that consumers were unaware of the average levels of emissions caused by different products, and therefore this information could be confusing. The presence of other sustainability claims or logos was also considered, and in this study, these have been defined as "Sustainable production" (see Figure 2). Origin is usually considered in the analysis of preferences in the agri-food sector. Thus, different authors [58,69–72] have used this attribute in their studies, generally concluding that is one of the most important attributes for the consumer. Finally, price is another relevant attribute that is used to calculate willingness to buy. Here, the different levels were determined via an analysis of food markets, in order to make the prices as realistically as possible. Table 1 shows the final attributes and levels used for this research.

Choice set 1			
Attributes	Product A	Product B	Option C
Production	Plant-based	Cultured	
Sustainable	No	Yes	I would not buy any of these
Carbon footprint	Yes	No	
Origin	Spain	Local	
Price	11 €/kg	15 €/kg	
Select the option	☐	☐	☐

Figure 2. Example of discrete choice experiment choice set.

Table 1. Attributes and levels selected for the choice experiment.

Attributes	Definition	Levels
Production	Type of meat	Conventional, cultured, plant-based
Sustainable	Sustainable production practices	Yes/No
carbon footprint	Reduced carbon footprint	Yes/No
Origin	Label showing the origin of production	Regional, Spain, imported
Price	Price of the product (EUR/kg)	EUR 11, EUR 15, EUR 19, EUR 24

The total set of hypothetical products, considering the selected attributes/levels, amounts to 144 ($3 \times 2 \times 2 \times 3 \times 4$), which constitutes an excessive number of products to be compared by respondents. Taking into account that they were to be presented with "choice sets" made up of two products plus a "no-purchase" option, this would constitute a total set of possible comparisons of 20,592 (144×143), which is unmanageable both economically and in terms of time. Therefore, a fractional design was proposed to reduce the number of comparisons to a sufficient level using Stata's "Dcreate" module, which allows such designs to be generated [73]. This module uses Fedorov's modified algorithm to create an efficient design [74]. The D-efficiency of the design was 1.066. Finally, eight choice sets were created and used for the survey. Figure 2 shows an example of the choice set.

Before conducting the choice experiment, participants were provided with the following information to ensure they had a basic understanding of the different attributes included in the study (Figure 3).

Figure 3. Information card provided to the participants. Source: own elaboration from [75–83].

2.3. Conditional Logit

Different models can be used within CEs; conditional logit is applied in this paper due to its wide use in research [61,84,85]. This model is based on random utility [86–88], which assumes that the utility function for each consumer is the sum of two components—a deterministic part that can be derived as a function of the factors influencing consumer utility, and another random part that is not directly observed and is considered stochastic. Thus, the utility U_{njt} for a consumer n who chooses alternative j in the comparison t is:

$$U_{njt} = \beta'_n x_{njt} + \varepsilon_{njt}, \tag{1}$$

where β'_n is the individual-specific vector of coefficients, x_{njt} is the vector of the observable attributes for individual n, and ε_{njt} is the random term that is assumed to be an independently and identically distributed extreme value. Therefore, the probability that consumer n chooses alternative j in the comparison t is given by the following expression:

$$L_{njt}(\beta_n) = \frac{\exp\left(\beta'_n x_{njt}\right)}{\sum_{j=1}^{J} \exp\left(\beta'_n x_{njt}\right)}. \tag{2}$$

Base levels have been selected for each of the qualitative attributes in order to set a benchmark (zero utility) for the other levels of the attribute. The selected base levels were "Import" (for the attribute Origin), "Conventional" (for Production), and "No" (for Sustainable and Carbon Footprint).

The econometric specification used in this paper can therefore be defined as follows:

$$U_{njt} = \beta_0 ASC + \beta_1 Regional_{njt} + \beta_2 Spain_{njt} + \beta_3 Carbon\ Footprint_{njt} +$$

$$\beta_4 Sustainable_{njt} + \beta_5 Cultured_{njt} + \beta_6 Plant-based_{njt} + \beta_7 Price_{njt} + \tag{3}$$

$$\varepsilon_{njt},$$

where β_0 relates to the present situation (ASC), i.e., do not purchase either of the two proposed products, and β_k is the marginal utility associated with each attribute provided by the specific product. Specifically, $Regional_{njt}$ refers to the regional origin of production; $Spain_{njt}$ reflects whether the product is manufactured in Spain; $Carbon\ Footprint_{njt}$ indicates whether the product has a carbon footprint label or not; $Sustainable_{njt}$ shows whether the meat is produced sustainably; the production method is represented by $Cultured_{njt}$ and $Plant-based_{njt}$; finally, $Price_{njt}$ is the price represented in continuous values.

On the other hand, when the price is included as an attribute in a choice experiment, the marginal substitution ratio between a coefficient and the price is called the willingness to pay (WTP) for the specific attribute, which is calculated as follows:

$$WTP_k = -\left(\frac{\beta_k}{\beta_{Price}}\right). \tag{4}$$

Therefore, $WTPk$ represents how much consumers would be willing to pay in monetary terms for each increase in the level of attribute k for a given product.

2.4. Consumer Segmentation

In this study, consumers were distributed into different segments in order to identify homogeneous groups that might show different preference patterns in terms of their meat consumption. The calculation was performed using K-means cluster analysis with IBM SPSS Statistics v22, following the procedure developed by [89]. The inputs used for the classification were variables relating to consumer behavior regarding meat and meat substitutes purchasing/consumption (meat consumption frequency; place of purchase of meat; responsibility for household food purchases; frequency of purchase of plant-based food) together with variables assessing perceptions of meat consumption and lifestyle. In

this study, a structure of three clusters was agreed upon, which took into consideration the adequacy of each cluster's size and its statistical significance.

3. Results

Table 2 shows the results obtained after applying the conditional logit model to the global sample.

Table 2. Results of the choice experiment for the overall sample.

Variable	Overall Sample	
	Coefficients (Standard Error)	z-Value
ASC	−0.6654 *** (0.1648)	−4.04
Regional	0.3831 *** (0.0858)	4.46
Spain	0.4253 *** (0.0606)	7.01
Carbon Footprint	−0.0630 (0.0506)	−1.25
Sustainable	0.3950 *** (0.0552)	7.15
Cultured	−0.5690 *** (0.1025)	−5.55
Plant-based	−0.3328 *** (0.0867)	−3.84
Price	−0.0612 *** (0.0074)	−8.24
Log Likelihood	−3378.4544	
AIC	6772.909	
BIC	6830.247	

p-value = *** ($p < 0.001$).

The results for the whole sample indicate a strong preference for regionally or nationally produced meat, conventional production, and sustainable practices labeling. All variables were found to be statistically significant, with the exception of the carbon footprint label.

Following the cluster analysis, three different groups of consumers were identified, whose socio-demographic and behavioral characteristics regarding meat purchasing and consumption are shown in Table 3.

Table 3. Socio-demographics and behavioral characteristics of the clusters and the overall sample (%).

		Overall Sample	Cluster 1	Cluster 2	Cluster 3	Signific. [a]
Gender	Women	58.3	57.5	64.2	51.5	*
	Men	41.7	42.5	35.8	48.5	
Age	18–30	53.3	60.4	49.0	50.8	
	31–50	32.8	30.6	39.1	27.7	***
	>51	14.0	9.0	11.9	21.5	
Level of education	Primary	9.9	12.0	6.0	12.4	
	Secondary/Vocational	25.9	28.6	23.8	25.6	n.s.
	University Education	64.2	59.4	70.2	62.0	
Monthly income	EUR < 900	7.8	9.8	4.7	9.4	
	EUR 901–1500	32.3	37.9	34.0	24.4	
	EUR 1501–3500	44.7	39.4	42.0	53.5	***
	EUR > 3500	15.2	12.9	19.3	12.6	

Table 3. *Cont.*

		Overall Sample	Cluster 1	Cluster 2	Cluster 3	Signific. [a]
Family size (persons)	1–2	23.9	18.7	26.5	26.2	
	3–4	63.4	64.2	64.2	61.5	n.s.
	5 or more	12.8	17.2	9.3	12.3	
Have you ever bought plant-based foods (veggie burgers, veggie sausages, tofu …)?	Never	59.0	45.0	50.0	51.1	
	Occasionally	36.6	46.4	43.8	42.4	n.s.
	Frequently	4.5	8.6	6.2	6.5	
Meat consumption frequency	Twice or less a week	27.2	28.4	30.5	22.3	
	3–4 times/week	51.8	53.0	50.3	52.3	n.s.
	>4 times/week	21.0	18.7	19.2	25.4	
Place of purchase of meat	Convenience store	5.9	6.1	4.0	7.8	
	Butcher's shop	35.1	28.0	41.6	34.9	n.s.
	Hypermarket/supermarket	59.0	65.9	54.4	57.4	
Are you in charge of food shopping?	Yes	58.6	53.7	63.6	57.7	
	No	7.7	11.2	4.0	8.5	n.s.
	Sometimes	33.7	35.1	32.5	33.8	

[a] Differences significant at: * $p < 0.05$, *** $p < 0.001$. n.s.: non-significant.

As Table 3 shows, the socio-demographic variables were significantly different between the clusters. Cluster 1 included mostly young consumers with the lowest income levels, while Cluster 2 was made up of middle-aged women with medium–high salaries. Finally, Cluster 3 was the most balanced in terms of gender and had the highest percentage of consumers over 50 years old, as well as the highest percentage of individuals with medium–high income. In view of the objectives of this study, it is worth noting that, although the trend was not significant, the youngest consumers presented the lowest meat consumption frequency and bought a higher percentage of plant-based food products.

Table 4 gives a complete description of these groups, showing their perceptions of meat consumption as well as their lifestyles.

Table 4. Perceptions of meat consumption, and the lifestyles of the clusters and the overall sample (%).

		Overall Sample	Cluster 1 Price-Sensitive Millennials	Cluster 2 Conscious/ Concerned Consumers	Cluster 3 Indifferent Consumers	Signific. [a]
Positive assessment of the impact of food on global warming/climate change	No	7.2	8.2	4.0	10.0	
	Indifferent	18.6	20.9	11.3	24.6	***
	Yes	74.2	70.9	84.8	65.4	
Importance placed on price when buying meat	Not important	4.1	1.5	3.3	7.7	
	Low importance	21.7	3.7	12.6	50.8	
	Average importance	30.4	31.3	41.1	16.9	***
	Important	33.5	48.5	32.5	19.2	
	Very important	10.4	14.9	10.6	5.4	
Importance placed on packaging and presentation format when buying meat	Not important	7.0	0.7	5.3	15.4	
	Low importance	20.0	3.7	7.9	50.8	
	Average importance	23.1	27.6	20.5	21.5	***
	Important	31.3	44.8	39.1	8.5	
	Very important	18.6	23.1	27.2	3.8	
Importance placed on origin when buying meat	Not important	8.9	0.7	0.0	27.7	
	Low importance	22.7	11.9	2.6	56.9	
	Average importance	29.6	55.2	19.9	14.6	***
	Important	25.3	27.6	44.4	0.8	
	Very important	13.5	4.5	33.1	0.0	

Table 4. *Cont.*

		Overall Sample	Cluster 1 Price-Sensitive Millennials	Cluster 2 Conscious/ Concerned Consumers	Cluster 3 Indifferent Consumers	Signific. [a]
Importance placed on quality seal (PDO, PGI…) when buying meat	Not important	6.3	0.0	0.7	19.2	
	Low importance	20.5	6.0	0.0	59.2	
	Average importance	22.7	42.5	11.3	15.4	***
	Important	33.7	38.1	53.6	6.2	
	Very important	16.9	13.4	34.4	0.0	
Importance placed on environmental seal (ecolabel, carbon footprint…) when buying meat	Not important	12.5	4.5	0.7	34.6	
	Low importance	31.1	32.8	5.3	59.2	
	Average importance	23.4	42.5	22.5	4.6	***
	Important	21.2	18.7	40.4	1.5	
	Very important	11.8	1.5	31.1	0.0	
Importance placed on local origin (low food mileage) when buying meat	Not important	10.1	3.0	0.0	29.2	
	Low importance	28.4	23.1	3.3	63.1	
	Average importance	22.4	44.8	15.9	6.9	***
	Important	25.8	23.1	49.7	0.8	
	Very important	13.3	6.0	31.1	0.0	
I am concerned about the influence of food on my health (0 = not at all concerned; 4 = very concerned)		3.4	3.2	3.7	3.4	***
I exercise regularly (0 = not at all frequent; 4 = very frequent)		2.5	2	2.9	2.5	***
I travel frequently for pleasure (0 = not at all frequent; 4 = very frequent)		2.4	2	2.6	2.3	***
I like to try new recipes (0 = not at all frequent; 4 = very frequent)		3.0	2.7	3.3	2.9	***
I participate in environmental protection tasks (0 = not at all frequent; 4 = very frequent)		2.8	2.3	3.4	2.6	***

[a] Differences significant at: *** $p < 0.001$. n.s.: non-significant.

The information included in Tables 3 and 4 allows for the definition of consumer clusters. Thus, Cluster 1 has been named "Price-sensitive millennials", since, as indicated in Table 3, most of its members were under 30 years old. In addition, they placed the greatest importance on price, which may be related to their lower income levels. Group 2 has been named "Conscious/concerned consumers", since they were concerned about the effects of food on health and the environment, and they also valued aspects such as quality labeling and regional foods. Finally, group 3 has been named "Indifferent consumers", since they saw less importance in all the aspects related to meat purchasing, and also had average or below average scores in the lifestyle variables.

Once the clusters were defined, the choice experiment was repeated for each group in order to identify whether their preferences would differ. Table 5 shows the results of the corresponding analyses.

Table 5 shows that the "Price-sensitive millennials" had a positive preference for both Spanish and regional products labeled under sustainable systems, and negative preferences for cultured and plant-based meats, as well as for their price, while carbon footprint labeling was not significant for them. The second group ("Conscious/concerned consumers") had similar preferences with similar significance; however, their probability of choosing a specific attribute was higher compared to the first group (z-values), since conventional production and sustainable labeling, as well as regional/Spanish origin, were more highly valued here.

Finally, the third group ("Indifferent consumers") yielded larger differences in terms of preference compared to the previous groups, since only sustainable labeling, price, and origin of production (regional and Spanish) were significant here. Moreover, this group displayed the lowest probability of choice for all the attributes, with the exception of price, the value of which was the highest.

Table 5. Results of the choice experiment for the consumer clusters.

Variable	Price-Sensitive Millennials		Conscious/Concerned Consumers		Indifferent Consumers	
	Coefficients	z-Value	Coefficients	z-Value	Coefficients	z-Value
ASC	−0.8061 *** (0.3051)	−2.64	−0.4301 (0.2805)	−1.53	−0.9958 ** (0.3105)	−3.21
Regional	0.3827 ** (0.1574)	2.43	0.6023 *** (0.1497)	4.02	0.1893 *** (0.1568)	1.21
Spain	0.4166 *** (0.1120)	3.72	0.5494 *** (0.1064)	5.16	0.2412 ** (0.1093)	2.20
Carbon Footprint	−0.0528 (0.094)	−0.56	0.0168 (0.0889)	0.19	−0.0509 (0.0913)	−0.56
Sustainable	0.3543 *** (0.1011)	3.50	0.6160 *** (0.0960)	6.42	0.2489 ** (0.1012)	2.46
Cultured	−0.7569 *** (0.1888)	−4.01	−0.8738 *** (0.1790)	−4.88	−0.2419 (0.1894)	−1.28
Plant-based	−0.4949 *** (0.1587)	−3.12	−0.5113 *** (0.1509)	−3.39	−0.1282 (0.1611)	−0.80
Price	−0.0629 *** (0.0136)	−4.61	−0.0523 *** (0.0125)	−4.17	−0.0773 *** (0.0141)	−5.47
Log Likelihood	−10,097.267		−11,362.664		−99,451.033	
AIC	2035.453		2288.525		2005.021	
BIC	2083.178		2337.258		2052.525	

p-value = ** ($p < 0.01$); *** ($p < 0.001$).

A further aspect that is relevant to the potential introduction of this type of product into the market is the consumer's willingness to pay. Thus, Table 6 shows the willingness to pay for each of the significant attribute levels in comparison to the base level for the whole sample and each of the three identified clusters.

Table 6. Willingness to pay (EUR/kg).

	Overall Sample	Price-Sensitive Millennials	Conscious/Concerned Consumers	Indifferent Consumers
Regional vs. imported	6.2528	6.0779	11.4978	2.4489
Spanish vs. imported	6.9418	6.6159	10.4869	3.1191
Sustainable vs. non-sustainable	6.4468	5.6283	11.7583	3.2188
Cultured vs. conventional	−9.2876	−12.0181	−16.6804	n.s.
Plant-based vs. conventional	−5.4324	−7.8589	−9.7608	−1.6580

n.s.: non-significant.

Table 6 indicates that the willingness to pay was the same for the whole sample and for all the different clusters in terms of all the significant values. However, in absolute terms, there are differences to be taken into account. Firstly, the highest willingness to pay was found for origin, with a clear preference for regionally produced products and those produced in Spain in comparison to imported products. Sustainability labeling came in third place. In contrast, plant-based and cultured meats were associated with negative willingness to pay when compared to conventional meats, with the highest negative value for cultured meat.

On the other hand, the three clusters manifested notable differences. In particular, the "Conscious/concerned consumers" showed the highest willingness to pay in absolute terms for all the attributes. While the "Indifferent consumers" showed the lowest willingness to pay for all of them, it is worth noting that this group's willingness to pay for cultured meat and plant-based meat, in comparison to conventional meat, was not statistically significant. Finally, "Price-sensitive millennials" were in the middle, revealing a degree of willingness

to pay for all the attributes that was closest to that of the overall sample; however, this willingness was slightly higher for cultured meat and plant-based meat, compared to conventional meat, and somewhat lower for the rest of the attributes.

4. Discussion

4.1. Acceptance of Meat Substitutes

The findings of this research reveal that, in general, both cultured meat and plant-based meat represent negative utilities for the consumers when compared with conventional meat, and were therefore rejected by the majority of consumers.

Type of production seems to be one of the most significant attributes shaping consumer preferences, and due to the novelty of both plant-based and cultured meats, this could be one of the main reasons for consumer rejection. In fact, the consumer rejection of new technologies due to concerns about safety and naturalness has already been found for conceptually similar food technologies, such as genetically modified food [90,91]. In this regard, ref. [92] found that association with familiar technologies could be key to the sense-making process surrounding the acceptance of cultured meat.

However, various studies have shown how the willingness to eat cultured meat varies depending on the type of information provided [93]. In this sense, familiarity with cultured meat and the provision of information are associated with increased acceptance [22,24,41]. In this sense, ref. [49] found higher rates of acceptance when non-technical information was given, due to differences in perceived naturalness.

Our results partly conflict with those of other recent studies on meat preferences, wherein origin was one of the most important attributes and the type of production was much less valued [82,84]. The explanation for this, however, may derive from the fact that in this research, conventional meat is compared with two novel products, with which consumers may lack sufficient experience, and which may therefore be affected by food neophobia [94]. It has been widely stated that, regarding meat, a food product affected by frequent serious safety scares, consumers identify known origin as a guarantor of quality [70], a fact that does not translate to meat substitutes.

Both the general sample as well as the "Price-sensitive millennials" and "Conscious/ concerned consumers" showed lower negative preferences for plant-based meat than for cultured meat, a result that coheres with that of previous research [60]. The fact that the "Indifferent consumers" presented non-significant preference coefficients for cultured and plant-based meats means that, for this group, the three products are equally preferred, a phenomenon found only among these consumers.

Although it has been claimed that various benefits can be derived from cultured meat and meat substitutes (food security, as animal products can be potentially contaminated with pathogens or residues; waste reduction, as only the part that will be consumed will be produced/sold; animal welfare; environment, etc.), several authors have reported that consumers generally believe that cultured meat would be less healthy than conventional meat, despite its lower fat content [22,33], and even that it could be dangerous for consumption [33].

However, studies dealing with the acceptability of plant-based meat have found that this product is preferred to cultured meat when consumers consider the concept of food naturalness [60]. Since the acceptance of meat substitutes is also associated with familiarity [17], it can be assumed that plant-based meat substitutes, which have long been included in traditional diets as an alternative source of protein, are therefore more appealing to consumers.

4.2. Carbon Footprint

Since the publication of the FAO's report "Livestock's Long Shadow" [95], awareness has been increasing regarding the influence of animal production on the environment through deforestation and GHG emissions. Meat production is particularly cited as causing these impacts, mainly due to the animals' inefficiency in converting feed into meat [65].

Cultured meat has generally been highlighted as carrying a significant potential advantage in terms of GHG emissions [8,27], although the long-term aspect is more controversial [29]. It has been suggested that bypassing animals' biological processes can result in lower emissions per unit of meat produced, due to the more efficient conversion of inputs into outputs (meat) in the lab. However, one must not only address emissions, but also sinks and other positive externalities of the animal production systems.

Within this context, and with the growing public concern about climate change, additional attributes—such as carbon footprint or sustainability production seals—may be preferred by consumers. However, the presence of carbon footprint information has not been shown to be significant in terms of consumer preference, either in the general sample or in various clusters. Some authors [2,21,96] found that consumers in general lack knowledge about the environmental impact of food (and specifically meat) consumption, which, together with a lack of familiarity with the concept of and the symbols referring to carbon footprint, could contribute to our results. In contrast, other studies identified the moderate impact of both environmental concerns [97] and carbon footprint labels [98]. Indeed, some consumers (sustainable consumers) placed great significance on these labels, although in our study not even the "Conscious/concerned consumers" displayed this behavior.

4.3. Segmentation

With regard to consumer segmentation, this paper shows that there are differences between consumer characteristics in relation to meat substitutes, i.e., cultured and plant-based meat. Specifically, three types of consumers have been identified: price-sensitive millennials (Cluster 1), conscious/concerned consumers (Cluster 2), and indifferent consumers (Cluster 3). These groups represent the segmentation of the market for these products, which is an aspect that has not previously been dealt with in the literature. Other papers have analyzed the characteristics of consumers of these products without specifying consumer clusters, as has been the case for Italy [48], China, Ethiopia [41], Germany [99], Belgium, the United Kingdom, and Portugal [22] (with the exception of [17]).

With regard to the socioeconomic variables, the "Indifferent consumers" group displayed a consumer profile suggesting a greater inclination to consume plant-based foods, since they were mostly young (between 18 and 30 years old) women holding a university degree—characteristics that cohere with other studies [60,100]. The "Price-sensitive millennials" cluster was composed of those who consume the products relatively more frequently than the other consumer groups, who stated they had occasionally or frequently consumed plant-based foods, which was again in line with other studies [55,101].

On the other hand, the consumer group that was most concerned about the effects of food on health (conscious/concerned consumers) also showed a lower preference for cultured and plant-based meats. This finding is partially in line with research carried out in the USA [24], which analyzed willingness to try in vitro meat and which concluded that consumers who were more appreciative of the benefits of these products were less willing to try them, as was the case for vegans and vegetarians, in comparison to meat eaters. Conversely, there is also research showing the opposite, such as [6], which found that consumers who were more likely to try such products were those with less meat or no meat in their diets.

4.4. Willingness to Pay

In this study, the willingness to pay for cultured and plant-based vs. traditional products was clearly negative, both for the general sample and for the different groups identified. This is consistent with the study of [60], which analyzed preferences for alternatives to burger meat, and found that only a small part of the sample were willing to buy cultured meat and plant-based meat at a similar price to traditional meat.

The analysis of [46] concerning cultured, lab-grown and artificial meats restated the negative willingness to pay, but also showed how, when the "effect of hearing" of these

products was included (if the consumer has heard something about the production system before), the willingness to pay increased significantly.

On the other hand, consumers who eat meat more frequently, such as the "Indifferent consumers", have also shown a greater willingness to pay for meat substitutes. This result is contrary to other studies [6], wherein it was observed that consumers who prefer not to include meat in their diets were more willing to pay for algae-based meat substitutes.

With regard to producing meat sustainably, both the global sample and the three groups showed a high and positive willingness to pay, which is in line with other papers that analyzed animal wellbeing or extensive production [66]. This indicates an interest in any practice aiming at sustainability, and suggests that increased consumer demand is relative to their concerns for the environment and their surroundings. Origin, on the other hand, was associated with a high willingness to pay in the three groups, with a tendency to pay more for regional or national produce as opposed to imported produce. This relates directly to more sustainable practices, which is in line with their higher willingness to pay for this attribute. This result agrees with the results obtained in other papers, which showed a greater willingness to pay for regional products versus imported products in the cases of lamb [72], beef [70], honey [51], and general products [33,102].

5. Conclusions

This study has shed some light on how Spanish consumers perceive the three types of products under analysis (cultured, plant-based, and conventional meat), both individually and comparatively. Additionally, this study has allowed us to dig into the motivations of consumers, and elicit certain concepts from them, from an integrative perspective, considering social characteristics, lifestyles, and environmental internal drivers. Moreover, this study may help the farming and food industry develop communication strategies in line with consumer's motivations and values. In this sense, how and what information is conveyed seem to be key to a positive perception of these products; e.g., laboratory vs. farm (natural), use of animals vs. no use of animals, or risk of residue presence. All the above are extremely sensitive areas for consumers, and must be taken into consideration by both producers and retailers.

This study has allowed us to classify consumers on the basis of their motivations, and to derive consumer conceptualizations of the above types of meat alternatives. All the clusters were found to be unlikely to pay a price premium for these "new meats" when compared to conventional meat, with the lowest value being allocated to cultured meat. Except for a small group of consumers (conscious/concerned consumers), who displayed a positive opinion of this type of meat alternative, most of the participants preferred to buy conventional meat produced through sustainable systems rather than consuming a laboratory-made or plant-based meat substitute. This thus represents an opportunity for currently active farms to apply best practices and adopt eco-friendly behaviors, to ensure their continued operation and sustainability in the near future, given the increased awareness of the negative environmental impacts of meat production.

Another point of interest raised by the results of this research is that consumers place great importance on the origins of meat products, something that would be difficult to consider in the case of meat substitutes, where the meat is either lab-grown or totally replaced with vegetal components.

In our opinion, "Conscious/concerned consumers" are an interesting target group that should be considered by food policymakers in the alternative meat industry. The research team also see the high potential of the "Indifferent consumers", since these were the only ones who showed a high willingness to pay for meat substitutes (cultured and plant-based) compared to conventional meat. Additionally, they showed the least willingness to pay for the origin attribute in relation to both types of meat substitutes.

However, the results presented in this paper should be considered as preliminary, given the limitations of the sample and that a wider study, with a more representative sample, would be necessary to validate our findings.

The authors acknowledge that the present study displays certain limitations with regard to the sample. A larger and more representative sample of the Spanish population would have been desirable. However, both the resources of the study and the general willingness to answer the questionnaire prevented this. This limitation is common in the literature and often encountered when surveys (especially online) are used.

Future research should focus on expanding the study of consumers' behavior in relation to the different product developments and marketing strategies of meat substitutes, in order to either promote these products, or improve the image and consumption of products of animal origin.

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