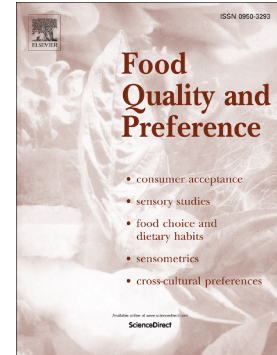


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ABSTRACT

This study aims to investigate the preferences of Spanish consumers regarding the use of natural preservatives in fruit, taking into account the different factors that may influence their purchase decision. Although preservatives are mainly used in packaged fruit, this study also considers other relevant factors in the purchasing process too, such as geographical origin and price. The study focuses on two of the most popular packaged fruits in supermarkets in Spain -plums and table grapes- with the aim of determining whether preferences are general for all fruits or whether they vary according to the type of product consumed. To carry out this study, a representative sample of Spanish consumers in terms of age and sex was surveyed. Results reveal that participants' preferences follow the same pattern for both fruits although with minimal differences in utility values. Generally, a growing consumer interest in healthier and more natural food options is found. However, even though theoretically consumers prefer natural preservatives, when put in purchase situation, they choose fruits without preservatives over those with natural ones.

KEY WORDS: *consumer, perceptions, fruit, natural preservatives, biocontrol, choice experiment.*

1. Introduction

Fruits have traditionally been a very important part of the human diet since our origins as foragers. With the passage of time, and the emergence of agriculture and cattle raising, the dietary emphasis

shifted to cereals and meat, although fruit continued to have a very positive valuation among a significant part of the population who seek healthier diets. However, although consumers increasingly recognise the value of fruit as part of a more balanced diet, it faces the handicap - compared to other foods - of its shorter shelf life, which has led to the use of chemical preservatives in certain packaging and sales formats. This is coupled with the growing interest of consumers in developed countries, both towards the sustainability of production systems - a sign of this being the growing interest in organic foodstuffs - and towards natural foodstuffs and their concern about additives added to foodstuffs.

Southern Europe is one of the major fruit and vegetable producing region in the world (FAO, 2020), with fruits and vegetables being an essential part of the Mediterranean diet, which is linked with the importance of these food products in the diets of countries such as Spain. Actually, Spain is the first producer of fruits and vegetables in the European Union (EU) with over 26% of the European production (MAPA, 2022). thus, it is relevant to study this market due to its importance both as a EU producer, but also as a major consumer market.

Consumers are increasingly aware of the benefits of fresh food and that fruit is a key component of a wholesome and balanced diet, whose consumption helps reduce the risk of chronic diseases and premature death (Dreher, 2018; Frankowska et al., 2019; Sun, et al., 2021). It also contributes to preventing malnutrition by providing essential vitamins and minerals (Pem & Jeewon, 2015; Slavin & Lloyd, 2012).

For all these reasons, it is recommended to consume between 400 and 800 grams of fruit and vegetables per day (FAO & WHO, 2004; Aune et al., 2017; Mujcic & Oswald, 2016), with worldwide production of fruit and vegetables growing in line with these recommendations. However, world production reached only 306 g. per person a day in 2000, scaling up to 390 g in 2017 (FAO, 2020), which could allow to foresee a potential for growth.

Fruit consumption is growing accordingly, although the average daily consumption is in most countries below the recommended levels, among other reasons due to changes in social patterns (Eldesouky & Mesias, 2014; Frankowska et al., 2019; Mesías et al., 2021). These social changes, especially those that have happened in the last decades, have made fruit (at least natural fruit) lose importance in our diets, mainly due to its lack of convenience and high perishability. These transformations, largely related to new work patterns and family structures, have resulted in less time available for household chores (including food shopping and cooking) and an increasing demand for ready-to-eat food models (Eldesouky & Mesias, 2014). In fact, minimal processing, which includes procedures that do not affect the freshness quality of fruits and vegetables -such as washing, sorting, trimming or chopping- (Gil & Kader, 2008) can be seen as an agri-food sector's response to these

changes in consumer purchasing and consumption habits. Hence, minimally processed foods are easier to consume and, where possible, have a longer shelf life, while retaining most of their inherent nutritional, physical, chemical and sensory characteristics (FAO, 2020).

In this sense, the popularization of minimal processing and other food technologies has gone hand in hand with the increased use and development of food additives, nowadays indispensable in food production in order to provide the “convenience” demanded by consumers (Shim et al., 2011). Food additives are natural or synthetic compounds added to foods with technological or sensory purposes; e.g. counteracting food perishability or enhancing food taste or colour (Bearth et al., 2014; Miao et al., 2020). These components have become essential for the food industry so that their produce can reach the market complying with legal and consumer requirements (Carocho et al., 2015).

There are different types of food additives depending on their function: preservatives, nutritional additives, colouring additives, flavourings... (Carocho et al., 2015). However, in fresh produce, such as fruit and vegetables, its use is almost exclusively limited to preservatives, that is, those added to prevent food decay by microbial development or by undesirable chemical changes.

Although there is a broad scientific consensus on the safety of food additives, consumers are concerned about their consumption and potential health effects (Bearth et al., 2014; Gebhardt et al., 2020). On the other hand, and despite this search for more convenient foods, an increasing number of consumers are interested in fresh, natural, less processed and additive-free foods (Lavilla & Gayán, 2018), which poses a technological and logistical problem for food processors.

In this context, it is relevant to understand how consumers perceive naturalness, as it is an especially important variable for the acceptance of foods and food technologies (Román et al., 2017). Naturalness, understood as “non-artificial”, is one of the attributes most valued by consumers along with freshness and minimal processing (Nielsen, 2015). This also links with other current food trends that are gaining momentum, such as authentic (i.e., unprocessed, natural) foods, which promotes the reduction of ultra-processed food consumption (Case, 2017; Rios, 2019; Escribano & Mesias, 2023). Although fruit is mostly sold unprocessed, consumers' perception -if they consider that unnatural products or products of dubious effect on health, such as chemical preservatives or fungicides have been added- can make them identify it as an unnatural product with unwanted implications from the marketing point of view (Lami et al., 2024).

This issue is especially relevant in the case of fruit and vegetables, given their high perishability. This means that losses can reach very significant levels in this type of products, being among the foods with the highest rates of wastage at farm level (Ludwig-Ohm et al., 2019). To get an idea of the magnitude of the problem - and bearing in mind that the diversity of products makes estimates difficult - studies such as Usall et al. (2016) indicate that average losses in fresh fruit and vegetables

in the USA are around 12% between production and consumption. Other authors, such as Kitinoja & Kader (2015) state that losses in fruit and vegetables are the highest of all foods - together with roots and tubers - reaching levels of around 45%. This is a serious concern as it undermines the sustainability of our food systems, since when food is wasted, all the resources used to produce it (water, land, energy, labour and capital) are squandered. Moreover, the disposal of wasted food in landfills generates greenhouse gas emissions that contribute to climate change, also negatively affecting food security, food availability, and therefore food costs.

In this context, one of the most important challenges for the fruit industry is to reduce these post-harvest losses -usually due to rotting caused by fungal growth-, which is normally tackled with the use of synthetic preservatives (fungicides). However, this is at odds with the aforementioned trends towards more natural and healthy foods and with the growing awareness of human exposure to preservatives and their health implications (carcinogenic, teratogenic effects, etc.), which has led to restrictions on their post-harvest use (Spadaro & Gullino, 2004; Wisniewski et al., 2016). All this has resulted in the development of abundant research to identify natural substances that can be used to prevent fruit spoilage without causing harmful effects on consumers.

The future of these natural preservatives is interesting, as they meet both the new consumer trends described above and the resulting changes in regulations and trade standards at the retail level (Droby et al., 2016). However, these new preservatives -which can be technically reliable and healthy- may not be accepted by consumers, who tend to be wary of new products and technologies due to lack of confidence, perceived risks or simply neophobia (Mesías et al., 2021). Therefore, it is necessary to analyse consumer attitudes and preferences towards the use of these additives in fruit, as certain factors that might hinder their acceptance could be identified. Furthermore, this analysis could help the industry with a view to future training and information actions, as well as for the design of policies for producers and distributors in the food supply chain.

The aim of this article is, therefore, to analyze consumer preferences in Spain towards the use of natural preservatives in fruit, differentiating between the different factors that can influence the purchase decision. Given that preservatives are mainly used in packaged fruit, the study focuses on this type of product, although other three factors relevant to the purchasing process, such as geographic origin, packaging and price are also taken into account and whose selection and relevance are fully described in the Methodology section. To better reach this aim it is important to analyze and receive information on other aspects that can define the typology of the participants, such as their fruit consumption, the importance they give to different attributes when purchasing fresh fruit and their knowledge and assessment of the use of preservatives in fresh fruits.

Therefore, the objectives pursued and the contributions studied with this research would be the following:

- Firstly, to analyse the level of consumer's awareness regarding the presence of chemical preservatives in fresh fruit.
- Secondly, to analyse the relative importance that consumers give to different attributes in their fruit purchase decision, in a hypothetical market, by means of a Choice Experiment (CE) applied to two specific fruits (plums and table grapes). This tool allows to check the relative importance in the purchase decision of both price and the other proposed attributes. This was done on the basis of the stated preferences given by respondents for each fruit through nine comparisons (each of them with three options, different in the levels of each of the four attributes), as explained in more detail in the methodology section. This experiment included essential attributes such as price, together with others to which consumers tend to attach increasing importance due to their growing concern about the impact of food consumption on the environment and health. Thus, the methodology section describes the attributes considered in addition to price, such as fruit origin (regional, Spanish or imported), the type of packaging in which the fruit is sold (plastic or paper), or the presence or absence of preservatives in the fruit (without preservatives, with natural preservatives, with artificial preservatives). This makes it possible to estimate a greater or lesser willingness to pay for products with different levels of the attributes considered.
- Thirdly, to analyse the presence of different consumer groups - more or less concerned about the impacts of their consumption - based on their stated preference for the attributes considered. These groups were further characterised using several questions included in the questionnaire. This clustering would allow, in a second stage, to provide an analysis of the differences in the estimated relative importance of the attributes considered in the CE.

It was understood that, although the study could be applicable to all fruits, it was necessary to focus it on some fruits in order to facilitate the elicitation of preferences. Therefore, plum and table grapes were selected for this study, since they are two of the most popular packaged fruits sold in Spanish supermarkets. Furthermore, this approach allows to determine whether preferences are generic with respect to fruits or vary according to the type of product consumed. It should also be pointed out that, since these fruits are highly perishable at the retail level, they are thus an excellent example for the study of consumer preferences for chemical vs. natural preservatives.

2. Materials and methods

2.1. Data collection

Data were collected in March-May 2022 by way of a nationwide online survey with Spanish consumers. The survey was administered by a professional market research company that was responsible for programming the questionnaire, hosting the survey and recruiting respondents. Participants aged 18 or above were approached by email to fill out an online self-administered survey. Quota sampling according to the Spanish demographic criteria provided by the National Statistics Institute (National Institute of Statistic of Spain, 2019) was used in terms of age and sex.

Based on the purpose of the research study, it was decided for the survey to be carried out only amongst fruit consumers and therefore the respondents were first asked about their fruit consumption. Only those respondents who indicated they ate fruit (even occasionally) were allowed to proceed with the questionnaire.

The research study was approved by the University of Extremadura's Bioethics and Biosecurity Committee (registration no. 137//2022). All participants agreed to participate in the study and were assured that their answers would be kept confidential and completely anonymous. Respondents did not receive any compensation for their participation in the study.

The questionnaire included an initial section consisting of closed-ended questions regarding habits and attitudes towards fruit consumption and purchasing. This section was followed by another focus on awareness and consumption of organic food and specifically fruits, which ended with open-ended questions regarding the reasons behind why they do or do not purchase or consume organic fruits.

The questionnaire focused then on the use of preservatives in fruits. Given that it was assumed that some participants might be unfamiliar with the issue, the following definition was previously presented: *“One of the most important challenges the fruit industry is facing is to avoid significant post-harvest losses due to mold rot. Companies often use chemical fungicides for this purpose, which are increasingly restricted due to adverse health effects, persistent residues in foodstuffs and negative environmental implications. Therefore, in recent years, various effective, safe and environmentally friendly strategies have been developed to extend fruit shelf life, including biocontrol (application of yeasts naturally present in the fruit, which are harmless to the consumer and control the development of molds”*. After this, several questions regarding awareness and attitudes towards the use of preservatives in fruits were presented. Table 1 presents all these questions, together with their scales and the references from which they were obtained.

Table 1. Variables on fruit perceptions, scales and references included in the questionnaire.

Subsequently, the participants had to answer a choice experiment task, which was the tool selected to

study consumers' preference towards the use of preservatives in fruits. Finally, participants were asked questions regarding lifestyle and sociodemographic aspects.

Although a total of 1,103 questionnaires were received, the final number of valid questionnaires used in this research study was 890, following the exclusion of 213 low-quality interviews from the final sample (mainly due to incomplete answers or because they did not pass the validation questions used for response quality). The final sample consisted mainly of women (51%) and individuals over 50 years old (47%) with also individuals aged 36-50 (29%). These figures were similar to the demographic profile of the Spanish population. In order to make sure that the questionnaire was designed in an appropriate, unambiguous and unbiased manner and that it would be valid for all possible responses (Stone, 1993), 14 participants were chosen to pre-test the questionnaire. This approach was also used to ensure the questions were clear and to improve the final version of the questionnaire.

2.2. Choice experiment

Amongst the various tools employed to analyse consumer preferences, stated preference techniques are recommended when consumers are required to make choices in situations that involve hypothetical markets, such as the case of natural preservatives (Jaeger & Rose, 2008). Within these tools, Choice Experiment (CE) is one of the most frequently-used tools in the area of food, as a quantitative methodology that holds that individuals make trade-offs when making a decision by choosing the alternative product or service that offers the greatest utility or benefit. Moreover, CEs can provide an empirical alternative to expert opinions, while taking into account possible interactions between attributes, which are otherwise often ignored (Terris-Prestholt et al., 2016).

CE is based on the idea that a good or service can be described through its components' attributes (Lancaster, 1966), and that consumers make purchasing decisions based on these attributes and their various levels (Steenkamp, 1987). A CE consists of alternative options of the same product made up of different levels of the attributes and prices, where the interviewee is required to select the option that best reflects his/her preference, although they may also choose to select none at all, if the options they are given do not meet his/her expectations. This procedure reproduces the typical purchasing situation consumers would face when buying products in real-life markets (Van Loo et al., 2011) which makes the task easier for the interviewee.

Over the last few years, this technique has been identified as a very useful tool to estimate consumer preferences and willingness to pay for the different attributes of various food products. It has also been pointed out that CE is a valuable method to obtain an unbiased welfare measure (Barreiro-Hurle et al., 2018). It has been used in several studies addressing food preferences towards different features, such as environmentally-friendly food (Aprile & Punzo, 2022; Lami et al., 2022; Mazzocchi et al.,

2022), local food (Ditlevsen et al., 2020), fish products (Menozzi et al., 2020) or meat and meat products (Van Loo et al., 2014; Escribano et al., 2021).

The first step in this research was the selection of the food product, which in this case were two different fruits -stone fruits and freestone fruits-, plums and table grapes respectively in order to be able to see if preferences would change depending on the fruit type.

Regarding the CE study, the first stage is the selection of the attributes and levels that will make up the different fruit options to be presented to the consumers. For the purpose of this research, the attributes and their levels were selected from a literature review of consumer fruit preferences (Baselice et al., 2017; Coderoni & Perito, 2020; Huang et al., 2021; Ketelsen et al., 2020; Thøgersen et al., 2019). The selected attribute levels must always be realistic and cover the full range of preferences that respondents might have. Table 2 shows the attributes and levels selected for this study for each of the fruits.

Table 2. Attributes and their levels used in the choice experiment for plums and table grapes.

Notably, price is a widely-used attribute in CE (Banovic et al., 2019; Carzedda et al., 2021; Vroegindewey et al., 2021) as, according to demand theory, it is essential to shape consumer's purchasing decision. It can also be used to determine the willingness to pay for a product and its component attributes, and it was therefore included in the analysis. Specifically, three price levels were defined for the purpose of this study, based on the research team's monitoring of table grapes and plums retail prices in Spanish supermarkets, with a low price (1.5€/kg per plums and 2€/kg per table grapes) reflecting the cheapest plums and table grapes; a second average price (2€/kg per plums and 3€/kg per table grapes); and finally, a third price (2.5€/kg per plums and 4€/kg per table grapes) corresponding to the highest-quality plums and table grapes. Additionally, three other relevant attributes were considered. The first one was the type of preservatives used in fruit, which could allow to differentiate the types of plums and table grapes available for purchase, according to whether or not they had been added preservatives -and if they were artificial or natural- in accordance with the purpose of this research. Secondly, the origin, in order to determine whether consumers might have a greater or lesser preference for fruit produced in a neighbouring area -which has been termed regional- as opposed to plums or table grapes that could come from other regions or other producing countries (Lami et al., 2024). And lastly, a fourth attribute was included that would differentiate the types of packaging used in fruits, with a more traditional option (plastic) and a more sustainable one (paper), which is becoming increasingly popular in the marketplace.

The set of hypothetical products that can be created by combining the selected attributes/levels amounts to 54 (3x2x3x3), which would provide an excessive number of products to be compared by respondents. Considering that they are presented within "choice sets" that are made up of two

products plus a “no-purchase” option, there would be a total set of possible comparisons of 2,862 (54 x 53), which is unmanageable in economic and time terms. Therefore, a fractional design using JMP v.16 software was applied to reduce the number of comparisons to be judged by the respondents to a manageable level, with the final number of choice sets to be presented reduced to six for each of the survey designs. The D-efficiency of the design was 1.059. Table 3 shows an example of a choice set used in this study.

Table 3. Example of a choice card presented to respondents.

Cheap talk was used to correct the hypothetical bias that may appear in this kind of research. Thus, in line with previous studies (Escribano et al., 2021; Ortiz et al., 2021), a text was included in the questionnaire explaining the hypothetical bias and its importance for the validity of the results. Finally, participants were asked to try to actively imagine themselves in a real purchasing scenario before answering the CE task.

2.2.1. Econometric Model

Conditional Logit, a model based on Random Utility (Mcfadden, 2015; Train, 2003), was applied in this research to estimate consumer preferences using JMP v.16 software. The model assumes that the utility function for each consumer is the addition of two components, a deterministic part that can be derived as a function of the factors influencing consumer utility and another random part, not directly observed and considered stochastic. Thus, the utility U_{njt} for a consumer n who chooses alternative j in the comparison t is:

$$U_{njt} = \beta'_n x_{njt} + \varepsilon_{njt} \quad [1]$$

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.

Reference 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 (Table 2). The selected reference levels were “Regional” (for attribute Origin), “Plastic” (for Packaging) and “Without preservatives” (for Preservatives). The econometric specification used in this paper is therefore defined as follows:

$$U_{njt} = \beta_0 ASC + \beta_1 Imported_{njt} + \beta_2 Spain_{njt} + \beta_3 Plastic_{njt} + \beta_4 Natural\ preservatives_{njt} + \beta_5 Artificial\ preservatives_{njt} + \beta_6 Price_{njt} + \varepsilon_{njt} \quad [2]$$

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.

On the other hand, when we include the price as an attribute in a CE, 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:

$$WTP_k = -\left(\frac{\beta_k}{\beta_{Price}}\right) \quad [3]$$

Therefore WTP_k represents how much consumers would be willing to pay in monetary terms for each increase in the level of attribute k provided by the product.

2.3. Cluster analysis

In order to define consumer groups as homogeneously as possible with respect to their preferences (Mesías et al., 2003), segmentation was considered one of the most interesting outcomes of this research. Therefore, a cluster analysis was performed to identify consumers segments with different preferences for fruit attributes. For this purpose, the input variables used were consumers' assessment of the importance for their purchasing decision of the fruit being more or less sustainable, natural (depending on the presence or absence of preservatives), local and with a higher or lower price as presented in the first section of Table 1.

The calculations were performed with the Cluster module of the IBM SPSS software package, v.21, using a two-step procedure combining hierarchical and non-hierarchical (k-means) clustering. This approach was selected because it allows one method's advantages to compensate for the other's shortcomings (Hair et al., 2014; Malhotra & Birks, 2006). K-means cluster procedure is among the most commonly used segmentation techniques (Jain & Dubes, 1988) and has several advantages, being one of the fastest and simplest supervised learning algorithms, without the need to establish assumptions or have prior knowledge of the data, providing the researcher with flexibility in the determination and interpretability of the groups, and being useful in the case of combining numerical, categorical and mixed data.

First, Ward's hierarchical clustering was carried out using the abovementioned input variables. The agglomeration coefficient provided by SPSS (Hair et al., 2014) allowed obtaining two possible solutions with 3 and 4 clusters, which provided the seeds for the non-hierarchical segmentation (Hair et al., 2014). Subsequently, K-means cluster analyses were performed based on the centroids of the clusters generated in the previous stage. Finally, and taking into account the size of the clusters obtained, the significant differences between the clusters through the clustering variables and the external validation through the interpretation of the clusters (Hair et al., 2014), a 3-segment solution was chosen. An analysis of variance showed that all the segments differed significantly ($p < 0.001$) from each other with respect to the variables which had been used in the segmentation.

3. Results

3.1. Assessment of fruit consumption and different attributes on fresh fruit purchasing decisions

The responses from the sample showed high levels of fruit consumption, with 47.5% of respondents reporting consuming 1 or 2 fruits per day, 39.1% with a higher daily consumption, and only 13.4% with a consumption of less than 1 piece per day. Although no significant gender differences were identified with respect to the frequency of consumption, there were significant differences in terms of the importance given by women and men to different attributes in their purchasing decisions.

As mentioned before, a question was included in which participants were asked to rate on a scale of 1 to 5 (1=Not at all important; 5=Very important) the relevance of various aspects (fruit origin, natural production, sustainability of products and price) in their fruit purchasing decisions. In all these variables, the importance given by the respondents reached an average of 3.6 to 3.4 according to this scale -refer to Table 7, Overall sample column-, an aspect that will be further discussed when dealing with the differences between clusters. Notably, it was observed that in the first two aspects, women gave statistically significant higher scores than men. These results may imply that these preferences could be linked to women's belief that locally produced organic foods are of higher quality than conventional ones. These and other aspects will be further explored in the subsequent sections on sample segmentation, which will reveal distinct consumer concerns and sensitivities.

3.2. Knowledge and Evaluation of the Use of Preservatives in Fresh Fruits

Data from this study also provide valuable insights into the knowledge and interest of Spaniards regarding the preservatives used in fresh fruits, which was one of the objectives of this research. As shown in Table 4, almost three-quarters of the surveyees (77.0%) were aware of the use of preservatives —whether chemical or natural— to enhance fruit shelf life. However, the percentage of participants who indicated never having read about the presence of preservatives on packaged fresh fruits labels was slightly higher (78.5%), despite the increasing prevalence of their presence.

Table 4. Knowledge and interest in the use of preservatives in packaged fresh fruits (N=890)

The limited attention of consumers on the presence or absence of preservatives in fresh fruits resulted in only 12.9% claiming to be aware of having purchased fresh fruits with natural preservatives on some occasions. Battalwar & Gupta (2015) have found that even though consumers usually read labels, their focus is on specific features -such as expiry date, ingredients or brand name- which receive most attention, while the use of preservatives is among the least important. However, the vast majority of consumers in the sample (93.2%) expressed their preference for the exclusive use of

natural preservatives in fresh fruits. It is noteworthy that the questionnaire included a brief informational sheet explaining these concepts beforehand.

This preference, considering that the common practice in the Spanish market involves the use of chemicals, was further confirmed -refer to Table 9, Overall sample column- with a high average rating (3.8), equivalent to an agreement with the statement that, if preservatives were to be used, they should be natural. Even more, respondents expressed a higher degree of agreement (4.2) to pay a premium to transition towards the use of natural preservatives in fruits, which are deemed environmentally friendly and safe for the end consumer.

It is noteworthy that surveyed consumers, collectively, expressed their disagreement (2.3) with the idea that the use of chemical preservatives is positive even though it is the most common practice in the market.

3.3. Choice Experiment

Results from the Choice Experiment provide a more precise snapshot of the importance that consumers attribute to the presence or absence of preservatives -chemical versus natural-. It also sheds light on other essential aspects in the final fruit purchasing decision, such as price, as well as other consumption-related impacts concerning the origin and distance travelled by the product from its place of production (local versus national or foreign products). Additionally, it explores the possibility of using paper packaging in packaged fruits versus plastic, reflecting the sustainability of production and consumption models.

Table 5 shows the estimated coefficients for the selected attributes and levels, as described in the methodology section. These coefficients are derived from the respondents' preference manifestations for different fresh fruits -plums and table grapes- where the use of preservatives in packaging is becoming increasingly common. It is worth noting that the results are similar on both fruits with same signs equivalent to same preference, and similar coefficients (importance). It should be noted that the Choice Experiment was carried out separately for both fruits, although the same attributes and levels were considered. The only exception was price, whose levels were adjusted for each of the fruits.

Table 5. Outcomes of the Choice Experiment for each fruit (N=890)

Results in Table 5 exhibited high levels of significance. In terms of the origin, the level of preference was much higher for the “regional” level, followed by “national” with the least preferred being the imported products, both in plums and in table grapes. The marginal utility that imported and national fruits provide is negative, which shows a lack of interest for these levels in comparison to the regional level.

Regarding the presence of preservatives, the minus sign before the coefficient of the artificial and natural preservatives reveals a greater preference for fruits without preservatives, although the negative coefficient for artificial additives is much more prominent than the one of natural additives in both fruits chosen for this study.

Lastly, price coefficient shows a minus sign, which implies that consumers tend to have a negative attitude towards price increases, a prevalent observation in various consumer research studies, and in coherence with economic theory.

It must be emphasized that in the case of plums, the negative coefficients among less sustainable attributes such as imported origin, artificial preservatives and plastic packaging, are more prominent than those in table grapes (Table 5), but the contrary happens when it comes to the Willingness To Pay (WTP) for the different attributes, as shown in Table 6.

Table 6. WTP (€/kg) for the various levels of the attributes for each fruit (N=890)

3.4. Typologies of fresh fruit consumers

The identification of different consumer segments was conducted through a K-means Cluster Analysis by assessing the importance of different variables such as price, origin, natural fruit production and sustainable food in their purchasing decision. As shown in Table 7, although the overall average rating was slightly above 3 for all variables, this mean value masks varying degrees of importance attributed by consumers in the sample. Thus, three distinct groupings were identified, leading to the segmentation of the sample into three Clusters (C). The first row of Table 7 describes the percentage of consumers included in each group. Subsequently, as part of a second-stage analysis, the average rating given by each cluster to the importance granted to the four variables used for segmentation is presented.

Table 7. Consumer segmentation and second stage analysis (N=890)

Thus, Cluster 1 (C1) consists of 22.9% of consumers for whom the origin of the fruit, its natural production and its sustainability are "not very important" in their purchasing decision. Price, on the other hand, is the most relevant factor in their purchasing decision. Therefore, this segment is referred to as "Price-concerned consumers".

Cluster 2 (C2), including 36.1% of consumers, consists of individuals who find price quite important in their purchasing decisions, similar to consumers in C1. Additionally, they show considerable concern about the origin of the fruits they consume. While price and origin take precedence, there is near-neutral importance given to the natural and sustainable aspects of fruits in their purchasing decisions. They are therefore referred to as the "price and geographical origin sensitive consumers" segment.

Lastly, consumers in Cluster 3 (C3) are neutral to price. They consider both the origin and the natural or sustainable production of fruits as "quite important" in their buying decisions. This segment is designated as the "Consumers aware of the impacts of consumption" group and represents 41% of the sample. This figure indicates a growing significance among Spanish consumers for aspects related to the sustainability of production, environmental protection, and impacts associated with their food consumption, particularly in fruits. A third stage of the analysis of the three identified segments involved examining the potential relationship between the clusters and their sociodemographic and consumption characteristics, as presented in Table 7.

A relationship was found between the groups described (ranked from least to most sustainability aware, from C1 to C3) and the variables used. The higher the consumers' awareness and the lower their price concern, the higher the consumers' age, the household income level and the frequency of consumption of organic fruit. On the other hand, the relationship with daily frequency of fruit consumption was inverse. This may be due to the fact that aware consumers may be more sensitive to issues such as food waste and may therefore be more careful not to buy or consume too much fresh fruit due to its short shelf life.

When comparing the results of the Choice Experiment per each cluster (Table 8), results allow us to observe that, concerning the price, utility decreases more significantly in Clusters 1 and 2 than in C3, confirming the importance that the first two segments attribute to the price, especially C1. Conversely, the increase in utility for consumers in all three clusters is maximum when the fruit is in paper packaging rather than plastic.

Table 8. Outcomes of the Choice Experiment for each cluster for each fruit (N=890)

Regarding the origin, consumers in C3 are the only ones who prefer local fruits over international or national ones. This result could be related to the importance that Clusters 1 and 2 give to the price, and which could justify their preference for fruits from Spanish regions which may offer more affordable prices due to their specialization.

It is worth emphasizing that in the case of Cluster 1, origin results are not significant for table grapes, meaning that this group is indifferent to this attribute when it comes to table grapes. In all clusters, consumers prefer products "without preservatives" over those using chemicals to increase their shelf life (given their negative sign). To a lesser extent, there is a preference for fruits "without preservatives" over those with "natural preservatives". It is worth mentioning that the only exception to this relationship occurs in the case of Cluster 2 for plums, where the maximum preference is achieved when plums have "natural preservatives" as opposed to having no preservatives. This exception might be explained by the perishability of the product.

Table 9 presents a characterization of consumer segments based on their evaluation of the use of preservatives and showing the significant differences between clusters (ANOVA) in this regard. The overall results show that respondents generally agree that the use of natural preservatives to extend fruit shelf life is positive, even if this would mean an increase in price. On the other hand, consumers tend to disagree with the use of chemical preservatives, or with their total withdrawal even if shelf life is compromised. The remaining columns of the table present the corresponding ratings for the three clusters.

As can be observed, while Clusters 1 and 2 place higher importance on the positiveness of using natural preservatives to extend shelf life, this importance is lower in C3. Additionally, C3 gives lower ratings for the positive use of chemical preservatives, expressing disagreement with this statement. On the contrary, there is a higher level of agreement in C3 with being willing to pay a premium for fruits with natural preservatives. It is also the only cluster where there is no disagreement with the statement that preservatives should not be added to fruits, even if it compromises shelf life, in contrast to C2 and C1.

Table 9. Characterization of consumer segments based on their evaluation of preservative use (N=890)

To conclude, Table 10 intends to characterize the consumer segments by presenting the importance that respondents granted to different intrinsic fruit attributes (colour, freshness, etc.) and showing the significant differences between clusters (ANOVA). For the entire sample, taste, freshness, and the smell of the fruit are the three most important attributes, in that order. The importance given to these attributes, inversely related to price, shows a direct relationship with belonging to Clusters 1 to 3. The differences in mean values among the groups are significant according to the ANOVA analysis of responses. In particular, C3 is the consumer group that gives the highest importance to intrinsic aspects of fruits such as taste, freshness, and smell, although they are also relevant for the other clusters. Moreover, this group is relevant because they are the consumers who are more favourable to the use of natural preservatives -versus chemical preservatives- even if this could mean an increase in prices. They are also the most opposed to the use of chemical preservatives and, in general, to the use of preservatives on fresh fruit.

Table 10. Characterization of consumer segments for fresh fruits (N=890)

Finally, among the numerous aspects included in the study, the last rows of Table 10 show that C3 is again the segment where the belief in a direct link between their diet and health is highest. It is also

the segment where the highest value is reached in the statement expressing elevated personal concern for health.

4. Discussion

The data presented in the previous section verified the importance that Spanish consumers currently give to attributes such as the origin of the product or the fact that they are produced naturally, slightly above other essential aspects in their purchasing decision such as -the price. This first analysis allowed us to identify a greater concern among women -compared to men- for the two aspects indicated. This greater significance that women grant to the origin and natural production of fruits is in line with the findings of Ureña et al. (2008) in their study on organic foods in Spain. They describe that this preference could be linked to women's belief that locally produced organic foods are of higher quality than conventional ones. These and other aspects will be further explored when discussing on sample segmentation, which will reveal distinct consumer concerns and sensitivities.

In that sense, it is worth remembering that different studies (Kiefer et al., 2000, 2005; Marshall et al., 1994; Li et al., 2018; Zipfel & Herzog, 2000) suggest that this disparity in fruit consumption between genders may occur due to different factors such as satisfaction associated with healthier habits, a preference for fruit snacks and the tendency towards wholesome diets. Moreover, societal norms and expectations often encourage women to be more health-conscious and mindful of their dietary intake, which might lead women to prioritize fruit consumption as a part of a healthier lifestyle.

Similarly, it has been quantified that almost three out of every four Spanish consumers are aware of the presence of preservatives used to improve fruit shelf life. However, this knowledge contrasts with a very similar percentage of consumers who have never read on labels about the presence of preservatives (chemical or natural), with only one in ten stating they were aware of having purchased fruit with natural preservatives in it. Battalwar & Gupta (2015) have found that even though consumers usually read labels, their focus is on specific features -such as expiry date, ingredients or brand name- which receive most attention, while the use of preservatives is among the least important.

Despite the limited attention to preservative information on labels, it is important to highlight the majority preference revealed for the use of natural preservatives - as opposed to chemical ones -, and a willingness to pay for the use of the former, which points to their growth potential in the market. In fact, various studies have confirmed the positive perception and behaviour of consumers toward the use of natural preservatives in comparison to artificial ones (Devcich et al., 2007; Shim et al., 2011; Bearth et al., 2014; Carochio et al., 2014; Perito et al., 2020). On the other hand, respondents rated slightly higher (2.7) the belief that no preservatives should be added to fruits, even though this might

be a problem for fruit preservation.

CE allowed us to verify, not only the expected negative relationship of consumer preferences with fruit purchasing price - consistent with economic theory - but also their preference for more natural and sustainable foods, consistent with the results of previous studies. Thus, for the overall sample their preference is highest for fruits without any preservatives -or natural rather than chemical-, produced in nearby areas or in the region -or national rather than imported from other countries- and packaged in paper containers rather than in plastic ones. Studies such as those of (Bearth et al., 2014) and (Devich et al., 2007) suggest that consumers are nowadays better informed and therefore opt for natural preservatives over synthetic alternatives. This may be associated to the increasing importance that is given to sustainable development (De-Magistris & Gracia, 2016) and is in agreement with the preference for paper over plastic in packaging. Preference for local products has been identified in various studies as well, such as those of Feldmann & Hamm (2014) and Meyerding et al. (2018).

This preference structure gave rise to a segmentation of the sample, which allowed to identify three large consumers groups differing on the importance that the attributes analyzed have in their final purchase decision. A common result for all three groups is the increased utility they derive from the use of paper versus plastic packaging when purchasing fruit, despite the advantages described in the literature for the use of the latter. This contradicts previous studies where preferences for plastic packaging have been found due to different reasons such as that paper absorption of moisture or liquid (Lignou & Oloyede, 2021), while plastic package is perceived as more durable and functional and more resistant to transport and handling (Koenig-Lewis et al., 2022; Sokolova et al., 2023). Also, other studies such as that of Magnier & Crié (2015) suggest that eco-friendly packages, because of their simplicity, minimalism and lack of colours, are often perceived as less appealing. Finally, transparent packaging has proven to increase willingness to buy, expected freshness and expected quality in different food categories, as consumers in general prefer to see the content of the packaging (Deng & Srinivasan, 2013; Simmonds et al., 2018).

The most relevant segment from the point of view of this study is Cluster 3, which encompasses 40% of the sample. This is the consumer group that is less concerned by price in their final purchasing decision, giving more importance, not only to the origin of the product, but also to its naturalness (in terms of the presence of preservatives) or to the use of more sustainable packaging, such as that of paper. All these trends have a growing significance among Spanish consumers for aspects related to the sustainability of production, environmental protection, and impacts associated with their food consumption, particularly in fruits.

The analysis of the characteristics of the respondents in each cluster showed that Cluster 3 preferences are related to socio-demographic characteristics, such as a higher income level or age. Other studies

have found that, regarding income levels, the study by (Ubilava et al., 2010) found that the higher the income, the lower the economic concerns and the higher the financial flexibility, which enables consumers to take more ethical and environmental aspects into account in their food purchasing decision.

In addition, this is the segment that: a) most frequently consumes organic food; (b) shows a lower preference for the use of chemical preservatives and a greater willingness to pay a premium for the use of natural preservatives; (c) agreed to refrain from using any kind of preservatives, even if this could lead to a shorter fruit shelf life; (d) attaches the greatest importance to intrinsic product characteristics such as taste, freshness and smell; (e) finally, it is the segment that most strongly identifies the relationship between food and health and shows a greatest interest in their health condition. These characteristics identified in this important consumer segment, which is growing in Spain, would be in line with segments and trends identified in previous research described below. Different studies have confirmed the significant relationship between the sociodemographic characteristics with consumers' sustainable awareness. For example, Carpenter & Yoon (2011); Guido et al., (2022); Peluso et al. (2021) have found that older individuals follow different decision-making processes, which can be associated to the cognitive changes of ageing. This segment of the population tends to focus more on the personal meaning or relevance of their consumption choices, potentially making them more aware of the impact of their purchasing decisions. In parallel, the concept of "active ageing" suggests that older consumers may show a tendency to adjust their consumption habits in pursuit of a better lifestyle, including more environmentally friendly choices. This behaviour may be driven by their time perspective and life circumstances, which may vary significantly among the older population (Peluso et al., 2021).

5. Conclusions

This research significantly contributes to a broader understanding of consumer attitudes towards a more sustainable food system. By delving into relatively understudied factors, such as the impact of preservatives and, to a lesser extent, packaging, this study shows how these elements affect consumer choices and perceptions. Although two fruits were used in this study with the intention of determining whether preferences are generic with respect to fruits or vary according to the type of fruit consumed, we can conclude that preferences have followed the same pattern across the two types of fruits - Table grapes and Plums - although with minimal differences in utility values. In addition, this study generally shows a growing consumer interest in healthier and more natural food choices.

The cluster analysis revealed that usually the more aware consumers are about the environmental impacts of food consumption, the more likely they are to opt for more sustainable food. This growing

preference not only encompasses natural foods but extends to environmentally sustainable products -greater preference for national and regional vs. imported origin, paper vs. plastic packaging- indicating a greater awareness of sustainability in the context of food consumption.

However, although participants dislike artificial preservatives and consider natural preservatives to be good and necessary, when it comes to the purchasing situation (choice experiment), they prefer fruit without preservatives. This may be due to the higher price of foods with natural preservatives and the lack of information regarding these types of foods, as they are less common in the markets.

The results of this study highlight the need for educational campaigns led by both manufacturers and retailers to inform consumers about the benefits of these products in order to encourage more sustainable and healthier food choices. In addition, through strategies such as subsidies, tax incentives or more efficient production methods, it is essential to lower the high cost of more sustainable foods, such as those using natural preservatives, to make them more accessible. Clear labelling to distinguish between different types of preservatives (artificial vs. natural) will also help consumers to become more informed and make more informed choices.

Although it would have been desirable to have a bigger and more representative sample of the Spanish population in terms of other sociodemographic characteristics such as income and academic level, it was difficult to achieve due to limited funding resources. Therefore, future research on this subject is recommended in order to extrapolate the results of this stated preference study, in three main areas:

Firstly, with regard to the segmentation of Spanish consumers of fruit and vegetables and other fresh foods. This analysis should confirm the representativeness of both results and sample reached. It should reinforce the analysis of the increasing relevance for consumers of different aspects related to food environmental sustainability. This could also be addressed with the use of other methodologies, such as consumer categorisation through hierarchical analysis.

Secondly, the analysis of the two fruits under consideration should be deepened. This implies considering other specific attributes of these fruits, such as the presence or absence of seeds in the case of table grapes, which is also relevant for other fruits such as watermelon.

Finally, it is important to expand the analysis to other fresh fruits and vegetables. The relative importance of the attributes considered should be contrasted and other product features - intrinsic and extrinsic - not included in this research should be incorporated. These attributes could be ripeness, colour, smell or size. Furthermore, labelling information may be considered, as well as the presence or absence of quality certifications and geographical indications, among others.

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Table 1. Variables on fruit perceptions, scales and references included in the questionnaire.

Importance granted to different attributes in fruit purchasing decision	Scale	References
· Origin · Natural Production · Sustainable production · Price	From 1 (not at all important) to 5 (very important)	(Campbell et al., 2013) (Vaca & Mesías, 2014) (Ceschi et al., 2017) (Lami et al., 2024)
Knowledge and interest in the use of preservatives	Scale	References
· Awareness of the use of preservatives in fresh fruits · Having read on labels about preservatives used on packaged fruits · Awareness of having purchased packaged fruits with natural preservatives · Interest in the use of natural preservatives in fresh fruits	Yes/No	(Carocho et al., 2014) (Carocho et al., 2015) (Leyva Salas et al., 2017) (Mesias et al., 2021)
Perceptions on the use of preservatives in fresh fruits	Scale	References
· The use of natural preservatives to extend shelf life is positive · The use of natural preservatives is positive, even if it increases the price · The use of chemical preservatives to extend shelf life is positive · Preservatives should not be added, even if it compromises fruits shelf life	From 1 (completely disagree) to 5 (completely agree)	(Ragaert et al., 2004) (Shim et al., 2011) (Bearth et al., 2014) (Leyva Salas et al., 2017) (Lami et al., 2024)

Table 2. Attributes and their levels used in the choice experiment for plums and table grapes.

Attributes	Levels (reference levels are underlined)
Preservatives	Artificial; Natural; <u>Without preservatives</u>
Origin	<u>Regional</u> ; Spanish; Imported
Packaging	<u>Plastic</u> ; Paper
Price	1.5€/kg; 2€/kg; 2.5€/kg (Plums); 2€/kg; 3€/kg; 4€/kg (Table grapes)

Table 3. Example of a choice card presented to respondents.

Choice set 3			
			
	Option 1	Option 2	Option 3
Preservatives	Artificial	Natural	
Origin	Regional	National	
Packaging	Plastic	Plastic	None of these options
Price	2€/kg	3€/kg	
I would buy	()	()	()

Table 4. Knowledge and interest in the use of preservatives in packaged fresh fruits (N=890).

Preservatives	No	Yes
Awareness of the use of preservatives in fresh fruits	23.0%	77.0%
Having read on labels about preservatives used on packaged fruits	78.5%	21.5%
Awareness of having purchased packaged fruits with natural preservatives	87.1%	12.9%
Interest in the use of natural preservatives in fresh fruits	6.8%	93.2%

Table 5. Outcomes of the Choice Experiment for each fruit (N=890).

		Table grapes			Plums		
		Coef.	SE	p-value	Coef.	SE	p-value
Additives	Artificial	-2.8336	0.0455	***	-3.2544	0.0558	***
	Natural	-0.5309	0.0397	***	-0.6741	0.0478	***
Origin	Imported	-1.4768	0.0464	***	-1.9571	0.0574	***
	National	-0.0304	0.0378	***	-0.2187	0.0448	***
Packaging	Paper	0.8614	0.0271	***	1.1206	0.0332	***
Price		-1.3025	0.0442	***	-2.1782	0.1069	***
No-choice		-3.3056	0.1248	***	-3.7665	0.2026	***

Significance at: *p < 0.1; **p < 0.05; ***p < 0.001; n.s.: non-significant.

Table 6. WTP (€/kg) for the various levels of the attributes for each fruit (N=890).

	Table grapes	Plums
Artificial vs No additives	-2.1755***	-1.4941***
Natural vs No additives	-0.4076***	-0.3095***
Imported vs Regional	-1.1338***	-0.8985***
National vs Regional	-0.0234***	-0.1004***
Paper vs Plastic	0.6613***	0.5145***

Significance at: *p < 0.1; **p < 0.05; ***p < 0.001; n.s.: non-significant.

Table 7. Consumer segmentation and second stage analysis (N=890).

Cluster	C1 (22.9%)	C2 (36.1%)	C3 (41.0%)	Overall sample	
Importance of different aspects when purchasing fruit					F
Origin ^{a***}	2.0	3.8	4.4	3.6	644.6
Natural production ^{a***}	2.1	3.0	4.5	3.4	721.1
Sustainable Production ^{a***}	2.6	3.1	4.2	3.4	284.2
Price ^{a***}	3.8	3.7	3.0	3.4	69.0
Age (%)***					X ²
18-35 y.o.	41.0	23.6	14.4	23.8	
36-50 y.o.	25.5	28.6	33.4	29.9	51.4
>50 y.o.	33.5	47.8	52.2	46.4	
Sex (%)**					X ²
Female	51.0	49.4	59.7	54.0	8.2
Male	49.0	50.6	40.3	46.0	
Family Income (%)*					X ²
Less than 1.500 €	13.0	6.5	6.6	8.0	
1.500 € - 2.500	30.0	31.1	24.6	28.2	
2.501 €- 3.500	27.0	23.9	27.3	26.0	18.0
3.501 €- 4.500	18.0	24.5	23.5	22.6	
More than 4.500 €	10.0	11.8	15.7	13.0	
Fruit consumption (%)**					X ²
<1 piece/day	30.5	36.3	46.4	39.1	
1-2 piece/day	16.5	14.3	10.2	13.1	18.2
>2 piece/day	53.0	49.4	43.1	47.6	
Frequency of organic fruit consumption (%)***					X ²
Never	27.4	15.9	3.9	13.6	188.1
Very occasionally	43.1	40.3	17.2	31.5	
Occasionally	27.9	38.4	56.1	43.3	
Always (every week)	1.5	5.3	22.8	11.6	

^aRating scale: from 1 to 5, where 1 is considered not at all important and 5 very important.

Significance at: *p < 0.1, **p < 0.05, ***p < 0.001; n.s.: non-significant.

Table 8. Outcomes of the Choice Experiment for each cluster for each fruit (N=890).

		Cluster 1		Cluster 2		Cluster 3	
		Table grapes	Plums	Table grapes	Plums	Table grapes	Plums
Additives	Artificial	-3.1540***	-2.5385***	-2.8341***	-1.9651***	-3.2570***	-3.3643***
	Natural	-1.2143***	-0.7929***	-0.7528***	0.3192***	-0.1378***	-0.9298***
Origin	Imported	-0.2025 ^{n.s.}	-0.6248***	-1.3165***	-2.1150***	-2.2652***	-2.9499***
	National	0.0607 ^{n.s.}	0.1440***	0.0288***	-0.2155***	-0.1261***	-0.5154***
Packaging	Paper	0.2310**	0.5295***	0.7473***	1.2248***	1.7247***	1.7600***
Price		-2.2518***	-2.9235***	-1.6551***	-2.5259***	-0.5492***	-1.4917***
	No choice indicator	-6.3667 ***	-5.4676***	-4.3445***	-4.4814***	-0.9030***	-2.1127***

Significance at: *p < 0.1; **p < 0.05; ***p < 0.001; n.s.: non-significant.

Table 9. Characterization of consumer segments based on their evaluation of preservative use (N=890).

Preference for the use of preservatives ^a	C1	C2	C3	Overall sample	p-value
The use of natural preservatives to extend shelf life is positive	4.0 ^a	4.0 ^a	3.4 ^b	3.8	***
The use of natural preservatives is positive. even if it increases the price	4.0 ^b	4.1 ^b	4.3 ^a	4.2	***
The use of chemical preservatives to extend shelf life is positive	2.7 ^a	2.5 ^a	1.9 ^b	2.3	***
Preservatives should not be added. even if it compromises fruits shelf life	2.4 ^c	2.6 ^b	3.1 ^a	2.7	***

Significance at: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.001$; n.s.: non-significant.

^a Rating scale: from 1 to 5, where 1 is considered not at all important and 5 very important.

Values with the same letters (a.b.c) within a row indicate homogeneous subsets for $P=0.05$ according to Tukey's test.

Table 10. Characterization of consumer segments for fresh fruits (N=890).

Importance intrinsic attributes ^a	C1	C2	C3	Overall sample	p-value
Taste	4.6 ^c	4.7 ^b	4.9 ^a	4.8	***
Freshness	4.4 ^c	4.6 ^b	4.7 ^a	4.6	***
Aspect	3.7	3.7	3.5	3.6	n.s.
Color	3.5 ^b	3.7 ^a	3.6 ^{ab}	3.6	*
Smell	3.3 ^c	3.9 ^b	4.1 ^a	3.8	***
Price	3.8 ^a	3.8 ^a	3.5 ^b	3.7	***
Importance lifestyle attributes ^a	C1	C2	C3	Total	
Linking food and health	4.2 ^c	4.5 ^b	4.7 ^a	4.5	***
Healthy life	3.6 ^b	3.7 ^b	4.0 ^a	3.8	***

Significance at: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.001$; n.s.: non-significant.

^aRating scale: from 1 to 5, where 1 is considered not at all important and 5 very important.

Values with the same letters (a.b.c) within a row indicate homogeneous subsets for $P=0.05$ according to Tukey's test.

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Declaration of competing interest

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

Journal Pre-proof

Ethics approval and consent to participate

The research study was approved by the University of Extremadura's Bioethics and Biosecurity Committee (registration no. 137//2022). All participants agreed to participate in the study and were assured that their answers would be kept confidential and completely anonymous. Participants gave informed consent via the statement "I am aware that my responses are confidential, and I agree to participate in this survey" where an affirmative reply was required to enter the survey. They were able to withdraw from the survey at any time without giving a reason. Respondents did not receive any compensation for their participation in the study.

- Spanish consumers' preferences regarding the use of natural preservatives in fruit
- Growing consumer interest in healthier and more natural food is found
- Natural preservatives preferred, although consumers purchase fruits without them
- Price and lack of information are key factors when choosing natural-preserved fruit