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“HydroSOStainable” Concept: How Does Information Influence Consumer Expectations towards Roasted Almonds?

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Abstract: Water scarcity is one of the top five key global risks over the last years, and agriculture is the major and least efficient user of fresh water. In this scenario, the “hydroSOStainable” concept has been developed and registered to protect fruits and vegetables cultivated with a volume of water below the crop evapotranspiration. The purpose of this experimental study was to investigate how the information influence the consumer liking and preference of the roasting almonds labelled as “hydroSOStainable” and “conventional”, although belonged to the same sample. Thus, we explored 300 consumers (Seville, Spain (high levels of water stress) versus Donostia, Spain and Wrocław, Poland (regions with no water stress)) preference and acceptance of roasted almonds using satisfaction degree, CATA and willingness to pay questions. The present study demonstrated that both location and sociodemographic aspects influenced consumers perception and liking. Consumers living in areas with water restrictions were more susceptible to be influenced by the hydroSOStainable/conventional concept, while consumers from regions without water restrictions would need more information to choose a sustainable product. Both man and women, centennials and millennials scored higher the supposed hydroSOStainable almonds, while generation X was not really influenced by the information effect. Finally, 77% of consumers, regardless of location, were willing to pay a higher price for the almonds labelled “hydroSOStainable”. Consequently, these results provide valuable information for the government and food industry about consumer choice regarding sustainable products, depending on the location, knowledge, and sociodemographic aspects.

Keywords: water scarcity; sustainability; consumers; sensory analysis; cross-culture comparison; centennials; millennials; generation X; food choice

1. Introduction

Almond (*Prunus dulcis* (Mill.) D.A. Webb) is the major tree nut crop in Spain, this country being the top producer of almonds in Europe and the second-largest producer

worldwide, after the United States of America (USA). According to Food and Agricultural Organization of the United Nations, the area covered with almonds trees in Spain (657768 ha) was in 2018, 1.5-fold higher than United States of America (USA 441107 ha); however, USA produces 4.5-fold more almonds than Spain [1]. This occurs because almond crop in Spain has been mainly grown traditionally in marginal lands under rainfed conditions [2]. Thus, recently, the almond cultivated surface has increased, especially in irrigated areas previously occupied by other crops, in order to achieve yield intensification. The main reason behind it is because almonds are an economically and nutritionally valuable agricultural goods, widely consumed in the Mediterranean diet; thus, the higher demand and the relevant increases in prices, between 6.0 and 8.5 € kg⁻¹ during 2014–2016 and stabilized at ~6 € kg⁻¹ farmer price after 2016 [3,4] were the main reason to introduce the irrigation methods.

However, climate change together with the drastic growth of population and consequently food demand has led to an increase in water stress all over the world. For instance, a rise in population to 9 billion is predicted and subsequently a growth in food production needs (~60%) will be expected by 2050; thus, the access to fresh water is seriously jeopardized [5,6]. Water scarcity is one of the top five key global risks over the last years, and irrigated agriculture is the main user by consuming more than 70% of the available fresh water worldwide [7,8]. Irrigation water restrictions in south-eastern Spain are reaching dramatic levels, having a negative impact on traditional crops and leading to land abandonment in rural areas [9]. In this scenario, many studies have been reported the urgent need to improve irrigation water use efficiency by adopting controlled deficit irrigation (CDI) strategies [10,11]. Using these strategies, a controlled water stress is created in plants which leads to increase accumulation of carbon secondary metabolites in plants and bioactive compounds in fruits [12]. Fruits generated under CDI conditions are called “hydroSOSustainable” products, indicating that they are environmentally friendly and water saving products, characterized by a higher nutritional, functional, and sensory quality [13–15]. The “hydroSOSustainable” concept has been developed in Spain and registered since 2017 (M3647842(3)) in the Spanish Patent and Trademark Office by the Universidad Miguel Hernández and Gálvez Productos Agroquímicos, S.L., to protect fruits and vegetables cultivated under controlled deficit irrigation conditions [16]. According to the scientific literature, this concept is mainly related to a proper management of irrigation water; and the drought resistant fruits and vegetables species which might improve the water sustainability if an accurate irrigation management is applied [10]. In this sense, a lot of work has been done in almond crop [17–19], as well as in pistachio [20], olives [21], pomegranate [22], mango [23], avocado [24], tomatoes [25], etc. All these manuscripts clearly presented outputs about an increase in the sensory properties, as well as of polyunsaturated fatty acids, polyphenols, phytoosterols, phytofuranos, volatile compounds, minerals, sugars, lycopene, fiber, etc., in the products cultivated under controlled water stress conditions, or “hydroSOSustainable” products. The increase in these phytochemicals was related to the stress levels, and defense mechanism action of the plant; for instance, the plants polyphenols are enhanced by the water stress in agreement with their role as plant molecules against biotic and abiotic stress, because when the carbohydrates exceed the amount used for the plant growing, the excess of CO₂ assimilated under stressing conditions is used for the biosynthesis of carbon-based secondary metabolites [26,27].

Nowadays, society requires the incorporation of a sustainable plan for food supply and consequently the European Commission is working on a document dedicated to food system sustainability because its policy presents some gaps on this regard [8,28]. Studying the consumers’ behavior by using sensory analysis technics is essential not only to understand their preference and satisfaction degree but also to know their opinion on sustainable actions towards managing water scarcity [8,28]. It was reported that consumers are now more aware than ever about healthy diets and environmental protection, and they are even willing to pay more for eco-friendly and “hydroSOSustainable” products [4,20,29].

A different impact on consumer preference, satisfaction degree and/or attitude towards food supply and its sustainability is expected for different groups of consumers, depending on their profiles (gender, economic status, age generation) [29,30]. Generation is a group of people born in the same time span and the current consumer society consists of three main generations: (i) *generation X*, born between 1960–1979, (ii) *generation Y* or millennials, born between 1980–1995, and (iii) *generation Z* or centennials, born between 1996–2001 [29]. For instance, *generation X* are self-confident, independent, and mistrustful of institutions, and are more sophisticated in their buying habits appearing not interested on slick and generalized promotions [30]. On the other hand, millennials, the most educated generation, have been identified as an important consumer group and are used to provide indicators for future trends in brand purchase and their opinion is highly relevant to many companies [29,30]. Finally, centennials represents the consumers of the future and their purchasing behavior might be urgently analyzed in both online and offline contexts [29]. Scientific literature has paid little attention to consumers perception on the hydro-sustainability concept as well as the understanding of its influence on hedonic expectations.

Based on the above considerations, the aim of this work was to assess (i) the influence of the information (“hydroSOStainable” vs. “conventional”) on consumers liking and preference in 3 locations with different water restrictions and, (ii) whether the sociodemographic factors make any differences on consumers liking between “hydroSOStainable” and “conventional” roasted almonds.

2. Materials and Methods

2.1. Samples

Almonds were cultivated in the commercial farm “La Florida”, located in Dos Hermanas (Seville, Spain) and harvested in the 2019 season. After harvest, the almonds were naturally dried until a moisture content below 5% was obtained. Later, in-shell almonds were sent to Miguel Hernández University for roasting and affective tests.

Only one single almond treatment was used in the current study; this is, only fully irrigated almonds or “conventional” were considered for this study. However, these same almonds were presented to consumers under two labels: (i) “conventional” and (ii) “hydroSOStainable”. In this way, almonds were homogeneous, and the consumers’ opinion was based only in the information received about “conventional” and “hydroSOStainable” systems which included quality, health, and environmental aspects.

2.2. Roasting Process of Almonds

“Conventional” almonds with similar size (length = 25 mm; width = 15 mm; thickness = 9 mm) and moisture content (2.3%) were selected to have a uniform material for the roasting process. Roasting conditions were chosen based on preliminary study in which consumers decided that almonds roasted at 170 °C during 10 min were the most appreciated [31]. Thus, almonds (batches of 200 g) were roasted in one layer at 170 °C during 10 min in a hot-air circulation drying oven model My Chef (Distform, Lleida, Spain), equipped with temperature probes to measure the air temperature inside the roasting chamber. Once the heating treatment was completed, roasted almonds were immediately cooled to 50 °C, and then, they were removed and left to cool down until room temperature was achieved (25 ± 2 °C). Roasted almonds were vacuum sealed and kept at 4 °C until sensory analysis.

2.3. Location and Participants

Consumers from different regions with and without water restrictions were recruited. Seville located in southwest of Spain is an area with low rainfall and extremely high levels of water stress what lead to high irrigation water restrictions [32]. The opposite happens in Donostia/San Sebastián (Spain), a northern city in Spain, and Wrocław, a western city in Poland, locations with no water scarcity issues respectively according to World Resources

Institute [32,33]. Thus, the main reason to choose these 2 locations in Spain was that Andalusia and Basque Autonomous Community are two regions in Spain with a totally different climate with low- and high-water availability, respectively. Additionally, this study was extended to another country, Poland, as a model of Central European consumers located in an area with no water restrictions. In this sense, the initial hypothesis was that consumers from Andalusia will be more influenced by “hydroSOStainable” concept. Consumers, belonging to different generations such as generation Z or centennials (born between 1995–2009), generation Y or millennials (born between 1982–2000) and generation X (born between 1961–1981) was also considered within the present study (Figure 1), to check if the different characteristics of each group might influence in the consumer liking and satisfaction degree of almonds.

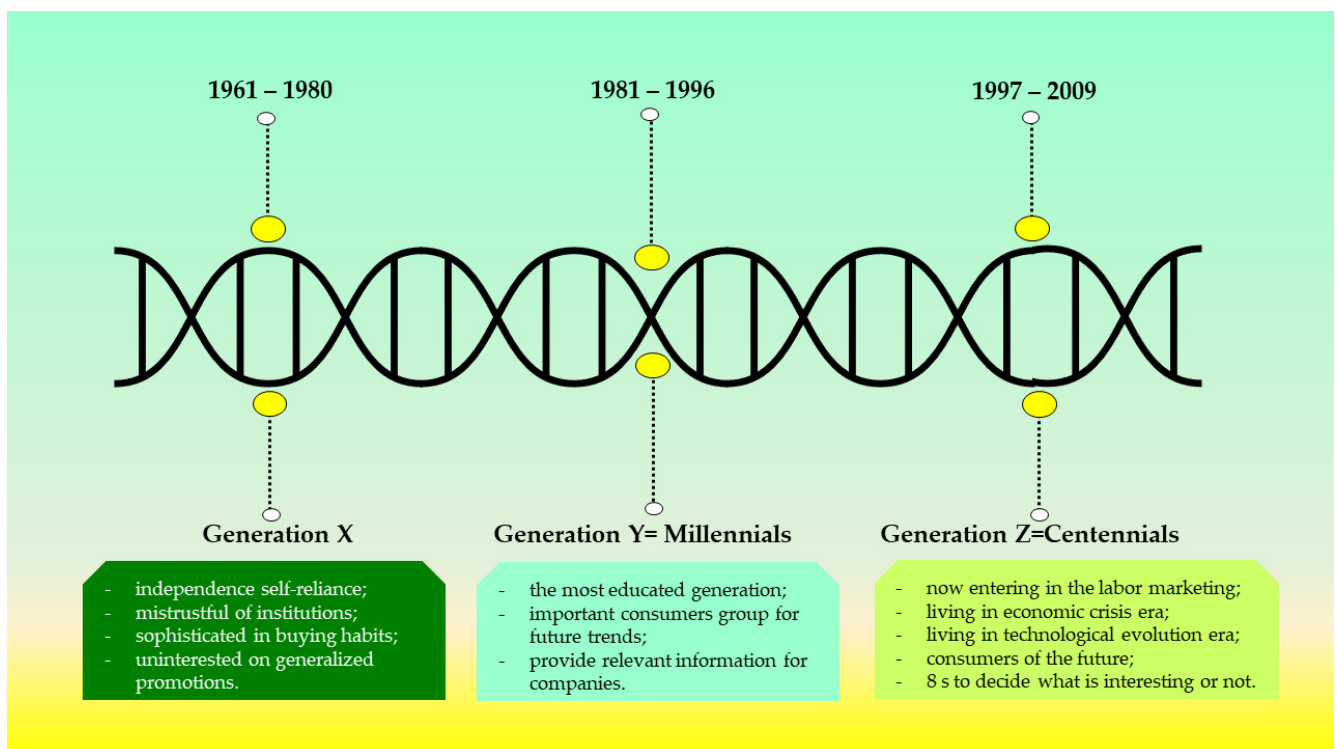


Figure 1. Different generation groups characteristics according to the scientific literature [30,31,34,35].

Consequently, a total of 300 consumers were assessed, with the following profile:

- 100 consumers from Wrocław (Poland) of which 17% were male and 83% female with age ranges 18–23 (41%), 24–39 (43%) and 40–59 (16%);
- 100 consumers from Seville (Spain) of which 54% were male and 46% female with ages 18–23 (48%), 24–39 (23%) and 40–59 (29%); and,
- 100 consumers from Donostia (Spain) of which 61% were male and 39% female with age ranges 18–23 (60%), 24–39 (35%) and 40–59 (5%).

The nut frequency consumption was as follows: (i) Wrocław: 9% daily, 31% several times a week, 25% once a week, 28% couple times a month and 7% once per month; (ii) Seville: 11% daily, 60% several times a week, 17% once a week, 11% couple times a month and 1% once per month; and (iii) Donostia: 10% daily, 44% several times a week, 27% once a week, 14% couple times a month and 5% once per month. Individuals who suffered from nuts allergies and those with a frequency of nut consumption lower than once per month were not involved in the study.

2.4. Procedure

2.4.1. Consumer Test

The experiment took place in two countries Poland (Wrocław) and Spain (Seville and Donostia) and was performed in three locations for 3 weeks. The studies were completed in the morning (9:00–13:00) at the sensory laboratories of Wrocław University of Environmental and Life Sciences, Universidad de Seville, and Mondragon Unibersitateea (Basque Culinary Center), which are designed according to ISO guidelines (ISO 8589).

The tests were carried out in individual booths and using a randomized block design. Consumers were provided with two samples of the same roasted almonds, one labelled “hydroSOSustainable” and the other “conventional”, although in fact it was the same exact product. The samples were served in biodegradable cups in which three roasted almonds per samples were placed. Before they started, an informed consent on the consumer study was read and signed by each consumer, followed by information about what the “conventional” and “hydroSOSustainable” almonds are and which are the health and environmental benefits of consuming these products. The “hydroSOSustainable” term has been registered (M3647842(3)) in the Spanish Patent and Trademark Office in January 2017 by the Universidad Miguel Hernández and Gálvez Productos Agroquímicos, S.L., to protect fruits and vegetables grown using deficit irrigation strategies also known to save irrigation water [16]. The purpose of the “hydroSOSustainable” concept refers on the one hand (i) to the use of plant phenology knowledge, to reduce the water in a certain moment of the growing cycle when the plant is less sensitive to water stress; or (ii) to apply a uniform volume of irrigation water along the season, but below the plant water requirements (crop evapotranspiration). In this sense, authors reported that the irrigation water can be reduced, without a detriment on the yield, and enhancing the nutritional, functional and sensorial quality of the “hydroSOSustainable” fruits [23,29,36,37]. As the “hydroSOSustainable” concept is relatively new, this is not already known by consumers, either from Spain or Poland. For this reason, a flyer with information on the meaning of “conventional” and “hydroSOSustainable” concepts was given to all participants prior to almonds tasting. Once everyone understood the two concepts under study, they started the test, 50% of the consumers started with “conventional” roasted almonds and the other 50% with the “hydroSOSustainable” ones, to avoid biased results due to order presentation. In the consumer willingness to pay section, they were given a commercial price for “conventional” roasted almonds obtained from popular supermarket (Carrefour) [3,11] € in Spain and 20 Polish złoty (4.40 €) per 200 g of roasted almonds] and 5 options to pay for the “hydroSOSustainable” roasted almonds.

2.4.2. Questionnaire

Two scales and sociodemographic questions have been used to evaluate the consumer behavior. The questionnaire initiated with a preference question (“Please taste these 2 samples and indicate which was the sample that you liked the most”), followed by a question about the reasons to choose that specific sample as the best one (due to the color, sweetness, flavor, crispiness, etc.) by using a Check All That Apply (CATA) question. Next, the participants were asked to score each sample, first from an overall point of view, and later, to score each sensory parameter from the three complex sensory properties (appearance, flavor, and texture). A 9-point hedonic scale was used to rate consumer liking (1 = dislike extremely; 5 = neither like nor dislike; 9 = like extremely). A question about purchase intent was placed at the end of each sample (“Would you buy this product?”). Finally, the questionnaire ended with demographic queries concerning gender, age, frequency of nut/almond consumption, education, employment, family monthly income and their willingness to pay for “hydroSOSustainable” roasted almonds. A CATA question about which are the most important parameters when purchasing this type of products (organic, healthy, sustainable, etc.) was also included in the questionnaire. Back translation from English to Spanish and Polish and contrariwise of the questionnaire was done to avoid artifacts due to language significance.

2.5. Statistical Analysis

Data was analyzed applying two-way analysis of variance (ANOVA), using “concept effect” and “location” as factors and one-way ANOVA to check the influence of sociodemographic factors on consumer liking between “conventional” and “hydroSOStainable” labelled roasted almonds. Tukey’s HSD (honestly significant difference) multiple range test was also carried out to determine if the relationship between samples is statistically significant ($p < 0.05$). For the CATA terms a correspondence analysis was performed using Friedman’s test in which data were subjected to nonparametric tests, comparison of K samples. Additionally, Cochran’s Q-test was used to find significant differences between alternatives within factors ($p < 0.05$). Finally, Levene’s and Bartlett tests were run to check the variance homogeneity; the data was run using parametric tests, k-sample comparison of variance. All the statistical analyses were performed using XLSTAT Premium 2016 (Addinsoft Inc., New York, NY, USA), while Sigma Plot 11 software was used for figures preparation.

3. Results and Discussion

3.1. Consumers Overall Liking and Satisfaction Degree of Roasted Almonds Influenced by “Conventional” and “HydroSOStainable” Systems Information and Location

Consumers were significantly influenced by the information, and they scored significantly higher both the overall liking and the satisfaction degree for all sensory attributes of “hydroSOStainable” coded almonds (Table 1). A significant difference in liking was also observed between locations, where consumers from Wrocław scored the almonds higher than those from both Spanish locations. Similar results were also reported in a previous study in which Romanian consumers tended to score higher than Spanish ones [8]. These differences in scoring among locations might be due to (i) the applicability of 9-point hedonic scale because its success has not been studied in other languages (e.g., Polish) as much as has been done in English, or (ii) because Polish consumers might consider almonds as a fancy nut associated with favorable food and lifestyle choices [33]. Previously it was reported that this 9-point hedonic scale is reliable and has a high stability of response, which is independent of regions and panel size [34]. To verify that the results were not a consequence of the scale use in different countries, the analysis data were normalized, and the same results were obtained. Finally, when the interaction between concept effect and location was considered, only consumers from Seville (those with severe irrigation water restrictions) were influenced by the “hydroSOStainable” information; they scored significantly higher the almonds coded with this label. On the other hand, no differences were observed for Polish and northern Spanish consumers (those with no irrigation water limitations). Similar results were reported by authors working with table olives, which concluded that the “hydroSOStainable” logo caused a clear effect on consumer overall liking and green-olive flavor perception, increasing these attributes with 1.1 and 1.3 units, respectively, compared to the control samples [35]. Consumers from the Valencian Community (Spain), a region with extremely severe water restrictions, were also influenced by the logo effect as reported by other authors [20]. These consumers scored higher overall liking and satisfaction degree for saltiness and crunchiness of “hydroSOStainable” pistachios than those from Galicia (area with high water availability). As observed the “hydroSOStainable” concept influenced the roasted almonds acceptability on those consumers with limited water resources but not as much for those with no water scarcity issues. In general, literature mainly focused on consumer behavior regarding recycling and energy saving but, limited research has specifically addressed to consumer opinion about water consumption and sustainability. These existing studies are mainly focused on areas where water supply is scarce, rather than in areas with no water scarcity problems. Considering that water scarcity affects each continent and the situation is changing very fast, which means that those areas with no water restrictions now can be affected and suffer risks in a very close future [36], studied on consumer behavior and choice with regard to hydro sustainable products are required. For instance, it has been reported that the perception of Welsh consumers was

that water was an endless resource and stated that there is a lot of water in Wales and found meaningless being worried about water consumption [36]. It has also been reported that most consumers have an unrealistic assessment of the total water consumption they spent, mainly neglecting the water consumed in the process of the production chain [36,37]. Thus, the present results showed that consumers from areas with water scarcity may be more aware of the importance of water and its sustainable use, while consumers from areas without water limitations might require more information to reach a rational choice regarding their water saving behavior.

Table 1. Overall liking and satisfaction degree of roasted almonds influenced by information effect and location.

	Liking	Color	Sweetness	Bitterness	Roasted	Aftertaste	Hardness	Crispiness
ANOVA Test †								
Information effect	***	***	***	***	***	***	***	***
Location	***	***	***	***	***	***	***	***
Information effect × Location	***	***	***	***	***	***	***	***
Tukey Multiple Range Test ‡								
Information effect								
“conventional”	7.1b	6.9b	6.4b	6.0b	7.1b	6.5b	7.0b	7.1b
“hydroSOStainable”	7.4a	7.3a	6.9a	6.5a	7.4a	7.1a	7.3a	7.3a
Location								
Wroclaw	7.6a	7.8a	7.0a	6.9a	7.7a	7.3a	7.6a	7.7a
Sevilla	7.3b	6.9b	6.6b	6.1b	7.2b	6.8b	6.9b	7.1b
Donostia	6.9c	6.7b	6.0c	5.8b	6.9c	6.4c	6.7b	6.8c
Information effect × Location								
“conventional” × Wroclaw	7.6a	7.6a	6.9a	6.7ab	7.7a	7.1a	7.6a	7.7a
“hydroSOStainable” × Wroclaw	7.7a	7.9a	7.2a	7.2a	7.7a	7.5a	7.6a	7.8a
“conventional” × Sevilla	7.0b	6.7bc	6.1b	5.8d	6.9b	6.2b	6.5c	6.8b
“hydroSOStainable” × Sevilla	7.7a	7.1b	7.2a	6.3bc	7.6a	7.4a	7.3ab	7.5a
“conventional” × Donostia	6.8b	6.5c	6.1b	5.6d	6.8b	6.3b	6.6c	6.7b
“hydroSOStainable” × Donostia	6.9b	6.9b	6.0b	5.9cd	6.9b	6.5b	6.8bc	6.84b

†, *** = significant at $p < 0.001$. ‡ Values followed by the same letter, within the same column and factor (information effect and location), were not significantly different ($p > 0.05$), according to Tukey’s least significant difference test. Wroclaw city of Poland, Sevilla and Donostia cities of Spain, with and without water scarcity, respectively.

3.2. Purchase Intent and Samples Preference

Consumers were also asked about their purchase intent, preference, reasons behind their preference and about the most important factors when purchasing this type of products. As observed (Figure 2A), the purchase intent between “conventional” and “hydroSOStainable” was always higher for “hydroSOStainable” samples as compared to control ones, with increases of 11 and 3% for Polish and Spanish (Seville and Donostia) consumers, respectively. Besides, it is important to highlight that most of the consumers liked almonds and showed their intention of buying them (mean of all treatments and locations of 90%); these high values make difficult to see a big differences among treatments.

However, in the sample preference question (Figure 2B), the “hydroSOStainable” almonds were clearly more appreciated by a larger percentage of consumers in all three locations; “hydroSOStainable” roasted almonds were preferred by ~68% of the international consumers as compared to 32% for the “conventional” samples.

Regarding the reason to choose the “hydroSOStainable” roasted almonds as the most liked (Figure 2C), all three locations agreed in supporting their selection on the following attributes: sweetness, almond-toasted flavor, crispiness and hydroSOStainability. Similar results were previously reported in a different study (blind test) where 3 “hydroSOStainable” treatments and one “conventional” of raw almonds were compared. The authors reported that both Spanish and Romanian consumers chose the “hydroSOStainable” sample as the most liked sample among four irrigation treatments, with sweetness, almond flavor and crispiness being the determinant attributes in their election [8]. In the present study, both “conventional” and “hydroSOStainable” samples in fact belonged to the same sample, this means that “hydroSOStainable” concept information determine the consumers to choose these attributes.

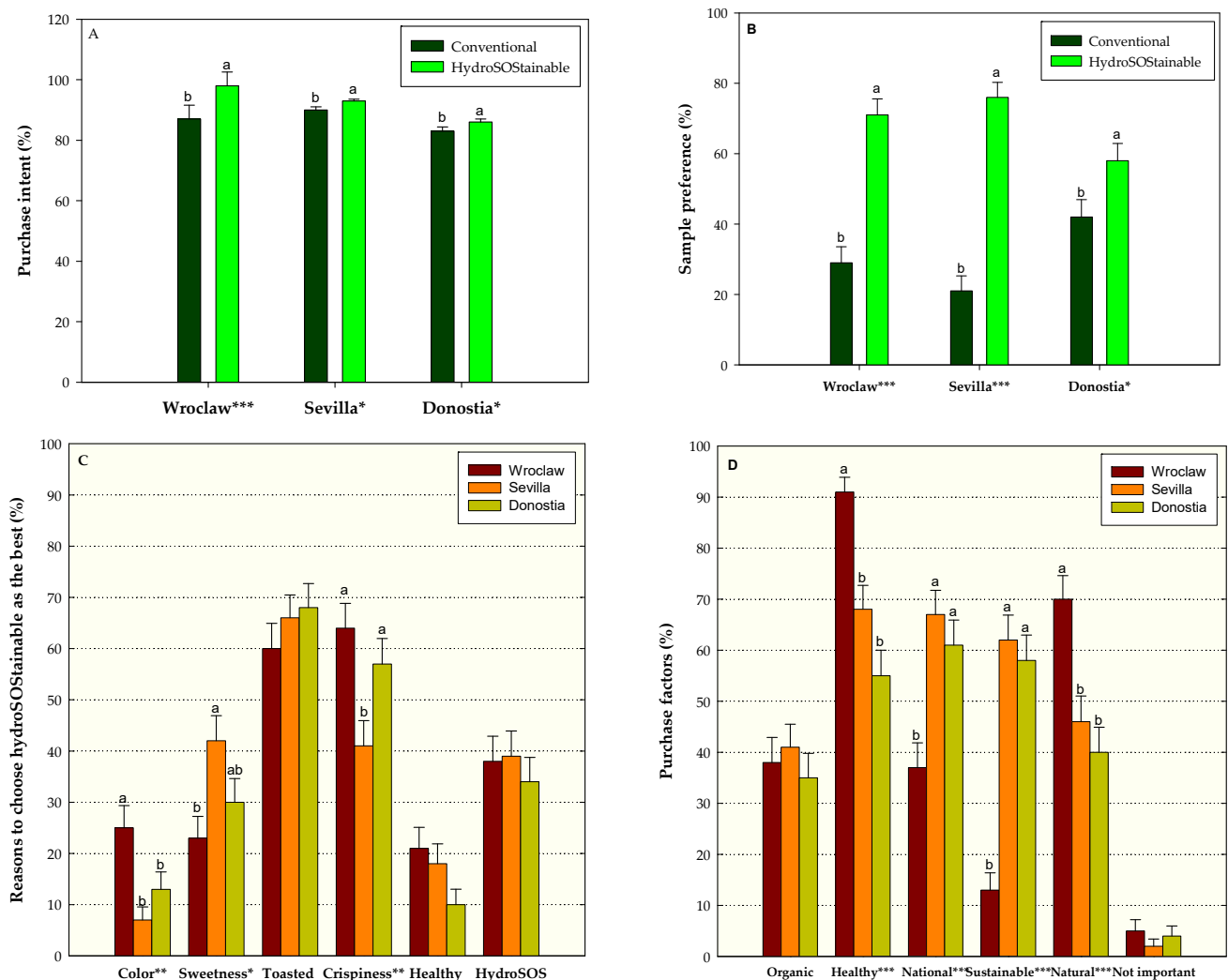


Figure 2. Purchase intent (A), sample preference (B), consumer reason to choose “hydroSOStainable” almonds as the favorite ones (C) and consumer purchase factors during grocery (D) in each location. Note: *, **, and *** significant at $p < 0.05$, 0.01 , and 0.001 , respectively. Group bars without letters and followed by the same letter, within the same bar and factor, were not significantly different ($p > 0.05$), according to Cochran’s Q-test.

Finally, data on the main buying-drivers are shown in Figure 2D. Polish consumers buy almonds and nuts thinking that they are mainly “healthy” and “natural”. For southern Spanish consumers, the most important factors are “national product” and “sustainable”, although a similar percentage also chose “healthy” attribute. As observed, Seville is the location with the highest percentage of consumers interested on “sustainable” aspect (62%). This may be one of the reasons why they were the most influenced by the “hydroSOStainable” information when studying the overall liking and satisfaction degree scores. The same factors were also chosen by northern Spanish consumers without significant differences between the location. Words such as “national”, “healthy” and “natural” were previously reported by other authors working with raw almonds surveys as being the most important driving factors for Spanish consumers, while “natural”, “healthy” and “ecological” were those essential for Romanian consumers [8]. Moreover, “national”, “rich in antioxidants” and “crunchy” were the expressions getting the highest attention of Spanish consumers when assessing “hydroSOStainable” pistachios [20]. Consequently, it can be stated that Spanish consumers are more interested in consuming local products, while Polish consumers are more interested in the “natural” character of nuts. The aspect “national” perhaps is not important for Polish consumers, because Poland is not a nut producing

country and, thus, it is difficult for them to associate the studied samples with a “national product” [38].

3.3. Consumer Willingness to Pay for “HydroSOStainable” Roasted Almonds

The willingness to pay as well as the flavor are two of the main drivers of consumer choice and certainly deserved to be studied. As can be seen in Figure 3, both Polish and Spanish were willing to pay a higher price for “hydroSOStainable”-labeled roasted almonds as compared to the control ones; however, this difference was larger in southern Spanish consumers (87%) and similar between northern Spanish (73%) and Polish participants (71%). Most of the interviewed consumers (44%) were willing to pay ~0.5 € (~2.25 Polish zloty, the official currency in Poland) more for “hydroSOStainable” roasted almonds with no significant differences among locations. Besides in Seville, another 40% of consumers were willing to pay up to 1.0 € more per 200 g of “hydroSOStainable” roasted almonds. These results led to accept the initial hypothesis about that (i) consumers living in regions with limited water resources (e.g., Seville) were significantly influenced by the “hydroSOStainable” concept regarding their product liking, preference and willingness to pay, and that (ii) although consumers from areas with no water restrictions (Wrocław and Donostia) were not influenced on their product liking, the information about the necessity to reduce water use in agriculture encouraged them to choose and spend more money in almonds cultivated under “hydroSOStainable” conditions.

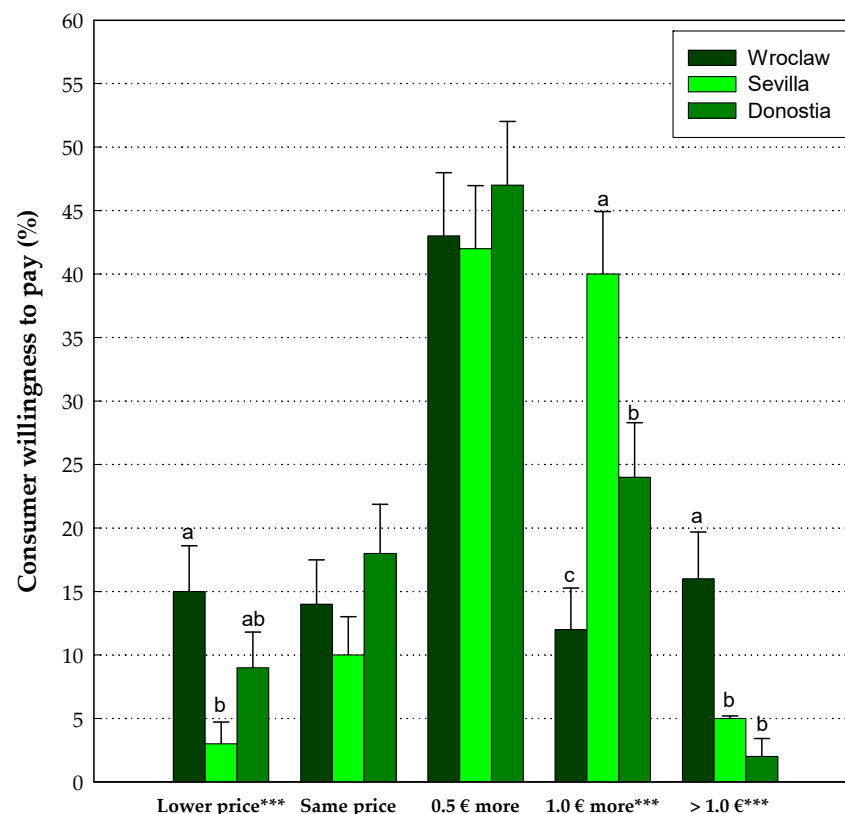


Figure 3. Polish and Spanish (northern and southern) participants willingness to pay for “hydroSOStainable” roasted almonds. Note: data is shown in the euro currency, but the Polish participants made their estimation in Polish zloty (1 € = 4.55 Polish zloty). *** significant at $p < 0.001$. Group bars without letters and those followed by the same letter, within the same bar and factor, were not significantly different ($p > 0.05$), according to Cochran’s Q-test.

Previous studies also reported that consumers were willing to pay a higher price for those products featuring labels certifying fulfillment with the environment [39]. For instance, it was also studied in “hydroSOStainable” raw almonds, olives and pistachios and

similar results were reported for all three crops [4,20,29]. For instance, both Spanish (77%) and Romanian (69%) consumers agreed to pay more for “hydroSOSustainable” almonds, 88% of Spanish participants for “hydroSOSustainable” olives and both northern (Galicia) and southern Spanish (Valencian Community) consumers were willing to pay an extra money for “hydroSOSustainable” pistachios. This last study, also reported that participants from Galicia were willing to pay a significantly higher price for “hydroSOSustainable” pistachios than those from the Valencia region (exactly 13.6 as compared to 12.9 € kg⁻¹), although both of them agreed that the price for this pistachios should be higher than for the “conventional” ones [20]. Moreover, a cross cultural study regarding the willingness to pay for raisins labelled eco-friendly also reported that both Swedish and UK participants were willing to pay a higher price for eco-labelled products, and this difference was larger for Swedish consumers [40]. This same study reported that consumers associated eco-labelled raisins with healthier food. This means that consumers in general become aware of the real and drastic reduction in the water resources worldwide if proper information is provided to them. Consequently, all these findings help to understand that proper knowledge on water scarcity and the benefits of consuming “hydroSOSustainable” almonds will help in making possible to set up sustainable water management programs because consumers are willing to pay higher prices for these products and these economic benefits will help in convincing farmers to bet on a sustainable use of the irrigation water.

3.4. Influence of Sociodemographic Factors on Consumer Liking of “Conventional” and “HydroSOSustainable” Labelled Roasted Almonds

Due to the unbalanced number of participants (*n*) among groups, the categories were not taken in consideration as a factor in the statistical data processing, and the type of sample was the only factor used in the statistical analysis of this section. Table 2 shows the overall liking and satisfaction degrees of Spanish and Polish consumers regarding “conventional” and “hydroSOSustainable” coded almonds as affected by gender (male and female) and age categories (centennials, millennials, and generation X) with similar incomes and education. As observed only male were significantly influenced by “hydroSOSustainable” concept regarding the overall liking, while both males and females showed higher satisfaction degrees for color sweetness, bitterness, and aftertaste of “hydroSOSustainable” roasted almonds. A coherent and consistent view of different male and female patterns in relation to food was widely demonstrated throughout literature. For instance, females were more linked to health and ethical concerns than males, being more ethically and environmentally sensitive in terms of the moral dimension of food choice [41]. Clear differences were also reported between men and women in the field of functional components, which are significantly more important for women than for men [42]. Females living in urban area were also reported to be more interested in buying labelled sustainable wines than others [43], while older females with lower levels of education perceive water as more unique. However, in the current study, male consumers were more influenced (overall liking) by the “hydroSOSustainable” information than the female ones.

Millennials was the only generation influenced by the “hydroSOSustainable” logo by scoring higher the overall liking. However, regarding their scores on satisfaction degree, beside millennials, the centennial generation was also influenced by the information, with a higher level of liking on color, sweetness, bitterness, hardness, and aftertaste for “hydroSOSustainable” roasted almonds. Centennials, or Z generation, are those now entering in the labor market, they live in an era of economic crisis and technological evolution and are reportedly able to decide whether something is interesting or not in 8 s of attention [44]. Previous studies reported that centennial consumers considered that environmental protection together with product characteristics related to health are essential in their purchase decision [45]. A higher percentage of centennials (63%) were reported to face an increased price tag for a responsible product comparing with the millennials (39%). The millennial generation was considered to seek out higher welfare products as long as they trusted labelled claims [46]. Millennials were also supportive of stricter environmental laws, more likely to favor environmentally friendly policies such as green energy development

and economic incentives for sustainability [47]. They were more interested in buying wines labelled sustainable than other [43], and although they have grown up in one of the most difficult economic situation, they were reported to be most willing to pay extra for sustainable offerings when compared to old generations [47]. Both centennials and millennials are important generations to assess consumer goods, but only few studies deal with their attitude regarding food and beverage and none of them about hydro sustainability. The present study also showed a sensitive approach regarding hydroSOSustainable products; both millennials and centennials consumers scored higher the “hydroSOSustainable” roasted almonds liking and satisfaction degree, when informed about the benefits of this type of products. Previous studies also highlighted that younger consumer are known to value environmentally sustainable features, because the authors found “environmental concern” as determinant expressive attribute amongst younger consumers when purchasing green/sustainable food [48]. Thus, communicating information on food hydro-sustainability by labeling and certification schemes is essential to reach the largest and the youngest generations of consumers trust, and consequently a sustainable lifestyle reducing the water footprint. These statement has been previously confirmed by other studies in which the authors reported that the perceptions of water uniqueness strengthen the value of water and water scarcity concerns [49]. They highlighted the importance of moral obligation as an essential driver of water resources conservation.

Table 2. Overall liking and satisfaction degree results of consumers belonging to different groups (male, female, centennials, millennials, and generation X) influenced by “conventional” and “hydroSOSustainable” information.

		Liking	Color	Toasted	Sweetness	Bitterness	Hardness	Crispiness	Aftertaste
ANOVA Test †									
Gender	Male	***	**	*	*	*	***	**	**
	Female	NS	**	NS	**	**	NS	NS	**
Age range	18–23	NS	**	NS	***	**	*	NS	**
	24–39	*	NS	NS	NS	*	NS	NS	**
	40–59	NS	*	NS	NS	NS	NS	NS	NS
Tukey Multiple Range Test ‡									
GENDER									
Male									
	“conventional”	6.9b	6.6b	6.9b	6.1b	5.7b	6.5b	6.8b	6.2b
	“hydroSOSustainable”	7.3a	7.0a	7.2a	6.4a	6.1a	7.1a	7.2a	6.8a
Female									
	“conventional”	7.3	7.2b	7.4	6.6b	6.3b	7.2	7.3	6.8b
	“hydroSOSustainable”	7.5	7.5a	7.6	7.1a	6.8a	7.4	7.4	7.3a
AGE RANGE									
Centennials (18–23)									
	“conventional”	7.0	6.9b	7.1	6.1b	5.8b	6.8b	7.0	6.4b
	“hydroSOSustainable”	7.3	7.3a	7.3	6.8a	6.2a	7.1a	7.2	7.0a
Millennials (24–39)									
	“conventional”	7.1b	6.9	7.1	6.5	6.2b	7.0	7.1	6.6b
	“hydroSOSustainable”	7.5a	7.2	7.4	6.7	6.7a	7.3	7.4	7.3a
Generation X (40–59)									
	“conventional”	7.4	7.0b	7.4	6.7	6.3	7.1	7.3	6.9
	“hydroSOSustainable”	7.7	7.6a	7.4	6.7	6.6	7.5	7.6	7.1

NS = not significant at $p > 0.05$; *, **, and *** significant at $p < 0.05$, 0.01, and 0.001, respectively. † Values followed by the same letter, within the same column and factor, were not significantly different ($p < 0.05$), according to Tukey’s least significant difference test.

Employment situation, monthly income and education were also important parameters influenced by the information and the results are presented in Table 3. It was observed that both employed and unemployed participants scored higher the overall liking and

satisfaction degree of the “hydroSOStainable” almonds, although with higher level of significance for the employed consumers.

Table 3. Overall liking and satisfaction degree results of consumers belonging to different groups (employment situation, monthly family income and education) influenced by “conventional” and “hydroSOStainable” information.

	Liking	Color	Toast	Sweet	Bitter	Hard	Crisp	Aftert
ANOVA Test [†]								
Employment situation								
“YES”	**	**	*	NS	***	**	NS	***
“NO”	*	**	NS	***	NS	NS	*	*
Monthly family income								
<1000 €	NS	NS	NS	NS	**	NS	NS	*
1001–2000 €	NS	**	*	NS	NS	NS	NS	NS
2001–3000 €	NS	NS	NS	*	**	NS	NS	NS
>3000 €	**	NS	NS	NS	NS	**	**	***
Education								
Vocational	*	*	NS	NS	NS	NS	NS	*
University	*	**	NS	*	***	NS	NS	**
PhD	NS	NS	NS	NS	NS	**	**	NS
Tukey Multiple Range Test [‡]								
EMPLOYMENT SITUATION								
“YES”								
“conventional”	7.2b	7.0b	7.2b	6.5	6.1b	6.9b	7.1	6.5b
“hydroSOStainable”	7.5a	7.4a	7.5a	6.9	6.7a	7.3a	7.4	7.2a
“NO”								
“conventional”	7.1b	6.9b	7.1	6.2b	6.0	6.9	7.0b	6.6b
“hydroSOStainable”	7.4a	7.3a	7.3	6.8a	6.3	7.2	7.3a	7.0a
MONTHLY FAMILY INCOME								
Income <1000 €								
“conventional”	7.4	7.5	7.5	6.7	6.4b	7.4	7.5	6.9b
“hydroSOStainable”	7.6	7.7	7.6	7.1	7.0a	7.5	7.6	7.3a
Income 1001–2000 €								
“conventional”	6.9	6.4b	6.8b	6.1	5.7	6.5	6.8	6.4
“hydroSOStainable”	7.3	7.0a	7.3a	6.5	5.9	7.0	7.0	6.8
Income 2001–3000 €								
“conventional”	6.9	6.6	6.8	6.1b	5.5b	6.6	6.8	6.2
“hydroSOStainable”	7.2	6.9	7.2	6.7a	6.2a	7.1	7.1	6.8
Income >3000 €								
“conventional”	6.8b	6.6	6.8	6.0	5.7	6.4b	6.5b	6.0b
“hydroSOStainable”	7.4a	7.0	7.1	6.5	6.2	7.2a	7.4a	7.1a
EDUCATION								
Vocational								
“conventional”	6.2b	5.6b	6.8	5.6	6.3	6.2	6.5	5.5b
“hydroSOStainable”	7.5a	7.1a	7.4	6.5	6.9	7.1	7.0	6.9a
University								
“conventional”	7.1b	6.9b	7.1	6.3b	5.9b	6.9	7.1	6.5b
“hydroSOStainable”	7.3a	7.3a	7.3	6.6a	6.3a	7.1	7.2	7.0a
PhD								
“conventional”	7.5	7.3	7.3	6.8	6.8	7.1b	7.3b	7.0
“hydroSOStainable”	7.9	7.6	7.7	7.3	7.1	7.8a	8.0a	7.5

[†] NS = not significant at $p > 0.05$; *, **, and *** significant at $p < 0.05$, 0.01, and 0.001, respectively. [‡] Values followed by the same letter, within the same column and factor, were not significantly different ($p > 0.05$), according to Tukey’s least significant difference test. Toast = toasted almond flavor; Sweet = sweetness; Bitter = bitterness; Hard = hardness; Crisp = crispiness; Aftert = aftertaste.

The monthly family income had a significant influence on the consumer perception, being the “hydroSOStainable” labelled roasted almonds better appreciated by the con-

sumers with monthly incomes higher than 1000 €, while no differences were observed for those with a family monthly income lower than 1000 €.

Education level was organized into three categories: vocational studies, university, and PhD. It was observed that consumers with a level of education vocational or university were significantly influenced by the “hydroSOStainable” logo both in liking and satisfaction degree. On the other hand, PhD holders were less sensitive to this issue and only scored higher two attributes of the “hydroSOStainable” roasted almonds, hardness and crispiness. These agreed with other authors who reported that respondents with a lower education level perceived the uniqueness of water to be high, on the other hand when individuals approach water as a commodity, the urge to conserve water was likely to stay low [49]. This is in line with the scarcity-engagement paradigm, because when the water is perceived as a scarce, it causes human engagement, and increases the value, desirability, and demand [49–52].

The link between consumers liking and satisfaction degree with their willingness to pay was also assessed and the results are displayed in Table 4. Indeed, the consumers who agreed to pay less or the same price for the “hydroSOStainable” roasted almonds, scored in a similar way both “conventional” and “hydroSOStainable” labelled roasted almonds liking. On the other hand, consumer willing to pay a higher price for the “hydroSOStainable” roasted almonds always scored higher the overall liking and their satisfaction degree for the key sensory attributes of these samples.

Table 4. Overall liking and satisfaction degree results of consumers grouped according to their willingness to pay, influenced by “conventional” and “hydroSOStainable” information.

	Liking	Color	Toasted	Sweetness	Bitterness	Hardness	Crispiness	Aftertaste
ANOVA Test [†]								
WILLINGNESS TO PAY FOR “hydroSOStainable” ALMONDS								
Less price	NS	NS	NS	NS	NS	NS	NS	NS
Same price	NS	*	NS	NS	NS	NS	NS	NS
0.5 € more	**	NS	NS	NS	***	NS	NS	***
1.0 € more	***	**	*	***	NS	***	*	***
More than 1.0 €	*	NS	NS	NS	NS	NS	NS	NS
Tukey Multiple Range Test [‡]								
WILLINGNESS TO PAY FOR “hydroSOStainable” ALMONDS								
Paying less price								
“conventional”	7.1	7.1	6.8	6.0	5.8	7.0	7.1	6.6
“hydroSOStainable”	7.0	7.4	6.7	6.4	6.0	7.2	7.2	6.6
Paying same price								
“conventional”	7.1	6.6b	7.0	6.5	5.8	6.9	6.9	6.6
“hydroSOStainable”	7.3	7.3a	7.2	6.6	6.0	7.2	7.1	6.9
Paying 0.5 € more								
“conventional”	7.1b	7.0	7.2	6.4	6.0b	7.0	7.1	6.5b
“hydroSOStainable”	7.4a	7.2	7.5	6.6	6.6a	7.2	7.4	7.1a
Paying 1.0 € more								
“conventional”	7.0b	6.7b	7.0b	6.0b	6.1	6.5b	6.8b	6.3b
“hydroSOStainable”	7.6a	7.3a	7.4a	7.1a	6.4	7.3a	7.3a	7.2a
Paying more than 1.0 €								
“conventional”	7.7b	7.7	8.0	7.5	7.5	7.3	7.4	7.7
“hydroSOStainable”	8.3a	7.7	7.9	7.8	7.0	7.8	8.0	7.5

[†] NS = not significant at $p > 0.05$; *, **, and *** significant at $p < 0.05$, 0.01, and 0.001, respectively. [‡] Values followed by the same letter, within the same column and factor, were not significantly different ($p > 0.05$), according to Tukey’s least significant difference test.

Finally, consumers considering sustainability as an important factor (Table 5) when purchasing their food, scored higher the overall liking and satisfaction degrees of “hydroSOStainable” almonds compared to those “conventional”. While the consumers for whom the sustainability was not an option were mainly not influenced by the “hydroSOStainable” concept.

Table 5. Overall liking and satisfaction degree results of consumers to whom the sustainability *is/is not* an important factor when purchasing these types of products, influenced by “conventional” and “hydroSOStainable” information.

	Liking	Color	Toasted	Sweetness	Bitterness	Hardness	Crispiness	Aftertaste
ANOVA Test [†]								
SUSTAINABILITY FACTOR AT PURCHASE INTENT								
“Sustainable”	***	**	**	***	**	***	**	***
“Not sustainable”	NS	**	NS	NS	*	NS	NS	NS
Tukey Multiple Range Test [‡]								
SUSTAINABILITY FACTOR AT PURCHASE INTENT								
“Sustainable”								
“conventional”	6.9b	6.7b	7.0b	6.0b	5.8b	6.5b	6.8b	6.2b
“hydroSOStainable”	7.5a	7.1a	7.4a	6.8a	6.3a	7.2a	7.3a	7.1a
“Not sustainable”								
“conventional”	7.3	7.1b	7.2	6.7	6.2b	7.2	7.3	6.8
“hydroSOStainable”	7.4	7.5a	7.3	6.7	6.6a	7.3	7.4	7.1

[†] NS = not significant at $p > 0.05$; *, **, and *** significant at $p < 0.05$, 0.01, and 0.001, respectively. [‡] Values followed by the same letter, within the same column and factor, were not significantly different ($p > 0.05$), according to Tukey’s least significant difference test.

4. Conclusions

This is the first study reporting a cross-cultural consumer behavior regarding “hydroSOStainable” concept on roasted almonds. This study revealed that in general consumers were positively influenced by the “hydroSOStainable” concept, with consumers from Seville (area with severe water restrictions) being the most sensitive ones. Consumers from regions with no important water restrictions (Wrocław and Donostia) were not influenced by the information effect; their overall liking and satisfaction degrees were not increased due to “hydroSOStainable” information; however, most of the consumers (Wrocław, Donostia, and Seville) were willing to buy and to pay a higher price for the “hydroSOStainable” almonds. Moreover, results indicated that the sociodemographic factors (gender, generation, employment situation, monthly income, and education) influenced consumer overall liking and their satisfaction degree for some of the key sensory attributes. Centennial and millennial, males, and participants with a monthly income higher than 1000 €, were the most influenced by the “hydroSOStainable” information. This also influenced those consumers willing to pay a higher price for the “hydroSOStainable” almonds and those mainly interested on the word “sustainable” as key factor when purchasing these types of products. This study presents clear results about the importance of information on the product acceptance by the consumers. In this way, government and/or industry actions might focus on providing consumers with proper information regarding “hydroSOStainable” products, while the farmers must implement deficit irrigation strategies in the fields and orchards, because the present results showed that consumer acceptance regarding sustainable products, depends on the location, knowledge, and sociodemographic aspects. Thus, communicating campaigns that focuses on the consumer information on the actual state of water as well as the health benefits of the hydro sustainable products (depending on the location) could reduce the knowledge gap and may be an effective action to reduce the irrigation water in almond crop. Finally, the present results might be interpreted in the context of the study’s limitations. The experiment was limited to investigations on three locations only of which two were from Spain, and only one outside of Spain as a model of different culture without water restrictions. In addition, the experiment was limited to one crop, and the outcomes may be different for other products. Saying this, further consumer research in this area could include more countries with and without water availability, and different products, as well as studies using real or virtual shopping environment to provide more certainty about the consumer choice between “conventional” and “hydroSOStainable” products.

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