

# Can fruit be more sustainable? A study on consumer preferences towards the use of natural preservatives in cherries

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## Abstract

*Consumer awareness on how food is produced, the effects of food consumption on health and the environment is growing, and with it the importance of sustainability and sustainable production. In this context, fruits are one of the healthiest and most demanded food products, but also, they are highly perishable, requiring the use of chemical preservatives to extend their shelf life. The latter is inconsistent with consumer demands for healthy and sustainable food products and paves the path for the development of natural harmless preservatives. Therefore, it was deemed necessary to study consumers' preferences towards different factors determining a sustainable approach in fruit production and distribution, such as the use of natural preservatives, the local/regional origin, or the organic production. Results reveal a growing interest in society for the use of natural versus artificial preservatives, linked to the increasing awareness of their benefits for health and the environment. However, there are also barriers that prevent these novel products from becoming more extended, such as the existence of a price premium which may turn many consumers away.*

**Keywords:** *Natural preservatives, Consumer profile, Conventional, Organic, Fruit, Spain.*

## 1. Introduction

Fruit and vegetables – taken to be the edible parts of the plants (for example, seed bearing structures, buds, leaves, stems...), either planted or harvested in the natural environment, raw or minimally processed (FAO, 2020) – are a fundamental part of the world's food production

and consumption. In fact, and against a world's meat production of 336 million tonnes in 2018, the world's production of fruit was 868 million tonnes, whereas for vegetables it reached 1,089 million tonnes (FAO, 2023). On the one hand, the main fruits in order of importance were Canary sweet bananas and ordinary bananas, citrus

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fruits (orange, mandarin, lemon, pomegranate, etc.), melon, apple and grape. On the other hand, the main vegetables were tomato, several kinds of alliums (onion, garlic, leek), brassica (cabbage, cauliflower, broccoli) and cucumber.

The major fruit and vegetable producing region in the world is East Asia, followed by South Asia. Other major producers are South America and Southern Europe (FAO, 2020). In fact, fruits and vegetables are an essential part of the Mediterranean diet, which is associated with the relevance these food products have in countries such as Spain, given that it is the first producer of fruits and vegetables in the European Union (EU) with 1,873,520 hectares of fruit and vegetable areas in 2021, representing over 26% of the European production and being the seventh top world producer (MAPA, 2023).

Fruit is considered to be an important part of a healthy and balanced diet, as it provides essential vitamins and minerals, having a crucial role in the prevention of malnutrition (Slavin and Lloyd, 2012; Pem and Jeewon, 2015; De and Tulipa, 2019; Ahmed *et al.*, 2022). Additionally, the regular consumption of fruit in our diet can reduce the risk of chronic disease and premature death (Dreher, 2018; Frankowska *et al.*, 2019; Sun *et al.*, 2021).

Given the importance of fruit in the diet, the World Health Organisation recommends the consumption of at least 400 g of fruit and vegetables a day (FAO and WHO, 2004), although recent studies have recommended the increase of these amounts to reach 800 g/day per head in order to improve health and prevent disease (Mujcic and Oswald, 2016; Aune *et al.*, 2017). However, the average daily consumption of fruit and vegetables in most countries is below the current indications, amongst other reasons due to the changes in the family and working models (Eldesouky and Mesias, 2014; Frankowska *et al.*, 2019; Mesías *et al.*, 2021).

The worldwide production of fruit and vegetables is growing in line with these recommendations. However, the world production reached only 306 g per person a day in year 2000, which scaled up to 390 g in 2017 (FAO, 2020), although these figures also include the non-edible parts, such as the core and the peel of the fruit, as well

as the parts that are lost or wasted, which are often very many. In fact, it is precisely the high percentage of the losses, together with the intrinsic perishable nature of fruit, that significantly hinder the attainment of the nutritional objectives. It is known that a major part of the harvest is lost or wasted at the production and distribution stages.

Although such losses are very hard to quantify due to the vast diversity of food products that are included in this category and the length of the commercialisation chains, which can reach even various continents, it is however easier to confirm that fruits and vegetables suffer from higher rates of losses than any other kinds of food products (Kitinoja and Kader, 2015; Ludwig-Ohm *et al.*, 2019). Various authors have mentioned that the losses of these kinds of products can reach very significant levels, with the average of losses of fruit and vegetables in the United States being 12% between the production and consumption stages (Usall *et al.*, 2016) and for fruits, vegetables, roots and tubers, of up to 45% according to Kitinoja and Kader (2015). More recent studies indicate that the level of waste worldwide was 17% of the total food products available to consumers in 2019, the equivalent of 121 kilos of food products being wasted each year per consumer – out of which 74 kilos are wasted in the homes – according to the estimates provided in the report on the “Food Waste Index Report 2021”, published under the United Nations Environment Programme, 2021.

This issue must be analysed within a context of the growing demand for convenience food products from consumers – especially in developed countries – deriving from the new consumption patterns, but also a growing awareness of consumers towards sustainability. Therefore, in recent years, the interest of citizens in food produced using sustainable or ethical production methods has increased (Risius *et al.*, 2019), which is associated with the sustainable use of resources and the concern for future wellbeing (Reisch *et al.*, 2013; Çakmakçı *et al.*, 2023).

This level of consumer awareness, which has given rise to the concept of sustainable consumption, has already been reflected for example, on the Sustainable Development Goals (SDG) for the Agenda 2030, particularly in Target 12.3 of

SDG 12, Sustainable consumption and production, which refers to the goal to “reduce food waste and losses along production and supply chains” (United Nations, 2015). In general, consumers are increasingly aware of the fact that sustainable consumption is key to protect the natural environment, offset current climate change and guarantee social fairness (Eldesouky *et al.*, 2018, 2020b).

In this context, and in order to increase the shelf life of food products along the commercialisation and consumption chains, several technologies can be used. In the case of fruit, they are primarily focused on the use of chemical preservatives (fungicides) in order to prevent rotting during the distribution process. Nevertheless, the use of these chemicals to extend the shelf life of food products clashes directly with the aforementioned concept of sustainable consumption, on account of its consequences for human health (cancerous or teratogenic effects, etc.) and the environment. This context of growing social concern has led to a restriction in the post-harvest use of chemicals, (Spadaro and Gullino, 2004; Wisniewski *et al.*, 2016) as well as to the development of abundant research to identify natural substances that can be used to prevent fruit deterioration and which are both less harmful and more appealing to consumers.

Amongst the new developments, biocontrol through the use of protective cultures – a set of living microorganisms deliberately added to food with the purpose of controlling its microbiological state without modifying its technological and sensorial qualities – (Ben Said *et al.*, 2019) stands out. These protective cultures contain biocontrol agents (BCA) and have become an interesting alternative to the synthetic fungicides used to extend the useful shelf life of fruit and vegetables (Droby *et al.*, 2016; Leyva Salas *et al.*, 2017; Linares-Morales *et al.*, 2018).

From a market point of view, the future of BCAs seems promising, as the above-described consumer trends have already materialised into regulatory changes (Droby *et al.*, 2016) and, especially, into changes to the standards that the major food retailers demand from their suppliers. In practical terms, this has resulted in a reduction in the levels of allowed chemical waste (Usall *et al.*, 2016), which explains the increas-

ing use of biopesticides and biopredators at the production stage, as well as the development of harmless BCAs in order to increase the shelf life of fresh fruit and vegetables during their marketing and consumption stages.

Nevertheless, and although the product proves to be interesting and safe for the industry from a technical point of view, it may not be necessarily in line with the attitudes of consumers in the subject. Consumers tend to be cautious when faced with new products and technologies on account of the potential perceived risks, lack of trust in the industry or neophobia – rejection of new things – (Mesias *et al.*, 2021).

Considering all the above, in this study will be addressed the following research questions:

- Which are the perceptions of consumers regarding the use of natural preservatives in fruits?
- Will there be factors that may hinder the acceptance of the natural preservatives in fruits?
- Given the increasing concern on sustainability and the association between the use of natural preservatives and sustainable production, how do various factors, such as organic production, preservative type, geographical origin, and final purchasing price, collectively influence consumer fruit purchase decision?

This analysis could help the industry towards future training and information actions, as well as for the design of policies for producers and distributors in the food supply chain. Although the study may be applicable to all fruits, it was necessary to focus on a specific fruit with the purpose of making it easier for consumers to state their preferences. Therefore, for the purposes of this study the cherry was selected as a highly valuable fruit, on which the application of techniques to attain better preservation without a negative response from consumers, could prove very relevant. Additionally, this fruit has experienced an increase in consumption in the last decades (Rivero *et al.*, 2022) and it is mainly oriented to the export market, where price and demand for quality are higher. Given that this fruit is highly perishable at a commercial level, it is also an excellent example for study of consum-

er preferences of chemical or natural preservatives. Lastly, this product has an important role in the economy of rural areas, given the income it generates and its complementarity with other productions, allowing farmers to diversify their production, thus increasing the profitability of their farms and their continuity (López-Ortega and Frutos-Tomás, 2008).

## 2. Methodology

### 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.

In order to capture diverse perspectives across different age groups and genders, quota sampling for age and sex was used (Futri *et al.*, 2022) according to the last available Spanish demographic criteria (National Institute of Statistic of Spain, 2022). This approach allowed us to explore different nuances in consumers' preferences, ensuring that our findings accurately reflect the diverse attitudes of the general population towards fruit choices.

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 n. 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.

Although a total of 842 questionnaires were received, the final number of valid questionnaires used in this research study was 763, following the exclusion of 79 answers from the

Table 1 - Sociodemographic characteristics of the Spanish population and the sample (%).

		<i>Spain</i>	<i>Sample</i>
<i>Age</i>	18-35 y.o.	24	19
	36-50 y.o.	29	38
	>50 y.o.	47	43
<i>Gender</i>	Female	51	55
	Male	49	45
<i>Family size</i>	1-2	56	37
	3-4	38	55
	5 and more	6	8

final sample (mainly due to incomplete questionnaires or because they did not pass the validation questions used for quality control). Table 2 presents the socio-demographic characteristics of the sample, comparing them with those 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 BCAs (Jaeger and Rose, 2008). Within these tools, choice experiment (CE) is one of the most frequently-used in the area of food, and it has been applied, for example, to analyse consumer preference for meat product packaging formats (Ortiz *et al.*, 2020), new foods obtained from aquaculture (Banovic *et al.*, 2019) or carbon footprint food labelling (Lami *et al.*, 2022).

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

The first step in a CE study is the selection of the attributes and levels that will make up the different cherry 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; Thøgersen *et al.*, 2019; Huang *et al.*, 2021). 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.

Notably, price is a widely-used attribute in CE (Banovic *et al.*, 2019; Carzedda *et al.*, 2021; Vroegindewey *et al.*, 2021) 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 cherry retail prices in Spanish supermarkets, with a low price (5 €/kg) reflecting the cheapest cherries; a second average price (7.5 €/kg); and finally, a third price (10 €/kg) corresponding to the highest-quality cherries, such as organic cherries. In addition to the price attribute,

Table 2 - Attributes and their levels used in the choice experiment.


<i>Attributes</i>	<i>Levels (reference levels are underlined)</i>
Origin	<u>Regional</u> ; Spanish; Imported
Production method	Conventional; <u>Organic</u>
Preservatives	Artificial; Natural; <u>Without preservatives</u>
Price	5€/kg; 7.5€/kg; 10€/kg

which is essential in the consumer's purchasing decision according to demand theory, three other relevant attributes were considered. The first is the production method, differentiating between certified organic and conventionally produced cherries, an attribute repeatedly used by different authors such as (Mesías *et al.*, 2012). Secondly, origin, with the aim of identifying to what extent consumers could have a greater or lesser preference for food produced in a closer environment, which was called regional, as opposed to cherries that may have been produced in other regions or in other producing countries (Giraud *et al.*, 2005). And lastly, a fourth attribute was included that would differentiate the possible types of cherries available for purchase, according to whether or not they had been added preservatives, in accordance with the objectives of this study. Furthermore, many other attributes which have been the focus of research in different countries and for different products, as reported in the recent meta-analysis by (Saija *et al.*, 2023), were discarded.

The total set of hypothetical products that can be created by combining the selected attributes/levels amounts to 54 ( $3 \times 2 \times 3 \times 3$ ), 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 ( $54 \times 53$ ), which is unmanageable in economic and time terms. Therefore, a fractional design is used to reduce the number of comparisons to a manageable level. Finally, six choice sets were created and used for the survey. Table 3 shows an example of a choice set used in this study.

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*

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

Choice set 3			
	<i>Option 1</i>	<i>Option 2</i>	<i>Option 3</i>
<i>Origin</i>	Regional	Spanish	None of these options
<i>Preservatives</i>	Artificial	Natural	
<i>Production method</i>	Conventional	Conventional	
<i>Price</i>	5€/kg	7.5€/kg	
<i>I would buy</i>	( )	( )	( )

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.

**2.3. 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  $\beta'_n$  is the individual-specific vector of coefficients,  $x_{njt}$  is the vector of the observable attributes for individual  $n$ ; and  $\varepsilon_{njt}$  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. The selected reference levels were “Regional” (for attribute Origin), “Organic” (for Production method) and “Without preserva-

tives” (for Preservatives). The econometric specification used in this paper is therefore defined as follows:

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

where  $\beta_0$  relates to the present situation (ASC), i.e., do not purchase either of the two proposed products, and  $\beta_k$  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.

**3. Results and discussion**

**3.1. Level of awareness of the presence of preservatives in tray-packaged fresh fruit**

As Table 4 shows, a very high percentage of the Spanish food consumers interviewed (78.37%) stated they were aware of the use of

Table 4 - Awareness and interest in the presence of natural preservatives (%).

	No	Yes
Are you aware or have you ever heard whether the fruit we eat has added preservatives in order to make them last longer?	21.63	78.37
Have you ever read on the label of plastic tray-packaged fresh fruit whether they contain any kind of preservative?	84.27	15.73
Have you ever bought fruit with natural preservatives?	86.89	13.11
Do you find it interesting for yeasts that are naturally present in fruit and harmless to consumers to be used to control the development of mould?	9.31	90.79
Would you be willing to pay more for the same fruit with natural preservatives?	12.84	87.16

preservatives in fresh fruit in order to increase their shelf life. However, the percentage was much lower when they were asked whether they had read information on the content of preservatives on the label of fresh fruit sold in plastic trays (15.73%), with an even lower percentage of respondents stating that they had bought fruits with natural preservatives (13.11%). These findings are in line with those of (Bouranta *et al.*, 2022) regarding the high appreciation of the labelling of systems implemented by food companies such as the Quality Management System (QMS) or the Food Safety Management System (FSMS). Also, Spaniards showed a high level of trust in food manufacturers, and do not care much about food safety (Kennedy *et al.*, 2008; Bouranta *et al.*, 2022), which can explain why they don't pay much attention to the content of specific information on labels.

It is worth mentioning as well, that on many occasions, no detailed information is provided

on the presence of preservatives in tray-packaged fruit, whether these are chemical or natural.

The above results are in contrast with the stated interest of the majority of consumers (90.79%) for the use of natural preservatives that are harmless to consumers and useful to increase shelf life and consumption of fruit, with also a high percentage of consumers (87.16%) being willing to pay a premium to use these products. The selection of products with less preservatives or with natural preservatives has also been found in a study carried out by (Leyva Salas *et al.*, 2017), where there is a notable increase in demand of natural preservatives, although, at the same time, people are alarmed about food additives in general. Nevertheless, previous studies (Carocho *et al.*, 2014) have also found that natural preservatives are perceived as a healthier option.

We also analysed whether the purchase of fruit with natural preservatives was more common amongst consumers with higher frequency

Table 5 - Association between the frequency of daily fruit consumption and the purchase of fruit with natural preservatives (%).

Fruit consumption frequency per day						
Frequency (%)		Occasional fruit consumers (< 1 piece/day) 14%	Regular fruit consumers (1-2 pieces/day) 46%	Major fruit consumers (> 2 pieces/day) 40%	Total sample	Sig.
Have you ever bought fruit with natural preservatives?	No	3.7	3.7	5.6	4.5	**
	Don't know	87.9	86.3	76.1	82.4	
	Yes	8.4	10.0	18.4	13.1	

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

of fruit consumption, with the outcomes being shown on Table 5, where an association between these two variables can be observed.

### 3.2. Interest in the presence of natural preservatives amongst organic consumers versus non-organic consumers

Given the association between the use of natural preservatives and sustainable production as is the case in organic production, consumers were initially asked about their level of awareness of organic food. Although 88.47% stated they were aware of organic food, 11.53% stated they did not know what this was exactly. It is important to highlight that the sample reflected a yet scarce development of the organic market, with only 10.62% of the respondents stating they were regular consumers (with at least weekly consumption) of organic fruit – hereinafter Organic Consumers –, with the larger percentage (42.46%) being occasional consumers (some frequency) – hereinafter, Occasional Consumers –, or consumers who never eat organic fruit (46.92%) – hereinafter Conventional Consumers –.

The Organic Consumers are middle-age consumers with larger families and women are slightly more predominant. On the other hand, Conventional Consumers include a slightly higher number of young consumers than the other groups, with families of 1 to 2 members, which

may be associated with their age range. Unlike the previous group, this group contains a slight majority of men. Finally, Occasional Consumers are a transition group that is the only group with a clear sex trend (the majority are women). These outcomes are in line with previous research studies, which found that women are more likely to act with moderation when selecting food, as they tend to be more concerned about their appearance (Chambers *et al.*, 2008). Besides, according to (Ragaert *et al.*, 2004; Chambers *et al.*, 2008), large families tend to have healthier eating habits including less processed foods, as the parents feel obliged to set an example for their children. On the other hand, no significant differences were found amongst the groups in terms of income, although (Shuai *et al.*, 2014; Vecchio and Annunziata, 2015) found in their research studies that monthly income is one of the main factors when selecting more sustainable products.

Once consumer groups were defined, Table 6 presents the average ratings granted by the different consumer groups to some statements about interest and willingness to pay for natural preservatives.

Based on the overall results we can conclude that, in response to the first research question, perceptions regarding natural preservatives in fruits are positive amongst all consumers, even though the more frequent the consumption of organic fruit, the higher the level of interest in

Table 6 - Interest and willingness to pay for natural preservatives for the different consumer groups.

<i>Consumer groups according to consumption of organic fruit</i>						
<i>Frequency (%)</i>		Conventional	Occasional	Organic	Total sample	Sig.
<i>Have you ever read on the label of plastic tray-packaged fresh fruit whether they contain any kind of preservative?</i>	No	54.5	48.1	44.4	50.7	*
	No, but I am aware	31.6	36.4	30.9	33.6	
	Yes	14.0	15.4	24.7	15.7	
<i>Have you ever bought fruit with natural preservatives?</i>	No	5.0	3.4	6.2	4.5	*
	Don't know	85.2	80.6	77.8	84.2	
	Yes	9.8	16.0	16.0	13.1	
<i>Would you be willing to pay more for the same fruit with natural preservatives?</i>	No	16.5	9.9	8.6	12.8	**
	Yes	83.5	90.1	91.4	87.2	

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



the information on the use of preservatives and the higher the willingness to pay for the use of natural preservatives in fruit. This change in consumer attitudes is also seen in other studies (Gil *et al.*, 2000; Ragaert *et al.*, 2004), where consumers with healthier habits, like organic ones, were more willing to buy, pay or receive information on natural food and food that is less processed.

### 3.3. Assessment of fruit attributes and food consumer attitudes in the various types of consumers

With the purpose of gaining further insight into consumer profiles, the respondents were asked about the importance they placed on the various

fruit attributes, as well as their food consumption habits, with Table 7 presenting the average ratings granted by the different consumer groups.

Table 7 reveals that flavour and freshness are the factors most highly valued by consumers, followed, in this order, by odour, origin, price, appearance, colour and natural production. In fact, quality indicators have previously proven to be one of the most relevant attributes in the purchase of fruit (Campbell *et al.*, 2013; Moor *et al.*, 2014; Migliore *et al.*, 2015).

Results in Table 7 also show that Organic Consumers are the group conferring the highest value to organoleptic factors such as flavour, freshness, odour, origin or, to a higher extent -as was to be expected-, to the fact that fruits come

Table 7 - Assessment of various fruit attributes and food consumption habits for the different consumer groups.

<i>Consumer groups according to consumption of organic fruit</i>					
	Conventional	Occasional	Organic	Total sample	Sig.
<i>Assessment of fruit attributes (1: Not important a 5: Very important)</i>					
Flavour	4.76	4.82	4.89	4.80	*
Freshness	4.63	4.66	4.79	4.66	*
Appearance	3.73	3.67	3.25	3.65	***
Colour	3.68	3.61	3.42	3.62	**
Odour	3.65	3.78	4.00	3.75	**
Origin	3.40	3.94	4.19	3.71	***
Natural production	2.61	3.73	4.53	3.29	***
Price	3.78	3.63	3.19	3.65	***
<i>Attitudes and food consumption habits (1: Totally Disagree a 5: Totally Agree)</i>					
I am concerned about how my diet can impact my health	4.37	4.57	4.77	4.50	***
I like to try new recipes/ food	4.15	4.32	4.41	4.25	**
I am interested in having information relating to food	4.00	4.28	4.62	4.19	***
I frequently eat fruit and vegetables	4.37	4.56	4.63	4.48	**
I frequently eat out	2.55	2.56	2.41	2.54	n.s
I tend to have a diet that contains little meat	2.83	3.18	3.40	3.04	***
I value sustainable production (lower environmental impact)	2.92	3.63	4.25	3.36	***
My lifestyle is healthy	3.70	3.88	4.11	3.82	***
Price is a determining factor for me when buying food	3.77	3.47	2.77	3.53	***

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

from natural production systems. They are also the least concerned about appearance, colour or price of the products, with these aspects being the most valued by the Conventional Consumers group. (Ragaert *et al.*, 2004) found in a study on the perception and selection by consumers of minimally-transformed packaged vegetables and fruit that conventional buyers were the least interested in flavour and information relating to the food product, coincidentally with our study. On another line, price is usually a determining factor when purchasing food (Campbell *et al.*, 2013; Eldesouky *et al.*, 2020a).

Once again, in terms of attitudes and consumer habits toward food, it seems very relevant that the Organic Consumer group is the one conferring the highest importance to the factors above mentioned, except for price, for which this group was again confirmed to be less price sensitive. Price limitations (potential rejection of excessively high prices) and preference for natural preservatives versus artificial preservatives have been highlighted in the article written by (Carocho *et al.*, 2015) where health is the main reason for this behaviour.

Women have also been identified to be the segment placing the highest importance on appearance and organoleptic attributes, also giving higher scores in the attitudes and consumer habits under study. This finding could be associated with the fact that women are usually in charge of food purchasing in the household or because, as we mentioned earlier on, women tend to pay more attention to the food they select and maintain healthier lifestyles due to their higher concern for physical appearance (Chambers *et al.*, 2008). Price differences, however, are not significant between sexes.

In terms of age, although the differences are less significant, the trend has been that with the increase in age, the importance given to such attributes also increases, except in the case of price, where young people place higher importance on price. These outcomes are in line with those of (Chambers *et al.*, 2008), who conclude that young people are less likely to eat healthily due to lack of time, and moreover they don't use labelling to find out information on a regular basis.

### 3.4. Choice Experiment

Table 8 presents the outcomes of the Choice Experiment for the entire sample. The sign of the estimated coefficients shows whether the presence of the level of an attribute adds (plus sign) or subtracts (minus sign) utility for consumers to or from the reference level of that attribute. As the methodology section states, the reference levels have a null utility assigned.

As Table 8 shows, all the coefficients were very significant. 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. The marginal utility that imported and national cherries provide is negative, which shows a lack of interest for these levels in comparison to the others. This outcome fell within the expected figures, as preference for local products had already been identified in various studies such as those of (Feldmann and Hamm, 2014; Meyerding *et al.*, 2018). Additionally, (Stefani *et al.*, 2012) found that one of the main drivers of preferences and attitudes in consumers towards food is the country of origin.

Also (Aytop and Çankaya, 2022) have found that consumers relate foods with geographical indication (GI) as "healthier", "higher quality", and "more reliable" and that they are willing to pay more for them, thus highlighting the importance of the origin of the food they purchase. Both regional origin and GI food products are often deeply rooted in the cultural identity of a specific area. Consumers may therefore value the authenticity and traditional production methods associated with these products, making them more appealing.

The minus sign before the coefficient of the artificial and natural preservatives reveals a greater preference for cherries without preservatives. This result is coherent with other studies that have proven that consumers are nowadays better informed on the food additives and tend to select natural additives against synthetic products (Devcich *et al.*, 2007; Bearth *et al.*, 2014). However, the lower value of the negative coefficient for natural preservatives – compared to cherries without preservatives – shows a smaller prefer-

Table 8 - Outcomes from the choice model for the global sample.

<i>Level of the attribute</i>	<i>Estimate</i>	<i>Std Error</i>	<i>Sig</i>
Origin [Imported]	-2.1864	0.0579	***
Origin [Spanish]	-0.2521	0.0429	***
Preservatives [Artificial]	-3.3540	0.0574	***
Preservatives [Natural]	-0.5568	0.0470	***
Production [Conventional]	-0.6822	0.0312	***
Price	-0.5263	0.0215	***
No Choice Indicator	-3.3695	0.1488	***

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

ence gap between these two options, which is likely to grow due to the increasing importance given to sustainable development (De Magistris and Gracia, 2016).

However, despite the positive perceptions regarding natural preservatives, these are not translated into actual purchases, which answers to the second question related to possible existing factors that may hinder the acceptance of natural preservatives in fruits.

In terms of the production method, organic production appears to be preferred over conventional production, a trend that has been quite common in various studies (Gil and Soler, 2006; Ureña *et al.*, 2008). And, lastly, as was to be expected, price shows a minus sign, which implies that consumers tend to have a negative attitude towards price increases, a common finding in consumer research studies.

Therefore, in response to the third research,

question we can conclude that all the attributes used in the choice experiment influence consumers' fruit purchasing decisions. Overall, the sample has a stronger preference for sustainable attributes,

### 3.5. Preferences by consumer group

The Choice Experiment, applied to each group of consumers, allowed to discover various patterns of preference for fruit. Table 9 shows outcomes of the Choice Model for each type of consumer.

The three groups show similar behaviours, although the intensity of preference varies. Organic Consumers have a more intense behaviour towards attributes relating to sustainability, for example, lower preference for imported cherries, or a much more intense negative preference for artificial preservatives or conventional production.

A strong preference for products without preservatives was also found in a study carried out

Table 9 - Outcomes of the Choice Experiment for each type of consumer.

	<i>Consumer group according to organic fruit consumption</i>					
	<i>Conventional</i>		<i>Occasional</i>		<i>Organic</i>	
<i>Term</i>	<i>Estimate</i>	<i>Std Error</i>	<i>Estimate</i>	<i>Std Error</i>	<i>Estimate</i>	<i>Std Error</i>
Origin [Imported]	-1.370***	0.056	-2.063***	0.0644	-2.682***	0.137
Origin [Spanish]	-0.124***	0.046	-0.236***	0.0478	-0.328***	0.102
Preservatives [Artificial]	-2.459***	0.055	-3.311***	0.0634	-3.738***	0.143
Preservatives [Natural]	-0.910***	0.047	-0.658***	0.0521	-0.180***	0.114
Production [Conventional]	-0.037 n.s.	0.033	-0.610***	0.034	-1.108***	0.079
Price	-0.727***	0.023	-0.577***	0.024	-0.313***	0.050
No Choice Indicator	-4.812***	0.156	-3.777***	0.167	-1.630***	0.349

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

by (Gil *et al.*, 2000), where all the consumer groups, both organic and conventional, preferred and were willing to pay more for food without preservatives.

On the other hand, Conventional Consumers do not differentiate between organic and conventional production and they are the most price-sensitive segment, which makes sense, given that conventional products are usually offered at lower prices. These outcomes are in line with those of other research projects such as that of (Mesías *et al.*, 2011; Sama *et al.*, 2018), where the consumers that were most price-sensitive were also less inclined to choose organic production.

### 3.6. Willingness to pay

When price is included in a research study on stated preferences, it is possible to estimate consumer willingness to pay (WTP) per attribute level. Given that a preference level has been established, WTP must be understood here as the difference in euros/kg between what the consumer is willing to pay for a kilo of cherries with a specific level in comparison to the reference level. Table 10 reveals the outcomes of WTP for the various levels of the attributes.

Table 10 shows consumer willingness to pay (WTP) estimates for the product under study, the cherry, depending on whether it presents certain levels of the attributes considered. In addition, the results corresponding to the three consumer segments described (conventional food consumers, occasional organic consumers, frequent organic consumers) are presented in different columns.

Thus, and starting with the preference for

cherries of regional origin over imported cherries, it can be seen that organic consumers have the highest positive WTP – indicating a greater preference –. This would mean, using the data obtained (+8.58), that if the purchase price were, for example, 4 euros/kg for imported cherries, they would be willing to pay up to 12.58 euros for a basket of cherries of regional origin.

This gap in WTP is significantly reduced in all groups – including the eco-consumer segment – when regional vs. Spanish cherries (thus produced at a greater distance but in other Spanish regions) are compared. The estimated data would indicate that, if a basket of cherries of regional origin cost, for example, only 0.17 euros/kg more than one of Spanish origin, it would lead to the group of “conventional consumers” being indifferent to the purchase of both product options.

Similarly, in the comparison of cherries with “artificial preservatives” vs. “no preservatives”, the former is the option with the lowest preference in all consumer segments, although it is again the group of organic regular consumers where this WTP for food without preservatives is highest. Perhaps not as expected is the result achieved in the comparison of cherries with “natural preservatives” vs. “without preservatives”, where, although the latter option is again preferred, the group of organic consumers has the lowest willingness to pay and is therefore the most willing to purchase the fruit with natural preservatives.

Finally, there is a higher positive WTP for organic cherries – compared to conventional ones – in both segments of organic consumers (either

Table 10 - WTP (€/kg) for the various levels of the attributes included in this study.

		<i>Consumer groups according to organic fruit consumption</i>			
		<i>Conventional</i>	<i>Occasional</i>	<i>Organic</i>	<i>Total</i>
Origin	Regional vs Imported	+1.89	+3.58	+8.58	+4.15
	Regional vs Spanish	+0.17	+0.41	+1.05	+0.48
Preservatives	Without Preservatives vs Artificial	+3.38	+5.74	+11.95	+6.37
	Without Preservatives vs Natural	+1.25	+1.14	+0.58	+1.06
Production	Organic vs Conventional	n.s.	+1.06	+3.54	+1.30

*n.s.*: non-significant.

occasional or frequent), whereas conventional consumers are indifferent to organic production.

Although some research studies have found that consumer behaviour is not consistent with their opinions, especially in terms of social, ethical or environmental attributes (Vermeir and Verbeke, 2006), this research study has found the segment that is most willing to pay is Organic Consumers, who showed much more sustainable consumption attitudes and habits. Besides, the highest willingness to pay is related to a reduction in chemical preservatives, which derives from the perception of the consumer that avoiding these products prevents health issues (Grolleau *et al.*, 2009).

#### 4. Conclusions

This research study is set within the current context of increased fruit consumption, which generates enormous ethical, social and environmental issues due to the spoilage these products suffer along the food chain. This issue, which food industry has traditionally attempted to solve with the use of artificial chemical preservatives, clashes with an increasing consumer demand for more natural and healthier food with no negative effects on health, such as those attributed to chemical additives used in modern diets.

In this sense, the use of natural preservatives could prove to satisfy the needs of both stakeholders. Nevertheless, and even though consumers in this study have revealed a very positive behaviour towards natural preservatives, a weaker preference has been seen in comparison to fruits without preservatives.

This result suggests that, in general, citizens in developed societies want to ensure the maximum shelf life for the food they consume, an issue linked to current shopping and living habits. But it also shows that, although many consumers express a preference for the use of natural preservatives, they do not seem to be willing to pay the price premium that would result from replacing current chemical preservatives with more natural or harmless preservatives. All this shows the importance of consumer education and information, which could increase aware-

ness and preference towards food without chemical additives, even if this would mean a shorter shelf life of fresh produce.

Frequent consumers of organic food would be the group with the greatest potential for developing the use of natural preservatives, since although it has been observed that this is the segment that most prefers local foods, it is also the one that is most willing to pay for the replacement of artificial preservatives by others that are more environmentally and health friendly.

Hence, any actions purporting to promote awareness of natural preservatives, both in terms of their characteristics and recognition at the time of shopping, can have a heavy impact on their acceptance and a positive influence on WTP the necessary price for these quality food products. Price continues to be the transcendent variable affecting consumer decision to purchase, and therefore the industry must always take into account the limitation of prices in order to avoid overpricing.

In spite of this, the consumer positive attitudes and perceptions towards the more sustainable attributes and their willingness to pay for them generally show once again the increasing concern and participation of consumers in sustainability.

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