



Research article

Consumption vs. non-consumption of plant-based beverages: A case study on factors influencing consumers' choices

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Abstract: Plant-based beverages (PBBs) represent a growing global alternative to cow's milk. However, their development is strongly influenced by consumers' expectations of new foods introduced into the diet: environmental sustainability, balanced nutritional content, health aspects, and organoleptic properties. This study analyzes consumers' preferences and choice orientations towards plant-based beverages through the assessment of their eating style and concern towards environmental and health issues. To that end, an online questionnaire was conducted with a sample of 233 respondents living in the South-East area of Italy. Initially, principal component analyses were performed to identify distinct dimensions of individuals' orientation towards food quality, environment and health involvement. Then, the emerging dimensions were used as dependent variables for ANOVA comparisons between consumers and non-consumers of plant-based beverages, considering also individuals' preferences towards different PBBs. The main results showed a strong consumer concern for environmental sustainability issues, which was found as the main purchasing driver for plant-based beverage consumers. On the other hand, many respondents stated that they do not consume PBBs due to their negative organoleptic aspects and the unfamiliarity with these products. Furthermore, the individual's dietary style influences the consumption of plant-based beverages and, in particular, the search for nutritional and balanced compounds plays a key role in consumption choices. Finally, despite that the almonds cultivation for the traditional 'almond milk' production is typical in various

Italian regions, consumers expressed averagely a weak connection with this product. In conclusion, considering our results, the market development of PPBs at a national level might be supported by marketing strategies dedicated to different individuals' profiles. At the same time, however, direct actions on the production process are needed to improve the organoleptic profile of these products and meet the dissatisfaction expressed by consumers.

Keywords: plant-based beverages; novel food; sustainability; eating styles; attitudes; consumer analysis

1. Introduction

Consumer acceptance of new food is influenced by many factors: pleasant or familiar taste, nutritional information, health benefits and product sustainability [1,2]. The latter elements of preference compare two market segments that often contrast each other when making consumption choices [3]: plant-based beverages (PBBs) and cow's milk. The different consumer opinions about these two products are related to various factors (e.g., health, animal welfare and environmental sustainability), lifestyles (e.g., vegetarian and vegan) and familiarity (taste, experience and habit) that can influence acceptance, perception and motivation to consume the product [2,4]. Cow's milk has always been considered an essential source of human nutrition, especially from a health perspective due to its high content of calcium, protein and vitamins [5,6]. Moreover, the success of dairy products has been driven by preferences toward local food with national origin and toward traditional production [7–9]. However, new consumer attitudes, habits and lifestyles have negatively affected the consumption of cow's milk. The dairy supply chain is today the subject of much social attention because of its environmental impact and the ethical consideration of animal welfare [10].

Consequently, plant-based diets have become popular as a means of reducing the environmental footprint of the diet and promoting human health and animal welfare. From the point of view of environmental sustainability, as well as indirectly (as an alternative source to animal protein), the production of plant-based beverages fits directly positively into the current context of ecological transition that national agriculture is currently experiencing. There are several projects and initiatives for the promotion of the twin transition in the agri-food industry. New resources fit in with the up-cycling of by-products in the feed industry as an energy resource in the perspective of the circular economy. Such applications are becoming increasingly important for the vegetable beverage sector where tegument or processing waste finds important locations for a more sustainable and innovative agriculture from an environmental (food waste reduction and re-employment valorization) and social (i.e., food competition problem) perspective.

In countertendency, plant-based beverages consumption showed an increasing trend in the last years [11,12]. The positive tendency toward vegan diets has increased by 360% in 10 years globally, driven by affirmed individuals' food style (vegetarian or vegan), market drivers (the declining market price of plant-based substitutes for cow's milk) together with social and ethical concerns related to animal production systems (credence towards animal welfare, gas emission, land usage and water usage) [13,14].

In addition, consumers are also choosing plant-based beverages for health reasons [15–17]. In particular, the increasing lactose and casein intolerance in modern society has meant that the absence of these nutritional components in plant-based beverages has been an additional driver for choosing plant-based alternatives over animal milk [12].

In Italy, in 2022, the number of consumers buying PBBs is steadily growing and this segment recorded sales of 292 million euros, positioning itself as the category with the highest market value in the plant-based segment. The best-selling type of PBBs is soy-based PBBs, followed by oats and almonds, which are steadily growing [20].

However, about 40% of Italian buyers of PBBs state that they are driven by curiosity about this type of product [21,22]. Consequently, the presence of off-flavor determined by the enzymatic activity of lipogenesis is often recognized in the product, which often results in poor acceptability to new consumers [15,18,19]. In fact, despite the spread and market differentiation of vegetable-based beverages, in some geographical areas including Italy, consumers continue to harbor a feeling of skepticism towards a product far removed from culinary tradition. In Italy in particular, outside of the so-called “almond milk” (a sweet almond-based drink traditionally consumed nationwide), typically produced in the country's southern regions, PBB consumption is relatively recent (dating back to the early 2000s). In the literature, several international studies have analysed the choice motivations of plant-based beverage consumers. McCarthy et al. (2017) [12] conducted a comparative study between consumers of cow's milk and consumers of plant-based beverages exploring the personal values behind the purchase of each product and the importance given by different product attributes. Giacolone et al. (2022) [23] conducted a review of the main barriers to the consumption of plant-based products, showing a high impact on sensory properties, familiarity and usage and the credence attributes of products. Therefore, various aspects influence the consumption and choice of plant-based beverages. In an extremely dynamic and emerging market, especially for certain product variants, the following hypotheses were developed in this research:

H1: There is a significant difference between the consumers and non-consumers of plant-based beverages in terms of food style.

H2: The two groups show significant differences in terms of concerns for the environmental sustainability of food production.

H3: There is a significant difference between the two groups in terms of concerns for the food's nutritional and health aspects.

H4: There is a significant difference between the two groups in terms of the attention given to the different intrinsic and extrinsic attributes of food.

H5: The two groups show significant differences in terms of sensitivity towards the different issues related to the food sustainability concept.

In this context, a questionnaire was shared in Apulia (South-Eastern Italy), the second most important region for Italian almond production (from which is made the "almond milk"), to reach the following aims: 1) Define the characteristics of consumers and nonconsumers of PBBs. 2) Explain the attitudes towards the environment and health and the food styles that guide the choices of the two groups of consumers. 3) Assess the consumers choice preferences towards plant-based beverages. 4) Evaluate the heterogeneity of individuals choices concerning different kinds of PBBs available on the national market. The choice of the Apulia region as the context for data collection was made to facilitate the achievement of the main research objective, i.e., the comparison between consumers and non-consumers of plant-based beverages. To this end, we have specifically chosen a region with a high vocation and traditionally linked to the production of almonds for the production of vegetable drinks to start from a context closer to the product.

This study contributes to enriching the scientific literature by representing one of the few studies conducted in Italy on the factors influencing consumer acceptance of plant-based beverages in one of

the areas of the country most associated with the production of raw materials used in PBB production. The research contributes to filling a gap in the scientific literature concerning the identification of the choice profiles of plant-based beverages with a holistic approach that considers not only preferences but also attitudes towards environmental protection and health concerns by comparing consumers and non-consumers of PBBs. In addition to framing the choice factors and awareness of the interviewed consumers, this study aims to highlight any problems encountered at the commercial level.

2. Materials and methods

2.1. Data collection

An online-based survey was developed and administered to a convenience sample of 233 voluntary participants in the period between May and September 2022 using Google Forms. The validated version of the questionnaire was submitted to individuals from the Apulia region (Southeast of Italy) using social and electronic media such as Facebook, Instagram, WhatsApp and e-mails. The survey was conducted following the ethical standards laid out in the Declaration of Helsinki and was approved by the Bioethics Committee of the University of Turin (protocol number 0202725, 13/04/2022). Informed consent was obtained by the participants before they started filling in the questionnaire. The questionnaire was anonymous, did not include sensitive data and was developed in the Italian language. An initial question in the survey was designed to ask whether the respondent consumed PBBs to divide the sample into PBBs consumers and nonconsumers. Inclusion criteria to fill in the questionnaire were required, i.e., to be at least 18 years old.

The questionnaire was divided into 4 different sections. The first section investigated the socio-demographic characteristics of the respondents. The second section dealt with the analysis of eating habits and attitudes towards food. In particular, consumers were asked to value the importance of different items related to food sustainability and nutritional value (*Food sustainability and nutritional characteristics scale*) (Table 1) [23,24]. This latter scale was composed of 15 items (Cronbach's Alpha was equal to 0.95) adapted by combining the items of the environmental impact of the food chain introduced by [25], the social and economic sustainability indicators included in [26] and the nutritional characteristics of food introduced, in general by [27] and in particular relating to plant-based beverages, by [28]. Answers were given on a 6-point Likert scale ranging from 0 = not important at all to 6 = extremely important.

Subsequently, consumers were asked to rate the importance associated with 10 items contained in the *Dietary Styles Scale* (Table 1) (Cronbach's Alpha 0.82) adapted by [29–31]. Answers were given on a 6-point Likert scale ranging from 0 = strongly disagree at all to 6 = strongly agree.

In the same section, the *Food choice preferences scale* was employed to assess the importance given by consumers to 15 food attributes derived from the combination of items already used by [23,32] (Cronbach's Alpha 0.95). In this scale both credence, intrinsic and extrinsic attributes were included. Answers were given on a 6-point Likert scale ranging from 0 = not important at all to 6 = extremely important.

Specifically, intrinsic attributes are product's own characteristics (color, nutritional characteristics, organoleptic characteristics), extrinsic attributes are assessable by observing the product (packaging, brand name, price), while credence attributes are characteristics whose veracity cannot be assessed even after purchase and consumption (local origin, organic certification, etc.) [33,34].

In the third section, the sensitivity of the sample towards several aspects of environmental sustainability was assessed by administering the *Sustainability Scale* published by [35] and composed of 38 items measuring 5 factors (Table 2). Answers were given on a 6-point Likert scale ranging from 0 = strongly disagree at all to 6 = strongly agree.

The fourth section of the questionnaire measures the consumption aspects of PBBs: 1) motivations for consumption or non-consumption of PBBs; 2) the type of plant-based beverages habitually consumed (only for consumers).

2.2. Data analysis

To verify the factorial structure of the scales, principal component analyses (PCAs) were performed. This technique allows the identification of distinct consumption patterns defined by individual preferences toward selected items [36]. A total of four PCAs were run considering the scales already described in Tables 1 and 2.

The application of PCA involves organizing a dataset as an $m \times n$ matrix, where m denotes the number of measurement types and n is the number of trials. This analysis considers a smaller number of parameters, compared with the starting one, that represent the new latent variables (or principal components) and their contribution is ranked according to variance [38]. In addition, it makes it possible to limit the loss of information and interpretation of the matrix containing the source data by grouping the responses from a large number of questions into a limited number of components [39].

PCA is a widely used multivariate statistical methodology in market analysis, particularly in studies assessing consumer preferences and attitudes as a function of purchasing behavior and product characteristics [36,40–42]. In addition, the use of this type of analysis shows the possibility of applying mathematical methods to achieve practical solutions to problems arising from the implementation of consumer choice of a specific food product [43]. This approach is useful for applying critical decisions to the agribusiness context [44]. Furthermore, the differences in respondents' attitudes and orientations were evaluated using one-way analyses of variance (ANOVAs), comparing consumers and non-consumers of PBBs. In particular, the ANOVA technique allowed us to detect significant differences in the components that emerged from the PCAs [45], after verifying their reliability through the examination of Cronbach's Alpha. Further ANOVAs were performed to compare the preferences for different types of PBBs (i.e., soya, coconut, rice, oats and almond).

Finally, a correlation analysis (Pearson's r) [46-48] was run among the different components that emerged in the PCAs. All statistical analyses were performed using IBM SPSS statistics software (version 28.0).

Table 1. Description of scales used for PCAs.

Question	Scale	Items	Cronbach's Alpha
<i>How important do you rate from 0 (not at all important) to 6 (very important) the following characteristics related to food sustainability and nutritional characteristics?</i>	<i>Food sustainability and nutritional characteristics scale</i>	Use of alternative energy	0.95
		Carbon footprint certification (for low CO2 emissions)	
		Water footprint certification (for limited water use)	
		Reduced use of chemical compounds (e.g., pesticides)	
		Short supply chain	
		Local origin	
		Organic production method	
		Biodegradable or recyclable packaging	
		Vitamin content	
		Mineral content	
		Protein content	
		Caloric content	
		Fat content	
		Sugar content	
Unsaturated fat content			
<i>How much do you agree from 0 (strongly disagree) to 6 (strongly agree) with the following attitudes and food choices?</i>	<i>Dietary styles scale</i>	I pay more attention to quality than quantity	0.82
		I avoid unnatural ingredients	
		I eat fresh foods	
		I eat with moderation	
		I eat in a chaotic and unregulated way, without a schedule	
		I don't pay attention to what I eat	
		I am focused mainly on taste and palate enjoyment	
		I pay attention to the calories I consume	
		I try to balance all nutrients	
		I pay more attention to quantity than quality	

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Question	Scale	Items	Cronbach's Alpha
<i>How important do you rate from 0 (not at all important) to 6 (very important) the following food attributes during your food choices?</i>	<i>Food choice preferences scale</i>	Processing area	0.95
		Local/regional origin of raw material	
		Organic certification	
		Sustainability of the production chain	
		Ethical certification	
		Environmental sustainability of packaging material	
		Label information (indications on how to use the product)	
		Label information (nutritional value)	
		Nutritional content	
		Easy opening of the package	
		Price	
		Presence of offers	
		Taste	
Familiar brand			
Expiration date			

Table 2. Items of the *Sustainability scale* (Haan *et al.*, 2018).

<i>Thinking about the guiding principles that guide your lifestyle and choices, indicate the degree to which you agree with the following statements (0 = strongly disagree; 6 = strongly agree)</i>		
Factors	Items	Cronbach's Alpha
Spending	Sustainable living is too expensive	0.89
	I am fine with green power being slightly more expensive than other forms of energy	
	It is understandable that sustainable living costs a little extra	
	I am willing to pay slightly more for environmentally friendly products	
	I am willing to pay slightly more to drive an electric car instead of a regular one	
	Sustainability is overrated	

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Factors	Items	Cronbach's Alpha
Trust	I lack concern for sustainability	0.71
	I find living comfortably more important than living sustainably	
	The value of organic products is overrated	
	People worry too much about the environment	
	As time goes by, nature will recover again	
	I believe hunting is good for the balance in nature	
	Animal rights are blather	
Responsivity	The government should ensure a sustainable society	0.85
	Sustainability is important in my choice for a political party	
	Supermarkets should only sell organic meat	
	Companies should be subsidized for being sustainable	
	Nature shops should receive subsidies	
	I worry about the rising sea level	
	The government should do more to solve climate-change problems	
Support	You should be really careful with all resources provided by Nature	0.75
	Sustainability is a threat to a strong economy	
	I find it annoying having to use different containers for different types of waste	
	I am in favor of installing as many solar panels as possible	
	Many people exaggerate in their efforts for saving energy	
Mobility	Most people waste a lot of water	0.87
	I like to travel by public transport	
	I prefer to travel by car	
	Fuel should become more expensive, so that more people will travel by public transport	
	Car owners should pay more for driving their cars	
	Car owners are careless about the environment	

3. Results

3.1. Socio-demographic characteristics of the sample

Table 3 shows the socio-demographic characteristics of the 233 participants who completed the online questionnaire. The participants were equally divided between men and women, with a slight predominance of the male gender. Participant age ranged from 18 to 77 and the mean was 42.61 with a *sd* (standard deviation) of 16.78. More than half of the respondents belonged to the age group of 18 to 25 or the age group of over 55, had a medium to a high level of education, and belonged mainly to families of 4 members. Considering the population of Puglia as of January 1, 2021 (3,933,777 total inhabitants), the gender distribution in the sample of respondents was balanced and comparable to that of the region of origin, as was the proportion in the different age groups (except for the younger population, which was more represented in the sample considered than the regional population). The average number of household members in the sample was 3, slightly higher than the regional average of 2.3. Finally, considering the level of education, the sample considered was characterized by a medium-high degree of instruction, deviating from the regional average level. In fact, the average data for highest level of education achieved in Puglia shows that in 2020, 17% of the total population with an elementary school degree, a 32% with a lower middle school degree, a 32% with a high school degree and a 19% with a master's degree [49].

3.2. PBBs consumption or non-consumption

More than half of the respondents (57%) (n=132) did not consume plant-based beverages. Within the questionnaire, the response options concerning the causes of the presence or absence of consumption of PBBs could be selected multiple times by respondents, who could therefore choose several options within the single response concerning this topic. Consequently, in this context, the number of responses exceeded the number of respondents. Accordingly, the reasons for choosing not to consume this type of product are shown in Table 4. Most of the respondents had tasted a plant-based beverage at least once. However, among the factors for not consuming PBBs, lack of habit of consuming these products and not liking the taste prevailed. An interesting result is the significant percentage of individuals who chose as their motivation the one associated with lack of opportunities for use.

Table 3. Socio-demographic characteristics of the sample.

Variable	Description	Number of respondents	Share of sample (%)
Gender	Female	115	49.4
	Male	118	50.6
	I prefer not to answer	0	0.0
Age range (years)	18–25	65	27.9
	26–35	35	15.0
	36–45	23	9.9
	46–55	40	17.2
	56–65	52	22.32
	66–77	18	7.68
	Household composition	1	14
2		34	14.6
3		46	19.7
4		88	37.8
5		47	20.2
6		3	1.3
7		0	0.0
8		1	0.4
Presence of children	Yes	123	52.8
	No	110	47.2
Education	Elementary school	1	0.4
	Lower secondary school	5	2.2
	Upper secondary school	85	36.5
	Degree	113	48.5
	Post-graduate/Master's degree/ Specialization/PhD	29	12.4

Table 4. Main reasons for PBBs non-consumption.

Factors determining the absence PBBs non-consumption	Number of respondents	%
High-calorie content	4	2
Lack of PBBs consumption habit	71	37
I don't like them	65	34
High price	14	7
Never tasted product	1	1
Absence of consumption occasion of PBBs	34	18
Lack of knowledge about PBBs	1	1
Product considered too sweet	1	1
Product considered unhealthy	1	1
Product considered not environmentally sustainable	1	1
Total	193	100

Considering, instead, the reasons for consuming PBBs, the answers were more homogeneous among the 101 consumers. The most frequent reason was “I like it” referring to the taste aspect, followed by the statements that it is a healthy product and that it is an integral part of the diet. On the other hand, the least frequent reasons for consumption were “it is more digestible’,” “I use it in a protein-based diet,” “I use it in sport,” and “it is an ethical product.” In addition, “as an alternative to cow's milk” also emerged as a low motivation for consumption (Table 5).

Table 5. Main reasons for PBBs consumption.

Factors determining PBBs consumption	Number of respondents	% on total
I like them	70	32
They are nutritious	18	8
PBBs consumption habits	16	7
Product considered healthy	29	13
PBBs as an integral part of dietary style	30	14
Product considered sustainable	18	8
Product considered ethical	6	3
Lactose intolerance	17	8
Use in protein-based diets	1	1
Use as an alternative to cow's milk	7	3
Employment in the sports field	3	1
Product considered more digestible	1	1
Total	216	100

3.3. Attitudes and orientation towards PBBs: Consumers vs. non-consumers

3.3.1. Analysis of Dietary Styles

Based on the consumers' answers regarding eating habits (dietary styles scale), three main components were identified through the PCA that together explain 65% of the total variance. The first factor, named “healthy diet style” (explaining 34% of the total variance), represents eating habits related to product quality and freshness and moderated consumption. The second factor, named “chaotic diet style”, (explaining 19% of the total variance) represented those drivers of consumption that are mainly linked to taste and palatability. Subjects with this food consumption orientation do not pay attention to what they eat, and the time of consumption occurs haphazardly, without fixed schedules. The third component, named “hedonic diet style,” (explaining 12% of the total variance) focuses on the caloric components of food and the nutrient balance but attaches more importance to the quantity consumed rather than the quality of the products (Table 6).

Table 6. Promax rotated PCA on Dietary Styles Scale.

Items	Principal components		
	Healthy diet style	Chaotic diet style	Hedonic diet style
I pay more attention to quality than quantity	0.89		
I avoid non-natural ingredients	0.81		
I eat fresh food	0.70		
I eat with moderation	0.51		
I eat in a chaotic and unregulated manner, without a schedule		0.84	
I don't pay attention to what I'm eating		0.78	
I am focused mainly on taste and palate enjoyment		0.60	
I pay attention to the calories I consume			0.74
I try to balance all nutrients			0.71
I pay more attention to quantity than quality			0.60

Notes. Kaiser-Meyer-Olkin index = 0.75. Bartlett's sphericity test: Chi-square = 815.94; p-value = 0.000. Non-significant values ($\leq \pm 0.3$) are not shown.

The matrix of loadings obtained by each new rotated component was employed to compare the factors healthy, chaotic and hedonic diet styles between consumers and non-consumers of plant-based beverages (Table 7). The results showed that the consumption or non-consumption of PBBs did not affect the individuals' dietary style as no significant difference emerged (p -value > 0.05).

Table 7. Analysis of variance (ANOVA): dietary styles in the two groups of respondents.

Principal components	PBBs consumers/non-consumers	N	Mean	SD	F	Sig.
Healthy diet style	Non-consumers	134	3.90	1.27	0.551	n.s.
	Consumers	99	4.04	1.17		
	Total	233	3.94	1.24		
Chaotic diet style	Non-consumers	134	2.07	1.20	1.121	n.s.
	Consumers	99	1.88	1.05		
	Total	233	2.02	1.16		
Hedonic diet style	Non-consumers	134	2.81	1.17	0.061	n.s.
	Consumers	99	2.85	1.12		
	Total	233	2.82	1.16		

Sig.: Is referred to the statistical significance level (p-value); n.s. = not significant. N: number of responses; SD: standard deviation; F: Fisher Snedecor F-test.

These results reject the first research hypothesis (H1) highlighting no significant statistical difference between the two considered groups.

3.3.2. Sustainability and nutritional characteristics of foods

A further PCA analysis defined two new influential components (68% of the total variance) on consumers' purchasing behavior and attitudes towards PBBs focusing on the *Food sustainability and nutritional characteristics* scale. The first factor (accounting for 51% of the total explained variance) was named “Attention to the environment” and was characterized by high attention towards aspects linked to sustainable food production: the local and organic origin of products, short supply chain, biodegradable or recyclable packaging, and low emissions. On the other hand, the second factor (accounting for 17% of the total explained variance), was named “attention to nutritional and health aspects” and represented a food choice orientation based on the attention to the nutritional and health aspects of food, such as fat, vitamin, and mineral content (Table 8).

Table 8. Varimax rotated PCA on food sustainability and nutritional characteristics.

Items	Principal components	
	Attention to the environment	Attention to nutritional and health aspects
Use of alternative energy	0.81	
Carbon footprint certification (for low CO ₂ emissions)	0.80	
Short supply chain	0.79	
Vitamin content		0.79
Mineral content		0.78
Water footprint certification (for limited water use)	0.77	
Biodegradable or recyclable packaging	0.74	
Local origin	0.73	
Organic production method	0.70	
Protein content		0.33
Reduced use of chemical compounds (e.g., pesticides)	0.63	
Caloric content		0.50
Fat content		0.66
Sugar content		0.66

Kaiser-Meyer-Olkin index = 0.90. Bartlett's sphericity test: Chi-square = 2857.23; p-value = 0.000. Non-significant values ($< \pm 0.3$) are not shown.

Also in this case, the analysis of variance was employed to define significant differences in the importance attributed to environmental sustainability and nutritional and health-related characteristics comparing consumers and non-consumers of PBBs. The results reported in Table 9 show that the consumers of PBBs pay more attention to environmental issues than the respondents who stated that they do not consume these products. Thus, H2 is accepted. In contrast, regarding nutritional and health aspects, no significant difference emerged between the two groups. Thus, H3 is rejected (Table 9).

Table 9. Analysis of variance (ANOVA): attention to the environment, nutritional, and health aspects in the two groups of respondents.

Principal components	PBBs consumers/non-consumers	N	Mean	SD	F	Sig.
Attention to the environment	Non-consumers	134	3.47	1.40	12.627	***
	Consumers	99	4.12	1.39		
	Total	233	3.75	1.43		
Attention to nutritional and health aspects	Non-consumers	134	3.61	1.28	2.817	n.s.
	Consumers	99	3.91	1.41		
	Total	233	3.74	1.34		

Sig.: Is referred to the statistical significance level (p-value): *** < 0.001; n.s. = not significant. N: number of responses; SD: standard deviation; F: Fisher. Snedecor F-test.

3.3.3. Food choice preferences scale

The third PCA was performed considering the *Food Choice Preferences Scale*. Two factors were extracted explaining the 71% of the total variance. The first factor (accounting for 64% of the explained variance) was named “credence attributes” because it represents an attitude guided by the attention toward local origin, ethical certification and production chain sustainability. The second factor (accounting for 7% of the explained variance) was named “intrinsic/extrinsic attributes” and measured the attention to attributes linked to the food aspect, convenience and organoleptic characteristics (Table 10).

Table 10. Varimax rotated PCA on food credence and intrinsic/extrinsic attributes.

Items	Principal components	
	Credence attributes	Intrinsic/extrinsic attributes
Processing area	0.85	
Local/regional origin of raw material	0.84	
Organic certification	0.78	
Supply chain sustainability	0.77	
Ethical certification	0.76	
Environmental sustainability of packaging material	0.72	
Presence of offers		0.84
Taste		0.82
Expiration date		0.80
Price		0.77
Label information (nutritional value)		0.72
Nutritional content		0.72
Fat content		0.67
Well-known brand		0.54
Easy opening of the package		0.49
Label information (directions on how to use the product)		0.49

Kaiser-Meyer-Olkin index = 0.92. Bartlett's sphericity test: Chi-square = 1757.23; p-value = 0.000. Non-significant values (<±0.3) are not shown.

In Table 11, the differences in the preferences expressed by the sample in the function of the consumption/non-consumption of PBBs are described. In particular, significant differences emerged in the attention towards intrinsic/extrinsic comparing consumer and non-consumer of PBBs. In fact, consumers of PBBs, compared to respondents who stated that they do not consume them, attach greater importance to product attributes such as nutritional content, taste, price, expiry date, fat content and brand awareness. In addition, significant differences emerged in the attention toward credence attributes between the two groups of individuals. Thus, H4 is accepted.

Table 11. Analysis of variance (ANOVA): attention to extrinsic/intrinsic and credence food attributes in the two groups of respondents.

Principal components	PBBs consumers/non-consumers	N	Mean	SD	F	Sig.
Credence Attributes	Non-consumers	134	2.57	0.89	11.724	**
	Consumers	99	2.98	0.94		
	Total	233	2.74	0.93		
Intrinsic/extrinsic attributes	Non-consumers	134	3.89	1.68	8.287	**
	Consumers	99	4.45	1.11		
	Total	233	4.13	1.49		

Sig: Is referred to the statistical significance level (p-value): ** < 0.01. N: number of responses; SD: standard deviation; F: Fisher. Snedecor F-test.

3.3.4. Environmental sustainability

Table 12 shows the difference in the averages obtained from the importance attached to the different components already validated by Haas et al. (2018) by comparing consumers and non-consumers of PBBs. The results show a significant difference between the two groups of individuals. Only in the case of spending and trust factors, consumers of PBBs showed a greater willingness to spend on plant-based beverages that are identified as being more environmentally friendly and they showed a higher level of trust in sustainability processes compared to non-consumers of PBBs. These latter results allow us to partially reject the last research hypothesis (H5: the two groups show significant differences in terms of sensitivity towards the different issues related to the food sustainability concept).

Table 12. Analysis of variance (ANOVA) on sustainability scale factors in the two groups of respondents.

Principal components	PBBs consumers/non-consumers	N	Mean	SD	F	Sig.
Spending	Non-consumers	134	2.85	1.32	5.864	**
	Consumers	99	3.28	1.33		
	Total	233	3.03	1.34		
Trust	Non-consumers	134	4.32	0.93	2.950	*
	Consumers	99	4.53	0.91		
	Total	233	4.41	0.92		
Responsibility	Non-consumers	134	3.34	1.16	0.697	n.s.
	Consumers	99	3.22	1.14		
	Total	233	3.29	1.16		
Mobility	Non-consumers	134	2.02	1.17	0.240	n.s.
	Consumers	99	2.09	1.11		
	Total	233	2.05	1.14		
Support	Non-consumers	134	3.34	1.16	0.697	n.s.
	Consumers	99	3.22	1.14		
	Total	233	3.29	1.16		

Sig: Is referred to the statistical significance level (p-value): ** < 0.01; n.s.= not significant. N: number of responses; SD: standard deviation; F: Fisher Snedecor F-test.

3.4. Differences in consumer orientation and attitudes based on individuals' preferences toward PBBs type

In Table 13 (see Appendix) the results about the influence of the consumption of a specific plant-based drink (soya, coconut, rice, oats and almond) on the extracted factors are reported. The weighting given by consumers according to their preferences towards different plant-based beverages changes in a statistically significant way in the case of the healthy eating style component and spending attitudes towards sustainability. In particular, consumers of rice drinks were more attentive to healthy consumption patterns and less convinced of the spending aspects of environmental sustainability daily attitudes and behaviors. In parallel, the consumption of oat-based beverages seems to be dissociated with individuals with a chaotic food style but linked with people more attentive to the environment, nutritional and health aspects.

3.5. Correlation analysis (Pearson's *r*) among the investigated variables

Table 14 (see Appendix) shows the results of the correlation analysis. Only the significant coefficients are reported. The attention to quality aspects includes the consideration of both credence and intrinsic and extrinsic quality attributes of products. At the same time, the attention to aspects of credence was positively correlated with the willingness to spend on a sustainable product, a healthy lifestyle and attention to the environment. In parallel, instead, the attention toward the intrinsic attributes of the product was positively correlated with the attention toward the nutritional and health aspects of foods. Another interesting finding is the negative correlation between trust and responsibility and support.

Table 13. ANOVAs on the new obtained factors in function of the consumption of the different plant-based beverages types.

Dependent Variables (Principal components)	Almond			Soy			Coconut			Rice			Oat			F	Sig.
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD		
Healthy diet style	99	3.88	0.20	40	3.83	0.23	24	3.82	0.30	38	4.16	0.25	46	3.96	0.23	0.63	*
Chaotic diet style	99	1.78	0.19	40	1.94	0.22	24	1.61	0.28	38	1.61	0.21	46	1.52	0.21	0.85	n.s.
Hedonic diet style	99	2.92	0.19	40	2.81	0.22	24	2.97	0.28	38	2.65	0.21	46	2.86	0.21	0.42	n.s.
Attention to the environment	99	4.09	0.21	40	3.81	0.25	24	4.05	0.32	38	3.77	0.23	46	4.06	0.24	1509.87	n.s.
Attention to nutritional and health aspects	99	4.09	0.21	40	3.81	0.25	24	4.05	0.32	38	3.77	0.23	46	4.06	0.24	1033.55	n.s.
Credence attributes	99	2.93	0.15	40	2.97	0.18	24	2.86	0.22	38	2.79	0.16	46	2.93	0.17	1203.33	n.s.
Intrinsic/extrinsic attributes	99	4.42	0.24	40	4.47	0.29	24	4.33	0.36	38	4.15	0.27	46	4.35	0.28	1603.65	n.s.
Spending	99	3.27	0.21	40	3.42	0.25	24	3.18	0.32	38	2.91	0.23	46	3.12	0.24	1221.10	***
Trust	99	4.41	0.15	40	4.40	0.18	24	4.52	0.23	38	4.54	0.17	46	4.51	0.17	5270.06	***
Responsibility	99	3.33	0.19	40	3.31	0.22	24	3.50	0.28	38	3.24	0.20	46	3.28	0.21	1835.26	***
Mobility	99	2.03	0.19	40	2.14	0.22	24	1.93	0.28	38	2.28	0.21	46	2.13	0.21	735.63	***
Support	99	3.33	0.19	40	3.31	0.22	24	3.50	0.28	38	3.24	0.20	46	3.28	0.21	2115.88	***

Sig: Is referred to the statistical significance level (*p-value*): *** < 0.001; * < 0.05; n.s.= not significant. SD.: standard deviation; F: Fisher Snedecor F-test.

Table 14. Analysis of correlations (Pearson's *r*) between the investigated variables. In bold the correlation indexes higher than 0.4.

Correlations	PBBs consumption	Extrinsic/Intrinsic attributes	Credence attributes	Spending	Trust	Responsibility	Mobility	Support	Healthy diet style	Chaotic diet style	Hedonic diet style	Attention to the environment	Attention to nutritional and health aspects
PBBs consumption			0.26**	0.15*	0.13*				0.15*	-0.18**		0.24**	
Intrinsic/Extrinsic attributes	0.18**		0.43**	0.36**		0.16*	0.15*		0.39**		0.20**	0.53**	0.45**
Credence attributes	0.26**	0.43**	0.27**	0.55**		0.18**	0.23**	0.18**	0.50**		0.25**	0.63**	0.38**
Spending	0.151*	0.36**	0.55**			0.23**	0.21**	0.23**	0.40**		0.33**	0.48**	0.46**
Trust	0.13*					-0.43**	-0.29**	-0.43*		-0.26**	-0.14*		
Responsibility		0.16*	0.17**	0.23**	-0.43**		0.39**	0.10**	0.14*	0.16*		0.22**	0.15*
Mobility		0.14*	0.23**	0.21**	-0.29**	0.39**		0.39**	0.16*	0.15*		0.19**	0.19**
Support		0.16*		0.23**	-0.45**	0.23**	0.39**		0.14*	0.16*		0.22**	0.15*
Healthy diet style	0.15*	0.38**	0.50**	0.40**		0.14*	0.16*	0.14*			0.40**	0.62**	0.50**
Chaotic diet style	-0.18**			0.01	-0.23**	0.16*	0.15*	0.16*					
Hedonic diet style		0.20**	0.25**	0.33**	-0.14*				0.40**			0.33**	0.54**
Attention to the environment	0.24**	0.53**	0.63**	0.48**		0.22**	0.19**	0.22**	0.62**		0.33**		0.50**
Attention to nutritional and health aspects	0.15*	0.44**	0.38**	0.46**		0.15*	0.189**	0.152*	0.50**		0.54**	0.50**	

The statistical significance level (*p-value*): ** < 0.01; * < 0.05.

4. Discussion

Plant-based beverages are not yet a defining food in the nutritional habits of Italian consumers [48]. This statement is also verified by the results of our study. In fact, more than half of the participants said they do not consume plant-based beverages. Among the reasons for not consuming PBBs, lack of consumption habits was one of the most frequently cited. This result is in line with the theme of food neophobia, a term used to refer to the reluctance to consume new or unfamiliar foods often found among consumers when they first try plant-based alternatives [49,50]. The neophobia towards plant-based alternatives is strongly correlated with feelings of familiarity and attachment towards traditional gastronomy, which drive consumers devoted to cow's milk [51]. The second reason for not choosing PBBs was the perceived off-flavors of the product. In fact, there is evidence highlighting that one of the major problems with PBBs is the unpleasant taste of the final product [18]. Therefore, plant-based alternatives are discarded by most consumers probably when their expectations do not match the intrinsic sensory properties of cow's milk [52,53]. There are, however, production processes that can be applied to improve the organoleptic characteristics of the products, such as fermentation processes that allow the flavor intensity of the plant-based components to decrease [54]. In fact, a good number of the PBBs consumers recruited for this study stated that they choose to consume these products for organoleptic enjoyment. Another motivation related to the choice of PBBs is the inclusion of these beverages within one's dietary style. This result confirms that PBBs are often consumed because they are considered to provide health and nutritional benefits [55]. Despite the presumed importance of food styles in consumer choice, no significant difference in the choice of PBB consumption emerged between the different food styles identified, i.e., healthy, chaotic and hedonic with one exception, as the healthy food style positively influences PBB consumption. In particular, the reason for the latter result could be related to the fact that both rice and oat-based vegetable drinks have a lower fat content and, especially oat-based drinks, a lower sugar content [56]. In summary, the main factors driving the choice of PBBs are individuals' concern for environmental sustainability, animal welfare and a balanced diet [12,57,58]. In contrast, surprising results have shown that lactose intolerance/allergy is an uncommon motivation for choosing these products.

Considering the consumers' attention to environmental and health issues, significant differences emerged between PBBs consumers and non-consumers. In fact, those who consume PBBs showed a significantly more pro-environmental attitude with respect to the non-consumers [57]. On the other hand, no significant difference emerged between the two groups compared in terms of their attention to health issues. Therefore, the environmental component prevails over the health component. This result is not in line with expectations, as the properties for which consumers choose to consume PBBs also relate to the nutritional and health benefits that these products can provide. Nevertheless, it is well-known that some PBBs have nutritional deficits, such as protein and calcium content [3,12,59].

Moreover, our results show that PBB consumers are not sensitive to product credence attributes, while they show more attention to intrinsic attributes. This could result from consumers' increasing attention to the nutritional properties of products, particularly their protein, carbohydrate, lipid content and taste [60].

Our results showed that the healthy eating style, mainly linked to the consumption of rice- and oat-based PBBs, is closely related to the attention to the intrinsic properties of a product, highlighting a food choice conforms to their dietary and nutritional needs.

Correlation analysis revealed a positive link between a greater willingness to pay for more environmentally sustainable plant-based beverages and behavior identified as more environmentally

friendly. Therefore, this result confirms the centrality of the concept of environmental sustainability in the food choices of individuals, so much so that they are changing their consumption trends and behavior within their daily lives [61]. The presence of positive correlations between these environmental components and those related to different food styles or product attributes demonstrates how the attention to environmental issues is able to influence different consumer habits [62]. For example, a healthy eating style is strongly correlated with attention to one's own health but also with environmental concern and intrinsic and extrinsic product attributes. In the light of these results, it can be argued that a careful study of consumer habits and preferences could help professionals to meet the demands of a market that is increasingly articulated as a portfolio of products and producer brands [63,64].

5. Conclusions implications

This study shows consumers' preferences and attitudes towards PBBs consumption decisions highlighting also the motivation of nonconsumption in Italian consumers. PBBs consumers were characterized by assessing the individuals' eating styles and behavioral attitudes towards environmental issues. In particular, it seems that the attention to the environment significantly distinguishes the two groups of individuals: consumers and non-consumers of PBB. Consequently, the investigation of PBBs consumption and perceived properties allowed to shed light on how these "novel" foods are considered and whether they could become part of consumers' daily eating habits, given that they represent a concrete and functional alternative to protein sources of animal origin. The importance attributed to the nutritional properties of the different PBBs provides an increasingly topical view of recent consumer trends, in which awareness of the importance of pursuing a healthy, nutritionally balanced lifestyle that provides health benefits is increasing. Despite this focus on nutritional aspects, the sustainability aspect of the production processes involved in obtaining plant-based beverages should not be overlooked. This factor varies widely throughout the world and in some cases represents a critical point in the supply chain.

It is paramount to create a new awareness that leads to a better understanding of the characteristics of these products, which undoubtedly require significant innovations, especially from the point of view of nutritional enrichment (in particular associated with the protein fraction), to obtain homogeneous and nutritionally complete foods. In this context, accurate and precise information about plant-based beverages, their health benefits and their growing commercial potential could drive consumers to a higher consumption of PBBs. In addition, it should be suggested an improvement from an organoleptic point of view of these types of beverages which, compared to cow's milk, do not meet the consumer's sensory expectations.

The limitations of this study include the consideration of a limited convenience sample, which could be expanded both in numbers and in geographical coverage, in order to consider a broader spectrum of eating habits and trends related to PBBs consumption. However, it is important to consider and evaluate consumer study results reflecting the effect of the geographical and socio-economic context of the sample, in a heterogeneous context (in terms of socio-demographic, food production and consumption habits of the population). In this case, this data could be important not to generalize the results on the whole Italian population but to create a starting point to compare different samples with different geographical affiliations and culinary traditions related to PPBs. Another limitation is the explorative approach (i.e., PCA) used in the analysis and confirmatory approaches should be used

in future studies. Our study contributes to the understanding of the issue consumers consider when faced with the choice of replacing cow's milk with plant-based alternatives. In addition, it allows us to understand what the positive aspects of PBBs are that could increase their popularity and what aspects need to be improved to be competitive in the market and to broaden their target audience. In addition, our findings could have important implications for raising consumer awareness of the positive aspects associated with PBB consumption in terms of health and environmental sustainability and emphasizing the centrality they can take in specific dietary habits that avoid the intake of foods of animal origin. However, increasing consumer awareness of the plant-based beverage supply chain could help boost confidence and trust, especially given the skepticism that emerged from our findings. Finally, this research can help industry and manufacturers develop communication and marketing campaigns tailored by product and geographic area to meet the needs of consumers in their heterogeneity.

Use of AI tools declaration

The authors declare they have not used Artificial Intelligence (AI) tools in the creation of this article.

Conflicts of Interest

The authors declare no conflict of interest.

Acknowledgment

Dr. Valentina Maria Merlino worked at this research within the Agritech National Research Center and received funding from the European Union Next-GenerationEU (PIANO NAZIONALE DI RIPRESA E RESILIENZA (PNRR) – MISSIONE 4 COMPONENTE 2, INVESTIMENTO 1.4 – D.D. 1032 17/06/2022, CN00000022). This manuscript reflects only the authors' views and opinions, neither the European Union nor the European Commission can be considered responsible for them.

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