Research Article

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Consumption profile of organic fruits and vegetables by a Portuguese consumer's sample

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Abstract: The consumption of fruits and vegetables has been considered very important for human health. This research aimed to study consumption habits of fruits and vegetables from organic farming (OFV) within a convenience sample of Portuguese adults, including reasons for consumption, most valued mode of production sources, frequency of use, knowledge about characteristics and benefits, and information sources. An online questionnaire containing 30 questions was originally developed and shared on social networks and 300 questionnaires were obtained. The organic vegetables identified as the most consumed were lettuce (93.5%), potato (92%), and tomato (92%); the most consumed organic fruits were orange (83%), lemon (82%), and strawberry (82%). The strongest motivations to consume OFV include environmental benefits (57%) and health benefits (94%), namely the prevention of high total cholesterol (71%), the prevention of cardiovascular diseases (69%), and obesity prevention (68%). Regarding the level of information about the nutritional and chemical properties of OFV, 86% of the respondents consider themselves informed people. Meanwhile, there still are 33% of the respondents revealing no concern about the farming practices. As so, there is an opportunity to increase literacy about these products, to raise awareness about the benefits of organic products, and to promote higher consumption of OFV products, supported in the arguments of perceived positive impact of organic agriculture on ecosystems and human health.

Keywords: sustainable agriculture, organic fruits and vegetables, consumption profile, questionnaire, human health

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1 Introduction

Fruits and vegetables are a vital part of world's diets. In Portugal, the Food Wheel is used as a food guide for daily healthy eating incorporating the principles of the Mediterranean diet. The Food Wheel favours the consumption of foods from different groups, the balanced proportions to be ingested, and the adequate frequency of ingestion. Fruit and vegetable products occupy a prominent place due to their nutritional importance for human health. However, in recent decades, there have been several changes in the eating habits of the Portuguese and European population, especially in the Mediterranean area, with a decrease in the consumption of traditional Mediterranean foods and a generalized reduction in food quality [1].

The Portuguese Food Balance Sheet provides an exhaustive table of information regarding the pattern of food supply, during a given reference period, using the FAO methodology in its calculation. It indicates the quantities potentially available for human consumption, being a proxy measure of consumption from the point of view of food supply and not the actual consumption of food products. The energetic contribution of total fat and saturated fat calculated by the Portuguese Food Balance Sheet 2016–2020 was above the maximum limit recommended for consumption by World Health Organization (WHO) (30%). The contribution of carbohydrates was lower than the recommended limit and proteins are within the recommended range. Added sugars are within but near the upper limit of recommended intake. Considering the

energy available for human consumption, that represents a quantity high above the recommendation for a reference diet. However, the Mediterranean Adequacy Index calculated in 2020 was 1.157, meaning a predominance of energy from food products generally associated with the Mediterranean food pattern [2].

Comparing the available food products in Portugal with the recommendations presented through the Portuguese Food Wheel guide, the vegetables (fresh legumes and green leaves) group represents 14.4% (lower than recommendation, 23%), and fruits represent 15.3% (also lower than recommended, 20%) [2].

From the Portuguese Food and Nutrition Survey 2015–2016, the comparison between the Portuguese Food Wheel guide recommendations and the estimated food consumption for the Portuguese population reveals a consumption of vegetables (14%) and fruits (13%) lower than recommended in the Food Wheel [3].

The WHO has been emphasizing for a long time the role of the low consumption of fruits and vegetables as an important risk factor for the increase of several diseases and premature death [4,5]. In fact, it recommends consuming at least 400 g per day of fruits and vegetables to obtain health and nutritional benefits, although the vast majority of people do not consume enough fruits and vegetables [6]. In 2017, around 3.9 million deaths worldwide were attributed to diets characterized by insufficient fruit and vegetable consumption. It is estimated that about 14% of the deaths from gastrointestinal cancers, 11% of ischaemic cardiovascular diseases, and about 9% of strokes are directly related to low intake of fruits and vegetables [7].

The International Year of Fruits and Vegetables was celebrated in 2021 with the main purpose of raising awareness on the nutritional and health benefits of fruits and vegetables and their contribution to a balanced and healthy diet and lifestyle, as well as reducing losses and waste in its production and marketing [8].

The World Food Safety Day celebrated in 2022, aimed to draw attention to food-borne risks, and to highlight the role that safe and nutritious food plays in ensuring of human health. Safe food is the guarantee for good health, and unsafe and nutrient-poor foods are the cause of many diseases and contribute to the development of other precarious health conditions, such as impaired growth and development and micronutrient deficiencies and noncommunicable diseases [9]. Non-communicable chronic diseases related to diet and nutrition are associated with increased consumption of high-energy foods, use of foods rich in saturated fat, sugar and salt, and low consumption of foods rich in fibre and antioxidant vitamins, such as fruits and vegetables [10]. They include cardiovascular diseases, diabetes mellitus, some types of cancers, and obesity. These are generally slow and silent developing, long-lasting diseases that can start early in life and express several decades later and constitute some of the main causes of morbidity and mortality worldwide [11].

For the International Federation of Organic Agriculture Movements (IFOAM) [12], the organic production method can be summarized in four principles: health, ecology, fairness, and care. Organic farming is a system of agricultural production that seeks to obtain food of high nutritional quality, using techniques that guarantee the system sustainability, namely through preserving the soil, the environment and biodiversity, avoiding use of synthetic chemical products, favouring the use of local resources and being economically viable, and promoting social justice [13]. In the European Union, the Regulation (EU) 848/2018 [14] of the Council determines conditions for organic production and food labelling.

In Portugal, according to Eurostat [15], in 2020, the organic agricultural area was 319.540 ha, which is equivalent to 8.05% of the total utilized agricultural area, a value slightly lower than the EU-27 average (9.08%).

The organic production method plays a dual societal role, since, on the one hand, it supplies a specific market that corresponds to the demand for organic products by consumers and, on the other hand, it provides public goods that contribute to the protection of the environment and animal welfare, as well as for rural development [16]. From human health point of view, a systematic literature review and meta-analyses showed higher antioxidant and lower cadmium concentrations and lower incidence of pesticide residues in organically grown crops [17].

The attitude of consumers of fruits and vegetables from organic farming (OFV) is influenced to a large extend by external factors, including the social status of the consumer and the family, which is supported by the results of research conducted among consumers in Slovenia [17], Poland [5], and Romania [18].

Given that consumers in each country have a different perspective towards organic products, surveys on consumer behaviour are of great importance in order to obtain information on current market trends and policies. In addition, producers, traders, and distributors of organic fruit and vegetables could use these valuable results to develop and promote products in line with consumer requirements [18] and develop literacy and a broad demand for those food products.

The main objective of this study was to contribute to know the consumption habits of organic fruits and vegetables by Portuguese adults. To achieve this goal, several issues were addressed as reasons leading people to consume

organic fruits and vegetables, the acquisition sources, the most valued production modes, the most consumed organic products, the frequency of their use, the knowledge about their main nutritional characteristics and benefits, and the sources of information used.

2 Materials and methods

2.1 Sample and data collection

The survey was conducted on a convenience sample based on the availability of access to a digital platform and the willingness to answer the questionnaire. An invitation was scattered following a snowball methodology through email and social media contacts. Although it is acknowledged that convenience samples have some disadvantages, they are very useful for exploratory research [19,20].

The study included individuals with self-reported 18 years of age and over. Participants under 18 were excluded because of being under legal age, and so, since the questionnaire was applied through computational means, it was not possible to obtain the authorization of the legal guardians. In total, 300 valid answers were obtained, being 74% women and 26% men.

Informed consent: All the participants were volunteers, and their responses were anonymously collected. Each participant could only access the questionnaire after agreeing to participate and expressing informed consent, knowing that no personal identification would be collected. The data were kept strictly confidential so that none of the responses could ever be linked to the participant.

Ethical approval: The research related to human use complied with all the relevant national regulations, institutional policies and in accordance with the tenets of the Helsinki Declaration, and has been approved by the Ethics Committee of the Polytechnic Institute of Coimbra, with reference No 52_CEIPC/2022.

2.2 Instrument and data analysis

A questionnaire was prepared in the internet platform Google Forms tool (Google Inc., Mountain View, CA, USA). Data were collected using an original questionnaire consisting of 30 questions aggregated on three different sections. In the first part, sociodemographic characteristics of respondents (age, gender, professional situation, level of education, size of the household, monthly salary income) were addressed. The second section included questions addressing the use of organic food (choice, frequency, cooking method). The third part of the questionnaire addressed the knowledge of participants about nutritional and chemical characteristics of organic food and sources of information.

Descriptive statistical data analysis was performed in Microsoft® Excel® for Microsoft 365 MSO (version 2301 Build 16.0.16026.20002) 64-bit.

The parametric tests Levene, analysis of variance (ANOVA), and the chi-square and the non-parametric Kruskal–Wallis test were calculated in SPSS (IBM® SPSS® Statistics for Windows, version 26.0. Armonk, NY) following the statistical procedures described by Howell [21].

3 Results and discussion

3.1 Characterization of the sample

Figure 1 represents the Portuguese regions where the participants of this study live.

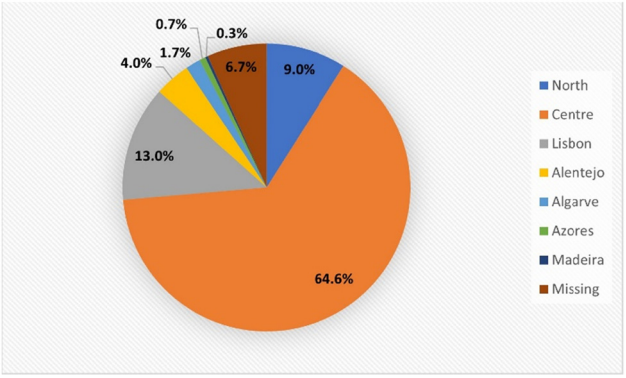

Figure 1: Percentage of respondents by Portuguese NUT II regions of residence.

All the seven NUT II regions (NUTS is a hierarchical system of geographical/administrative division of Portuguese territory) have respondents indicating that despite we are using a convenience sample, it contains subjects from all regions, including insular territories, Azores, and Madeira.

Table 1 shows the minimum, average, and maximum age of respondents, and how it is spread in each gender. We found that, for the whole sample, the age varied between 18 and 83 years, and the mean age is 40.65 years.

Table 1: Minimum age, maximum age, and average, by gender, of the sample

	Total (n = 300)			Female (n = 221)			Male (n = 79)		
Parameter	**Average ± SD**	**Min.**	**Max.**	**Average ± SD**	**Min.**	**Max.**	**Average ± SD**	**Min.**	**Max.**
Age (years)	40.65 ± 12.45	18	83	39.69 ± 12.03	18	72	43.32 ± 13.19	19	83

The mean age for females and males is 39.69 and 43.32 years, respectively.

Considering that academic qualification or monthly net income may have some influence on the knowledge and sensibility to use organic food and the economic power to purchase organic food in a non-massive commercial distribution system, we asked information about those sociodemographic factors. Table 2 provides that data from the sample. Therefore, for the total sample, 7% only have elementary education, 46.3% have a bachelor's degree, and 30.7% have a master's degree. Among subjects with a bachelor degree, being the majority of subjects, 50.7% are females and 34.2% are males.

Differences in the distribution of concern with the mode of production according to academic qualifications (elementary education, secondary education, professional and higher education) were investigated. For the participants who revealed concerning about the mode of production of products (organic *versus* conventional farming), 31.6% of the respondents have completed basic education, 48.2% with elementary, secondary, or vocational education, and 73.2% of those with higher education, the difference was statistically significant, $\chi^2(1) = 22{,}762$, $p < 0.001$.

Regarding the monthly net income of the household, for the total sample the largest percentage, 40.5%, is in the income class between 991 and 1,950 €. In females the highest percentage, 46.4%, is in the income class between 991 and 1,950 € while in males the highest percentage, 36.7%, is in the income class between 1,951 and 2,920 €. The Portuguese National Institute of Statistics estimates the median for income in 2021 with the value of 917.8 € per month (the Institute considers a referential annual revenue 11,014 €, divided by 12). That means middle-class with a monthly net income equivalent revenue between 688.35 and 1835.6 € [22].

Considering that the dietary use of a certain range of food products in the family context might be mostly determined by decision of the person responsible for the purchase and menu planning, we asked about some characteristics of the person responsible for the purchase of fruit and vegetable products. The female gender is the main responsible, with about 78.6%, followed by the male gender with about 49.8%, children 29.9% and another person 9.0%.

3.2 Organic fruits and vegetables – consumer behaviour

For fruits and vegetables' acquisition sites, Figure 2 shows that, for most respondents, 52.7%, large/medium-sized areas are the preferred place to do so. The local or community

Table 2: Academic qualifications and net income of the sample

Question	Total (n = 300)		Female (n = 221)		Male (n = 79)	
	N	***%T***	***n***	***%F***	***n***	***%M***
First cycle of elementary school (4th year)	5	1.67	2	0.90	3	3.80
Second cycle of elementary school (6th grade)	6	2	3	1.36	3	3.80
Third cycle of elementary school (9th grade)	8	3.33	4	1.81	4	5.06
Secondary education	42	14	34	15.38	8	10.13
Professional course	15	5	6	2.71	9	11.39
Bachelor	139	46.33	112	50.68	27	34.18
Master	62	20.67	45	20.36	17	21.52
Doctorate	21	7	13	5.88	8	10.13
Less than 635 €	10	3.29	8	3.57	2	2.5
Between 636 and 990 €	52	17.11	42	18.75	10	12.5
Between 991 and 1,950 €	122	40.45	103	46.43	19	24.05
Between 1,951 and 2,920 €	75	25.33	46	20.98	29	36.71
Between 2,921 and 4,850 €	31	10.53	19	8.93	12	15.19
More than 4,851 €	10	3.29	3	1.34	7	8.86

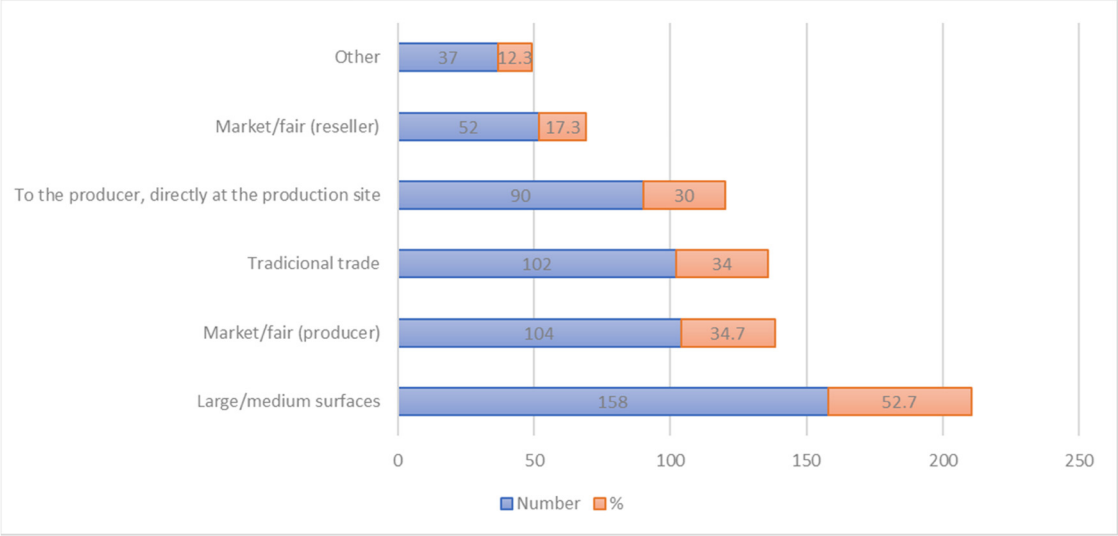

Figure 2: Organic fruits and vegetables' acquisition sites.

open markets and fairs held by the producer himself appear with 34.7%, the traditional trade (neighbourhood shops) with 34%, directly at the farm 30% and, the lowest percentage, from resellers at the markets or fairs, 17.3%. It should also be noted that 12.3% of the respondents answered that they use some other sources of acquisition. Of these, 83.8% pointed to their own production, family, or friends' production as a source of food acquisition and 5.4% buy at specialized places.

About 84.7% of the respondents prefer to purchase fresh OFV in bulk, while 43.3% prefer fresh and already packaged products, 18% choose frozen packaged, and 4.3% prefer to buy dehydrated products. Concerning the fruit products mode of production, 67% of the respondents assume their engagement, while the remaining one-third of the respondents indicate that they are not concerned about the mode of production.

That question defines a cutting point in the survey, separating the issues around concern (whatever it be emotional or rational) from issues about the effective practice of people valuing the mode of production. As so, for those 33% of the respondents not concerned about the mode of production, the survey ended up, being the following questions of the survey addressed only to the consumers who are concerned about how fruits and vegetables are produced.

For the 67% of respondents who continued to respond to the survey, the most consumed fruits and vegetables products are chosen from organic mode of production (64.2%), followed by conventional agriculture (43.3%). Among the consumers of organic fruit and vegetable products, 66.7% consume legumes, 56.7% grains, and 52.2% cereals or pseudo-cereals. Also, some 8.5% of the respondents answered that they use "other" types of organic products such as eggs, chocolate, and wine.

A higher proportion of women (69.2%) compared to men (55.4%) expressed their concern regarding the mode of production, being this difference statistically significant, $\chi^2(1) = 4.611$, $p = 0.032$.

The age variable obtained a standardized asymmetry of 0.189 and no outliers were observed. Homoscedasticity was tested with the Levene test, which was not statistically significant. After testing the assumptions, the one-way ANOVA statistical test was used to test the differences between the average ages in the answers to question about the concerning about the mode of production. No significant differences were found between the average ages of those who care about the mode of production ($M = 40.48 \pm 11.81$) and those who do not ($M = 40.12 \pm 13.01$), $F(1.287) = 0.056$, $p = 0.812$.

3.3 Organic vegetables consumption profile

The ten most consumed organic vegetables were as follows: lettuce (93.5%), tomato (92%), potato (92%), carrot (87.6%), onion (87.1%), garlic (84.6%), courgette (83.1%), cabbage (81.1%), sweet potato (80.6%), and pumpkin (80.6%) (Figure 3).

3.4 Organic fruits consumption profile

The ten most consumed organic fruit products, as shown in Figure 4, were as follows: orange (82.6%), lemon (82.1%),

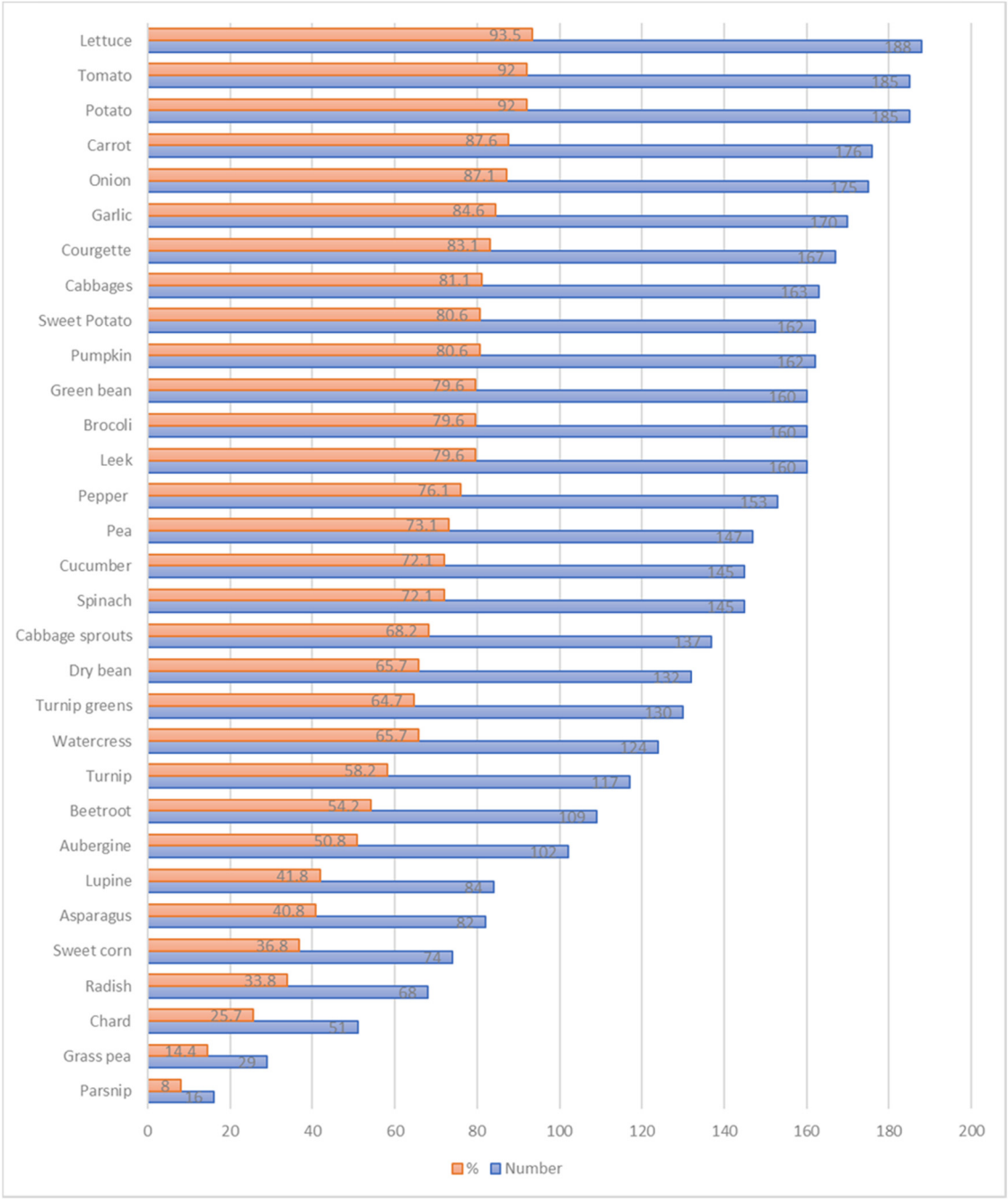

Figure 3: Most consumed organic vegetables.

strawberry (81.6%), apple (79.6%), grapes (73.6%), pear (71.1%), watermelon (69.7%), melon (69.2%), banana (68.2%), and loquat (67.2%).

3.5 Organic products' consumption profile

Regarding the onset of organic products consumption, the majority of respondents, 52.7%, have been consuming this type of product for more than 6 years (Figure 5).

When asked about the frequency of organic fruits and vegetables' consumption (Figures 6), 61.2% declare a daily use of organic food products, 13.4% use these food products between 5 and 6 times a week, and only 2% answered at least once a week.

Regarding the mode of preparation and cooking of organic fruits and vegetables, boiling is the most used method (for 89.1% of subjects), followed by raw (79.6%), roasted (64.2%), salted (59.7%), steamed (41.3%), and fried (14.4% of the preferences).

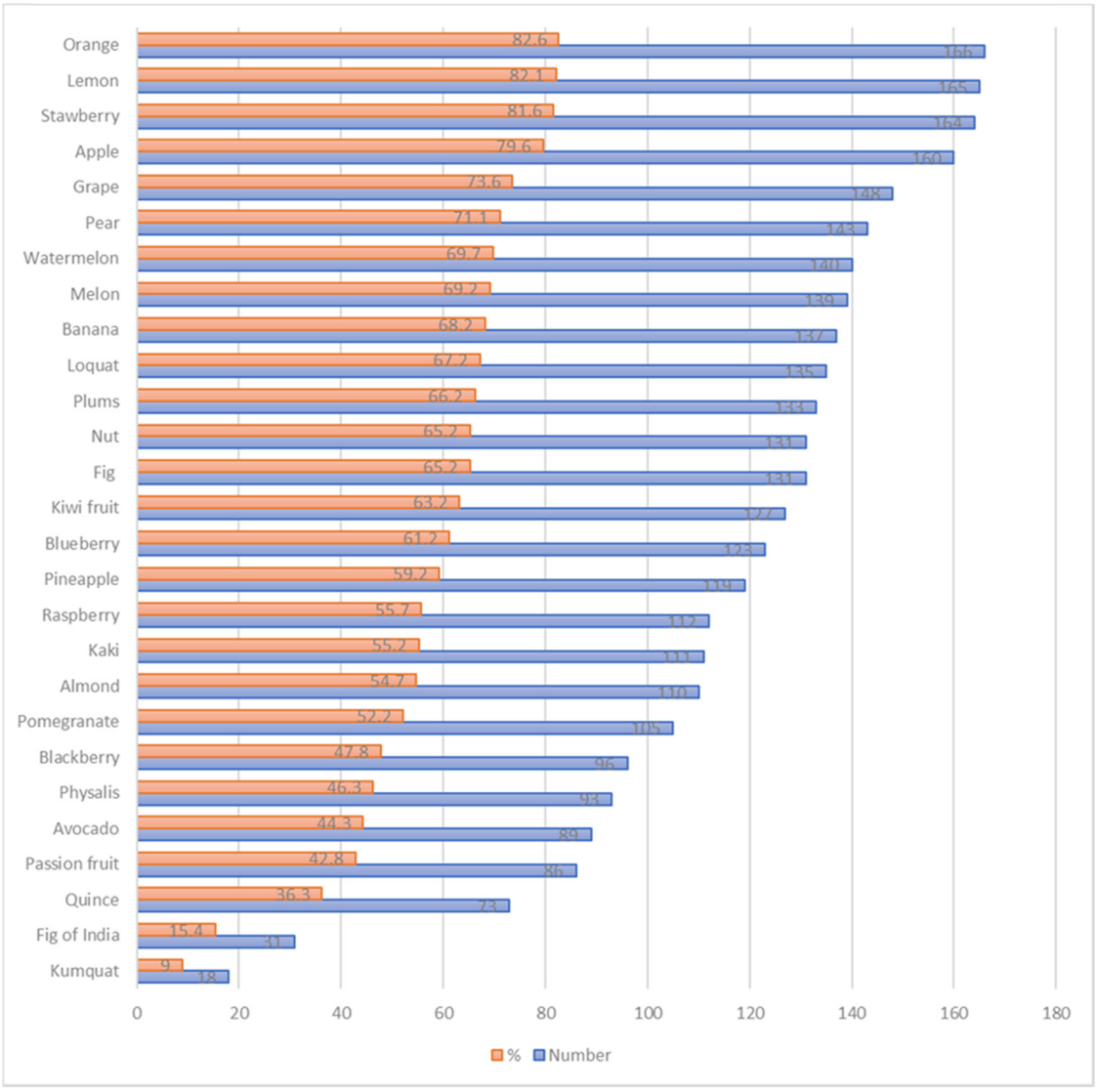

Figure 4: Most consumed organic fruits.

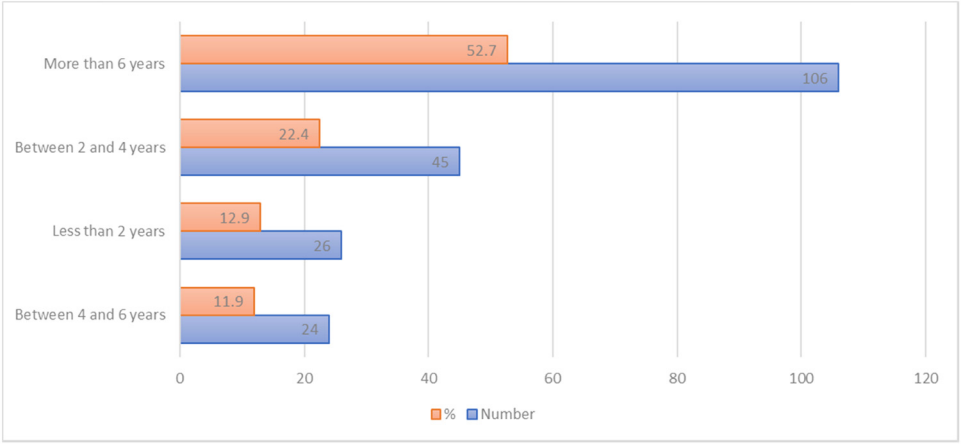

Figure 5: Organic products' consumption by four consumption time classes.

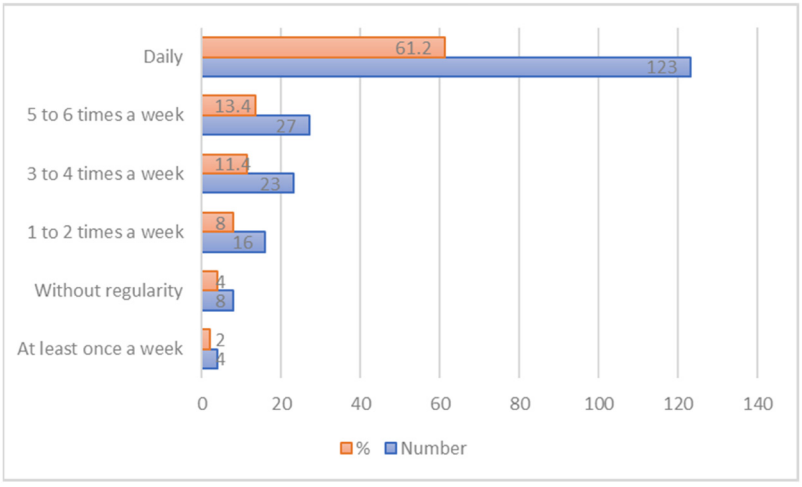

Figure 6: Frequency of OFV consumption.

When asked in which meal or part of a meal were OFV most used, the respondents show a preference for use in menu main courses (69.7%) followed by use in soups (53.7%). Subjects also mention the use of OFV in the preparation of beverages (13.9% of the respondents). When asked about the type of beverages in which OFV are used, juices were the most indicated option with 45.8% of the answers, the smoothies with 44.3% and the detox drinks 13.4%.

For 32.3% of the respondents, their meals are composed of 41–60% of OFV; for 30.3% of respondents, meals are composed of 21–40%; for 19.4% of respondents, the usage of OFV represents from 61 to 80%; and for 4.5% of the respondents, more than 80%. But there are also 13.4% of the subjects for whom these products represent less than to 20% of daily meal composition.

3.6 Motivations and perceived benefits of OFV consumption

This group of questions was directed to determine the main reasons for the OFV consumption and which aspects, for health, are most relevant to their consumption. Figure 7 shows that 94% of the respondents reported reasons centred on health benefits, 57.2% reported benefits for the environment, 34.8% sensory reasons, 28.4% of the respondents seek to minimize salt consumption, and 25.9% seek to minimize sugar consumption.

Considering broad health concerns associated with diet, to contextualize the specific health interest for OFV consumption, as shown in Figure 8, the most relevant reasons cited by subjects were, in descending order: the

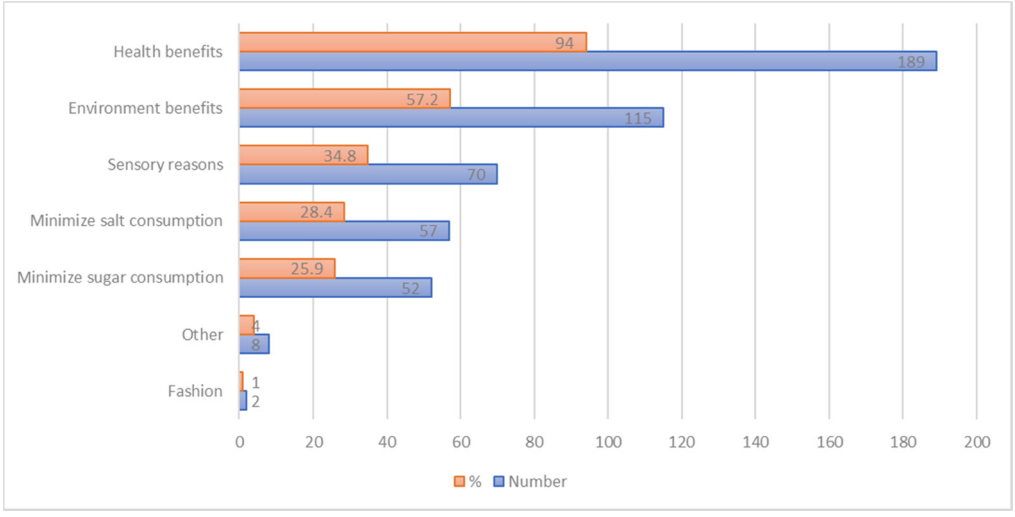

Figure 7: Main reasons for OFV consumption.

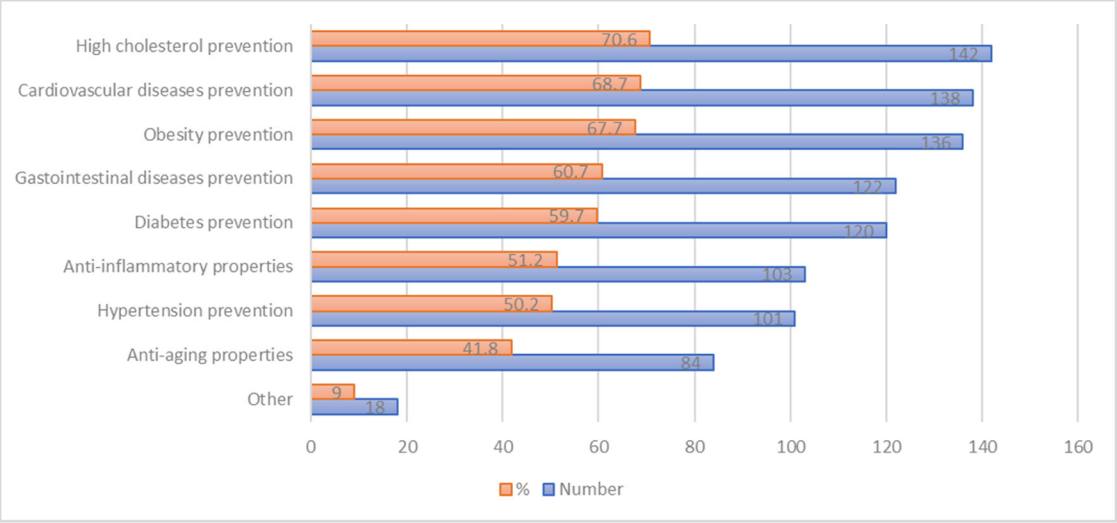

Figure 8: OFV consumption relevant health aspects.

prevention of high cholesterol, 70.6%; the prevention of cardiovascular diseases, 68.7%; the prevention of obesity, 67.7%; the prevention of gastrointestinal diseases, 60.7%; the prevention of diabetes, 59.7%; the anti-inflammatory properties of OFV, 51.2%; the prevention of hypertension, 50.2%; the anti-aging properties, 41.8%; and lastly, several other reasons, 9%, as well-being, taste, consumption as a philosophy of healthy living and a balanced diet, mental, and emotional balance, avoidance of toxicity by pesticides, cancer prevention, and osteoporosis prevention.

Regarding the information level on the OFV consumption potential benefits, 39.3% of the respondents consider themselves sufficiently informed, 33.8% consider themselves with a good level of information, and 12.9% consider themselves with an excellent level of information. However, 12.4% consider that they are poorly informed and 1.5% consider themselves insufficiently informed.

The influence of academic qualifications on the degree of information that the respondents referred to was not statistically significant ($H(2) = 3.637$, $p = 0.0162$). A statistically significant difference between genders in the degree of information of participants ($U = 2927.50$, $p = 0.717$) was also not found.

The last question of the survey was intended to hear about the origin of information on the benefits of OFV consumption. About 57.7% of the respondents obtained information through the academic education, 53.7% through books or magazines, 49.8% on the internet, 48.3% reported the acquisition of information through family tradition, 18.9% in clinical nutrition consultations 16.4% by television, 10.9% in medical consultations, and 4.5% in other sources.

4 Discussion

The commercial availability of food products from organic farming has been increasing in the last few decades, from local producers to small markets and large distribution supermarkets, following an increased demand from consumers and trying to persuade new consumers. It is a market centred on arguments such as health promotion, environmental sustainability, social responsibility, and justice.

In fact, health-conscious consumers are an important driver force since they show a growing preference for organic food over the conventionally grown food. This shift in the attitude of the modern consumers is greatly influenced by the rising incidence of lifestyle diseases, in which nutrition has a central role in development and control. The intent to purchase organic food to improve the quality of life has effects on the production, distribution, retail, and marketing [23].

The concept of organic agriculture is supported by a systemic approach based on four principles formulated by the IFOAM: health, ecology, fairness, and care [24].

As so, the idea of organic farming goes far beyond immediate and direct health concerns as it considers a whole rationale that includes environmental, social, and political aims. The aims are to produce food in an environmentally friendly way, with more energy-efficient transformation and distribution systems, and sustainable consumption patterns, as well as to contribute to social justice, including preserving rural communities and economy. A realistic approach accepts that achieving a transition from intensive agriculture systems needs an emphasis on the

co-evolution of technical and societal change. Organic farming may act as a prototype for sustainable agriculture, showing that it is possible to produce high-quality food in an environmentally friendly way and induce a transformation of the rest of the food chain (including food handling, marketing, and consumption) [25]. The need for a transition towards sustainable agri-food systems is increasingly recognized. But to strengthen organic farming's transformative potential it is essential to be aware that principles are respected, not just the regulations. Practices have to comply with the legal regulations, but also with the principles of organic farming to materialize its ability to fulfil the expectations of consumers and policy-makers [26].

Although "organic production" as a system of farm management and food production and its labelling are well defined by international entities as EU [27,28], consumers are not fully aware of an accurate definition and are not consistent in their interpretation of what "organic" is, with uneven perceptions about products, and mixing concepts as organic and local [29].

In this study, data were collected through a questionnaire spread on social networks. The authors are aware of possible bias resulting from its spreading among contacts that already share some kind of sensibility to the organic food theme, with a risk of bias in answers to the questionnaire. Even so, it was possible to define a cut-off point to differentiate those subjects that are really concerned with conscious arguments in favour of organic food, from those that might use organic products in their diet but are not concerned with the farming origin of those products. In fact, we obtained a sample of respondents in which one-third showed no concern in that matter.

It was not defined in the questionnaire what can be considered an organic product because the intent of the questionnaire was not to identify the quality of available and purchased food, meaning if it respects (or not) the conditions to be considered organic farming, but it was precisely to acknowledge how consumers perceive the benefits from consuming organic food products driving their choice and purchase.

A study centred on dairy products pointed to animal welfare as, in general, the most important reason to choose products from the organic mode of production. However, factors such as household income and existence or not of children in the family introduce some differences in the balance of reasons for that choice, adding issues such as environmental protection and health reasons [30].

It is interesting to note that evidence showed that even in a global context of accordance of benefits derived from the use of organic food, attitudes, buying motives and value concepts are product specific and vary according to consumer groups. As so, organic consumers may buy only certain kinds of organic products (even within the same family of dairy products) as they have a differentiated perspective on the benefits of specific organic production systems [30].

A study on the choice and purchase of two specific organic products (eggs and milk) showed that choosing organic for one of the two items reinforced the probability of purchasing also the organic version of the second item and also showed that organic buyers' demographic profile was not related to income neither to age nor to family size, but to the educational level [31]. Another study recognized the importance of primary socialization even over group effect in forming social norms and shaping behaviour and also showed that cultural orientations were good predictors for attitudes as well as for behaviour towards organic products [32].

Consumer perception about the value and interest of organic food is built over a large spectrum of reasons, from health benefits and food safety, to care for animal welfare, environmental and farming sustainability, and local economy. Additionally, there are factors modulating the effective acquisition like sensory attributes, price, and being trendy. Some evidence points to a general differential influence according to age and gender, being youngsters and women more prone to use organic food [33]. Another study points to demographic characteristics of the consumers driving preference with higher preference among women, more educated people, with higher income, and the age group 29–39 years old [34].

In our study, the mean age of subjects was around 40 years. Although some papers point to the interest from younger generations, the possibility that this questionnaire has been shared among a community of consumers and eventually producers or with close relation to producers may explain that difference. In fact, only 12.3% of the subjects answered that they use some non-market sources of acquisition; of these, 83.8% pointed to their own production, family, or friends' production as a source of food acquisition. However, those sources cannot be assumed or mistaken as reliable safety sources of food. Transparency and even some certification might be essential to assure consumers seeking organic production that local source is in fact organic production and not conventional production. The impact of local food systems on different social, economic, and environmental factors highly depends on the type of supply chain under assessment, with important differences across product types and countries [35].

Considering gender, in this study, women are not only the subjects to participate in the study, but also they are the

main ones responsible (78.6%) for organic food purchases. It does not mean that women are objectively more interested in organic food because cultural context must be considered, being food management in the household still a cultural issue more related to women, in Portugal. Gender plays a large role in purchasing decisions [36], with women generally focusing more on fruits and vegetables because they feel more responsible for the health of the family than men.

Promotion of information and all the conditions favouring the decision towards organic food purchase may benefit from actions designed to call for attention based on interests related to the demographic characteristics of purchasers.

Considering income, most subjects may be considered middle-class. And the school education level of respondents showed most people with an academic degree, which we may consider a favourable condition being an opportunity to understand the value, to choose, and to accede to reliable information sources. In fact, most of the subjects declare that they obtained information through the academic education (57.7%). More than two-thirds of the respondents consider themselves at least sufficiently informed or even with a good level of information about the potential benefits of consuming fruits and vegetables of organic origin. This finding is aligned with previous studies where regular consumers of organic foods are those with a high level of education, and who also have more knowledge about organic products [37].

About the possible influence of age on the concern of farming being organic or not, we did not find a significant statistical difference. Differently, regarding age, another study found that most people who buy organic products are generally 45 years old or less [38].

Evidence shows that health, availability, and education positively influence the consumer's attitude towards buying organic food. Overall satisfaction of consumers for organic food is higher than for non-organic food and is determined by several factors, the most important being a healthy content, even more than environmentally safe. It was also noted that even being organic food more costly than non-organic food, consumers are willing to pay more knowing that the product is healthy and eco-friendly [39]. These facts have practical implications, since it suggests that retailers can develop effective marketing programs and strategies to influence consumers positively and attract other potential consumers to buy organic food by emphasizing the health benefits and quality of organic food [39].

The knowledge about the effect of factors, such as socialization and education, food and health literacy, and exposure to advertising, might benefit from further research in different sociocultural contexts. Beyond philosophical and reasonable arguments, some evidence points to a more strong influence of advertising on younger people while adult people are more influenced by price promotions [33].

Considering the whole range of perceived benefits from organic food, evidence also showed that acceptance of organic products is strongly associated with behaviours that orientate different lifestyles among types of consumers. Some organic food purchasers are highly reflexive, focused on health, environment, and safety, with a kind of ideological or philosophical basis and a consumption style and behavioural pattern reflecting cultural orientations devoted to the search for quality food and ecological coherence. Other consumers are more prone to a mixed consumption of food from organic farming and conventional production, choosing products from organic origin more pragmatically and instrumentally. These consumers are not driven by strong symbolic values but merely because they recognize some products as healthier or safer, or as a solution to allergy and intolerance problems, and evaluate the products according to the same parameters applied to conventional products, such as goodness or freshness. Sometimes status and lifestyle symbolism are also drivers for the choice of organic food. In both cases, there seems to be a marked willingness among consumers to accept higher costs to buy organic products [40].

Another study also identifies two major kinds of consumers according to their major driven factors of motivation. For regular consumers, the relevance of moral considerations strongly affects the purchase intentions and food consumption, and they are willing to express this sensitivity through their purchase behaviour. For occasional consumers, food safety concerns or food-related risks are more likely to generate a favourable disposition towards organic products [41]. This positive attitude can be attributed to their beliefs, compared to conventionally produced foods, that organic ones have a visibly greater capacity to promote sustainability and protect the environment [42].

In this study, most subjects in the second step of the questionnaire were in fact regular (daily) consumers (61.2%). Likewise, to note is the fact that almost two-thirds of subjects in the second step of the questionnaire, those really concerned with the farming origin of products, have daily meals composed of 41–60% of organic fruits and vegetables; and for almost one-fifth of subjects, those products represent from 61 to 80% of daily use of those families of products.

Those characteristics of consumers have a pragmatic interest for all the agents involved in the lifeline of organic

products. Overall, food producers, distribution and market agents, regulatory bodies, and consumer associations interested in supporting the growth of the organic food sector may increase the receptiveness of their messages by considering that different groups of organic buyers have different values and interests. From that, policies directed at stimulating sustainable consumption patterns and fostering public confidence in the safety standards of organic farming may be implemented, supported by communication campaigns focused more on ethical issues and the welfare of nature, or in confidence on the organic label [41].

Research on consumer motivations towards the purchase of organic food found that health consciousness, quality, subjective norms, and familiarity influence purchase intentions, but familiarity was the only variable found to exhibit a significant relationship with organic purchase behaviour [43]. This finding reinforces the idea that availability (from farming and markets), accessibility (based on families' income), literacy (knowledge about food), and exposure (use in socialization contexts beginning in the family) from an early age might be fundamental conditions to make use of organic products as a normal, conscious, and rewarding option for consumers, whatever their final decision might be.

Beyond objective characteristics of the food products, perception seems to be a key issue for the consumer behaviour.

Even considering that the opinion and actions of consumers might be influenced by the peculiarities of a market, the perceived functional value influences the trust, and the perceived emotional value, considered the subjective aspects related to pleasure and well-being for the consumer when buying organic food, influences both the trust and the purchase intention of the consumers [44].

Guiné et al. [45], in a study conducted with Portuguese and Turkish adults, found that the strongest motivations to consume organic foods include benefits for human health and lower environmental impacts.

Regarding the healthiness of food, whatever the robustness of evidence about differences between organic and conventional food, in terms of their broad content (including nutritional and pharmochemical content), perception is an important driving force for the purchase and consumption of organic food. Consumers may use organic food considering nutrition quality to be high [46]; believing that organic foods are rich in vitamins and minerals (alongside with less chemical residues) [47]; some of them in a context of a balanced diet with controlling calories and fat [48]; and the existence of a family member or close friend suffering from some disease and believing that a proper diet may have effect on disease prevention [49].

A study in a large sample of French adults showed that regular consumers of organic products were more physically active and exhibited healthier dietary patterns than non-consumers and occasional consumers. Nutrition issues included more plant foods, less sweet and alcoholic beverages, less processed meat and milk, and lower daily intakes of proteins, saturated fatty acids, sodium, alcohol, and cholesterol [50].

In this study, asking about motivations to acquire and use organic fruits and vegetables, health benefits were clearly the most relevant argument, followed by environmental concerns.

There is a context of specific concerns about health in the study. It is not surprising because in Portugal, there is a long-time public awareness about the prevalence of obesity and chronic non-communicable diseases in which high sugar consumption is somehow involved in their pathophysiology, high cholesterol intake is associated to increased prevalence of cardiovascular diseases, high salt intake is associated to increased prevalence of hypertension, and in the last few decades, there are an increased discussion about cell inflammatory environment promoted by diet.

Other studies revealed that the main reason for buying organic fruits and vegetables is health, because organic products have less pesticides, additives, fertilizers, and more vitamins and minerals [51]. Moreover, concern for the environment and resources is, after health, the second reason for buying vegetables and organic fruits particularly among young people [37].

Sustainable food systems and healthy diets are important elements to achieve a sustainable planet and lifestyle for the wellbeing of current and future generations, an equilibrium between ecosystems and human needs in line with the Sustainable Development Goals [52].

Different studies conducted in different countries revealed that positive impacts on health and taste were the main reasons for the purchase of OFV [18,53,54].

There is a growing body of scientific evidence showing the significant health and wellbeing benefits, positive societal and economic impacts, and low environmental footprints of Mediterranean Diet [52].

Considering the food diversity promoted by Mediterranean Diet, it is very interesting to note the diversity of organic vegetables and fruits listed as products purchased by subjects in this study. Regarding the high percentage of products from plant origin in the Mediterranean Diet, it can be seen as a transitional form to a plant-based diet [55]. So, one particular issue from the discussion about the organic production of food and Mediterranean Diet is the potential for a high intake of antioxidants.

In a review article, Cunha et al. [56] state that fruits and vegetables have in their composition bioactive

substances with protective effects, especially antioxidants. These bioactive substances come from the secondary metabolism of plants.

The list of antioxidants introduced into the diet through the consumption of OFV is quite extensive, with three groups standing out: vitamins (vitamin E and its major constituent α-tocopherol, and vitamin C), phenols, and carotenoids. Within these compounds, polyphenols are the most abundant and have numerous biological effects, such as free radical scavenging, inhibition of cell proliferation, and antibiotic, antiallergic, and anti-inflammatory agents, thus presenting an important role in the prevention of cancers and cardiovascular diseases [56]. Scientific evidence indicates that the consumption of organic fruits, vegetables, and cereals provides doses of additional antioxidants equivalent to eating between 1 and 2 extra servings of fruits and vegetables, from conventional agriculture, per day [17]. The same study concluded that vegetables from organic farming have higher concentrations of antioxidants (19–69%), such as phenolic acids, flavanones, stilbenes, flavones, flavonols, and anthocyanins, compared to those from conventional agriculture, also showing that the level of residues of plant protection products was four times higher in conventional crops and they contained significantly higher concentrations of the toxic metal Cadmium (Cd).

The concern with sustainable farming and the idea of food safety may be underlying the purchase practices found in our study. In fact, local or community open markets and fairs held by the producer himself, the traditional trade (neighbourhood shops) and directly at the farm, even somehow combined, are sources used by at least 30% of the respondents.

Ferreira et al. [57] proposed an original model to represent the idea that organic agriculture is a sustainable strategy for promoting public health, which is why it is proposed to include organic agriculture as an indicator of public health in the group of health determinants. Corroborating this perspective and the main finding of our research, according to Nunes et al. [58], the increasing importance of the health concern attribute in organic food consumption predictors should be highlighted.

5 Practical implications

The practical implications of this study can be identified in two major perspectives.

The first is the research perspective being a major interest of this research and its exploratory character, generating applicable knowledge and insights to a deeper approach to the OFV consumption in Portugal.

An identified limitation of the study is the absence of more detailed information regarding the health condition of organic food users and how this eventually influences food preferences and practices. It raises a challenge to deepen the health approach in future research. Also, these data associated with socio-demographic and psychographic data may be very useful to understand consumers in terms of profiles, directing more accurately every intervention to be done.

Another perspective centred on action is the opportunity to increase literacy about organic products, to raise awareness about the benefits, and to promote higher consumption of OFV products, supported not only in objective arguments but also in the perceived positive impact of organic agriculture on ecosystems and human health by consumers.

According to the research results, an important task for the producers will be to increase consumers' knowledge of what an organic product is and how to differentiate it in the marketplace. Retailers could especially emphasize and publicize the confirmed benefits of organic products from the point of view of their contribution to the promotion of consumers' health. Additionally, this study could contribute for the decision-making of Governmental structures about support to be provided to organic farmers or potential organic farmers for specific fruits or vegetables' production, which were identified as the most consumed by the participants.

6 Conclusions

Organic farming and the increased recognition of value of OFV, for health, for environment, and for economy, create an opportunity to increase broad literacy about these products, to raise awareness about the benefits of organic products, and to promote higher consumption of organic fruits and vegetables, through interventions focused on food and organic farming.

This study showed the importance of food choice and the motivations to consume organic fruits and vegetables. The main reasons reported to consume these products are the benefits for human health, as well as the benefits for the environment. Regarding the human health, the prevention of high cholesterol, the prevention of cardiovascular diseases, and the prevention of obesity are the most preferred ones.

Although this research allowed some valuable insights into the consumption of OFV such as the reasons behind food choices, it is important to highlight some limitations,

namely the recruitment of participants, which followed a snowball methodology on a convenience sample. Recognizing this drawback, our exploratory findings may be helpful from a business point of view, especially in terms of production and distribution. In fact, 33% of the respondents stated that they are not concerned about the fruits and vegetables' organic or conventional production method.

This article gives an insight into buying behaviour and profile of OFV in Portugal. The results of the research could be used for planning further research, food education, support sales, and marketing activities.

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References

[1] Real H. Dieta Mediterrânica – um padrão de alimentação saudável [Internet]. E-book. Vol. 34, 2014. p. 66. [cited 2023 Feb 20]. https://www.apn.org.pt/documentos/ebooks/Ebook_Dieta_Mediterranica.pdf.

[2] Instituto Nacional de Estatística (INE). Balança Alimentar Portuguesa 2016–2020 [Internet]. Lisboa; 2021 [cited 2023 Feb 20].

[3] Lopes C, Torres D, Oliveira A, Severo M, Alarcao V. National Food, Nutrition, and Physical Activity Survey of the Portuguese General Population, IAN-AF 2015-2016 [Internet]. 2018 [cited 2023 Jul 2]. www.ian-af.up.pt.

[4] WHO. The World Health Organization Report 2002: Reducing risks, promoting healthy life [Internet]. WHO Library Cataloguing-in Publication Data. 2002 [cited 2023 Feb 20]. p. 232.

[5] Amine EK, Baba NH, Belhadj M, Deurenberg-Yap M, Djazayery A, Forrestre T, et al. Diet, nutrition and the prevention of chronic diseases. WHO – Tech Rep Ser; 2003;916:149.

[6] WHO. Healthy diet [Internet]. 2019 [cited 2023 Feb 20]. p. 20. https://apps.who.int/iris/bitstream/handle/10665/325828/EMROPUB_2019_en_23536.pdf.

[7] Afshin A, Sur PJ, Fay KA, Cornaby L, Ferrara G, Salama JS, et al. Health effects of dietary risks in 195 countries, 1990–2017: A systematic analysis for the Global Burden of Disease Study 2017. Lancet. 2019;393(10184):1958–72.

[8] FAO/WHO International Workshop on Fruits and Vegetables in preparation for the International Year of Fruits and Vegetables 2021. FAO/WHO International Workshop on Fruits and Vegetables in preparation for the International Year of Fruits and Vegetables 2021. 2021.

[9] WHO. A guide to Worl Food Safety Day 2022 [Internet]. Sustainable Development Goals. Vol. 7, 2022. p. 1–8. [cited 2023 Feb 20]. https://www.who.int/campaigns/world-food-safety-day/2022%0D.

[10] Azevedo EC, Diniz AD, Monteiro JS, Cabral PC. Padrão alimentar de risco para as doenças crônicas não transmissíveis e sua associação com a gordura corporal - uma revisão sistemática. Ciênc e Saúde Coletiva. 2014;19(5):1447–58.

[11] Gabriela A, Bento DA. Alexandra gabriela de almeida bento pinto porto, 2016 [Internet]. 2016 [cited 2023 Feb 20]. https://repositorio-aberto.up.pt/bitstream/10216/85090/2/139141.pdf.

[12] IFOAM. Principles of organic agricultura preamble. IFOAM Organics Internacional. [Internet]; 2020. p. 4. [cited 2023 Feb 20]. https://www.ifoam.bio/principles-organic-agriculture-brochure.

[13] Ferreira JM (AGROBIO). AGRICULTURA BIOLÓGICA O que é? A Estratégia e Plano Acção Nacional em Agricultura Biológica [Internet]. 2017 [cited 2023 Jul 4]. p. 36. http://www.draplvt.mamaot.pt/DRAPLVT/Comunicacao/Noticias/Documents/seminario_Agricultura_rio_maior_2017/3_AB_agrobio.pdf.

[14] Regulamento (UE) no 2018/848 de 30 de maio de 2018 [Internet]. Jornal Oficial da União Europeia. Vol. 2018, 2018. p. 92. [cited 2023 Jul 4]. https://eur-lex.europa.eu/legal-content/PT/TXT/?uri=CELEX%3A32018R0848.

[15] EUROSTAT. No Title [Internet]. 2022 [cited 2022 Mar 20]. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Organic_farming_statistics.

[16] Comissão Europeia. Regulamento (CE) N.o 834/2007 do Conselho de 28 de Junho de 2007 relativo à produção biológica e à rotulagem dos produtos biológicos e que revoga o Regulamento (CEE) no 2092/91. J da União Eur. 2007;72:1–39.

[17] Barański M, Średnicka-Tober D, Volakakis N, Seal C, Sanderson R, Stewart GB, et al. Higher antioxidant and lower cadmium concentrations and lower incidence of pesticide residues in organically grown crops: A systematic literature review and meta-analyses. Br J Nutr. 2014;112(5):794–811.

[18] Radulescu V, Cetina I, Cruceru AF, Goldbach D. Consumers' attitude and intention towards organic fruits and vegetables: Empirical study on romanian consumers. Sustainability. 2021;13(16):1–14.

[19] Guiné RPF, Florença SG, Villalobos Moya K, Anjos O. Edible flowers, old tradition or new gastronomic trend: A first look at consumption in Portugal versus Costa Rica. Foods. 2020;9:977.

[20] Guiné RPF, Florença SG, Barroca MJ, Anjos O. The link between the consumer and the innovations in food product development. Foods. 2020;9:1317.

[21] Howell D. Statistical methods for psychology. 8th edn. Pacific Grove: Duxbury; 2013.

[22] INE. Rendimento e condições de vida [Internet]. 2022 [cited 2023 Feb 20]. p. 27. https://www.ine.pt/xportal/xmain?xpgid=ine_tema&xpid=INE&tema_cod=1110&xlang=pt.

[23] Rana J, Paul J. Consumer behavior and purchase intention for organic food: A review and research agenda. J Retail Consum Serv. 2017;38:157–65.
[24] IFOAM. The Four Principles of Organic Agriculture [Internet]; 2020 [cited 2023 Feb 20]. https://www.ifoam.bio/why-organic/shaping-agriculture/four-principles-organic.
[25] Darnhofer I. Contributing to a transition to sustainability of agri-food systems: Potentials and pitfalls for organic farming. In: Bellon S, Penvern S, editors. Organic farming, prototype for sustainable agricultures: prototype for sustainable agricultures. Springer; 2014. p. 439–52.
[26] Darnhofer I, Lindenthal T, Bartel-Kratochvil R, Zollitsch W. Conventionalisation of organic farming practices: from structural criteria towards an assessment based on organic principles. A review. Agron Sustain Dev. 2010;30:67–81.
[27] European Union. European Union – Council Regulation (EC) No 834/2007 [Internet]. Official Journal of the European Union; 2007. p. L189. [cited 2023 Jul 4]. https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX%3A32007R0834.
[28] European Union. European Union – Commission Regulation (EC) No 889/2008 [Internet]. Official Journal of the European Union; 2008. p. L250. [cited 2023 Jul 4]. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32008R0889.
[29] Varaldo A, Borra D, Vassallo E, Massimelli F, Massaglia S, Merlino VM. A study on perceptions towards organic and local production, and individuals' socio-demographic and geographical affiliation influencing fruit and vegetable purchasing prefer-ences of EU households. Horticulturae. 2022;8(8):670.
[30] Sanders J, Richter T. Impact of socio-demographic factors on consumption patterns and buying motives with respect to organic dairy products in Switerland. In Socio-economic aspects of animal health and food safety in organic farming systems. In: Proceeding of the 1st SAFO Workshop - SAFO Sustaining Animal Health and Food Safety in Organic Farming A European Commission funded Concerted Action Project; 2003. p. 211–8.
[31] Hassan D, Monier-Dilhan S, Nichele V, Simioni M. Organic food consumption patterns in France. International Association of Agricultural Economists. 2009 [cited 2023 Feb 20]. p. 15.
[32] Gotschi E, Vogel S, Lindenthal T. High school students' attitudes and behaviour towards organic products: survey results from Vienna. Diskussionspapier. 2007;DP:27.
[33] Sharma N, Singhvi R. Consumers perception and Behaviour towards organic food: A systematic review of literature. J Pharmacogn Phytochem. 2018;7(2):2152–5.
[34] Sivathanu B. Factors affecting consumer preference towards the organic food purchases. Indian J Sci Technol. 2015;8(33):1.
[35] Enthoven L, Van den Broeck G. Local food systems: Reviewing two decades of research. Agric Syst. 2021;193:103226. doi: 10.1016/j.agsy.2021.103226.
[36] Zhen JS, Mansori S. Young female motivations for purchase of organic food in Malaysia. Int J Contemp Bus Stud. 2012;3:61–72.
[37] Radman M. Consumer consumption and perception of organic products in Croatia. Br Food J. 2005;107:263–73.
[38] Wier M, Calverley C. Market potential for organic foods in Europe. Br Food J. 2002;104(1):45–62. doi: 10.1108/00070700210418749.
[39] Paul J, Rana J. Consumer behavior and purchase intention for organic food. J Consum Mark. 2012;26(6):412–22.
[40] Pellegrini G, Farinello F. Organic consumers and new lifestyles: An Italian country survey on consumption patterns. Br Food J. 2009;111(9):948–74.
[41] Pino G, Peluso AM, Guido G. Determinants of regular and occasional consumers' intentions to buy organic food. J Consum Aff. 2012;46(1):157–69.
[42] Tandon A, Dhir A, Kaur P, Kushwah S, Salo J. Why do people buy organic food? The moderating role of environmental concerns and trust. J Retail Consum Serv. 2020;57(July):102247. doi: 10.1016/j.jretconser.2020.102247.
[43] Smith S, Paladino A. Eating clean and green? Investigating consumer motivations towards the purchase of organic food. Australas Mark J. 2010;18(2):93–104.
[44] Watanabe EA, Alfinito S, Curvelo ICG, Hamza KM. Perceived value, trust and purchase intention of organic food: A study with Brazilian consumers. Br Food J. 2020;122(4):1070–184.
[45] Guiné RPF, Florença SG, Costa DTVA, Çelik S, Ferreira M, Cardoso AP, et al. Comparative study about the consumption of organic food products on samples of Portuguese and Turkish consumers under the COVID-19 Pandemic Context. Agronomy. 2022;12:1385.
[46] Kranjac M, Vapa-Tankosic J, Knezevic M. Profile of organic food consumers. Ekon Poljopr. 2017;64(2):497–514.
[47] Nasir VA, Karakaya F. Consumer segments in organic foods market. J Consum Mark. 2014;31(4):263–77.
[48] Radojević V, Tomaš Simin M, Glavaš Trbić D, Milić D. A profile of organic food consumers—Serbia case-study. Sustain. 2020;13(1):1–22.
[49] Grubor A, Djokic N. Organic food consumer profile in the Republic of Serbia. Br Food J. 2016;118(1):164–82.
[50] Kesse-Guyot E, Péneau S, Méjean C, Szabo de Edelenyi F, Galan P, Hercberg S, et al. Profiles of organic food consumers in a large sample of French adults: Results from the Nutrinet-Santé Cohort Study. PLoS One. 2013;8(10):13.
[51] Padel S, Foster C. Exploring the gap between attitudes and behaviour: Understanding why consumers buy or do not buy organic food. Br Food J. 2005;107:606–25.
[52] Petkoska AT, Trajkovska-Broach A. Sustainable food systems and healthy diets: The case of mediterranean diet. Acta Hortic Regiotect. 2021;24(2):110–8.
[53] Schleenbecker R, Hamm U. Consumers' perception of organic product characteristics. A review. Appetite. 2013;71:420–9. doi: 10.1016/j.appet.2013.08.020.
[54] Talwar S, Jabeen F, Tandon A, Sakashita M, Dhir A. What drives willingness to purchase and stated buying behavior toward organic food? A Stimulus–Organism–Behavior–Consequence (SOBC) perspective. J Clean Prod. 2021;293:125882. doi: 10.1016/j.jclepro.2021.125882.
[55] Lima M, Costa R, Lameiras JBG. Plant-based diets: A narrative review. Acta Port Nutr. 2021;26:46–52.
[56] Cunha AL, Moura KS, Barbosa JC, Dos Santos AF. Os metabólitos secundários e sua importância para o organismo. Divers J. 2016;1(2):175–81.
[57] Ferreira F, Mendes-Moreira P, Botelho G. Is organic agriculture a potential public health indicator? Evidence from literature. Open Agric. 2021;5:914–29.
[58] Nunes F, Madureira T, Veiga J. The organic food choice pattern: Are organic consumers becoming more alike? Foods. 2021;10(5):983.