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Shaping consumer preferences for sweet peppers: exploring the role of social, environmental, and sensory attributes in the era of health consciousness and local sourcing

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Abstract

This study explores consumer segments within the fruit and vegetable market, with a specific focus on sweet peppers, to evaluate how product characteristics influence consumption patterns. A multivariate analysis was conducted to examine consumer preferences and behaviours, considering factors such as environmental concerns, intrinsic product attributes, health aspects, local product consumption, and shopping habits. Using a segmentation approach, consumers were categorized into five clusters: "Local Loyalty Shoppers", "Health-Conscious Consumers", "Sustainability-Conscious Seekers", "Flavour-Driven Convenience Seekers", and "Low-Interest". Each cluster was analysed according to socio-demographic characteristics, providing insights into the motivations behind consumer choices. The findings highlight that local market, sustainability, health-conscious decisions, seasonality, and convenience are key drivers of sweet pepper consumption and purchasing behaviour, offering valuable guidance for market players and policymakers.

Keywords: Consumer behaviour, Vegetables, Health perception, Sustainability, Cluster analysis

Introduction

In recent decades, food trends have significantly influenced consumption habits and practices, leading to the emergence of new consumer profiles (Horvat et al. 2019). This evolving consumer model is increasingly focused on healthy eating, favouring superfoods, functional foods, and "free from" products. Additionally, there is a growing demand for clean labels (Asioli et al. 2017), as well as low-calorie, natural, and minimally processed foods (Bugge 2015). Convenience is also a priority, with consumers opting for foods that offer ease of preparation (Jackson and Viehoff 2016), for example fresh-cut fruits and vegetables (Cloete et al. 2022). Furthermore, modern consumers are increasingly prioritizing food choices that align with economic, social, and environmental sustainability, recognizing their impact on health, lifestyle, and the planet (Aviles et al.

2024). This shift includes preferences and purchase intentions for plant-based, locally sourced, ethically produced, and origin-certified foods, as well as products with recyclable packaging (Grunert et al. 2014; Horvat et al. 2019).

Fruits and vegetables are essential in dietary guidelines due to their rich content of dietary fibre, vitamins, minerals, and antioxidants (Spina et al. 2024; Slavin and Lloyd 2012), and their role in preventing various diseases (Adebawo et al. 2006). Increasing the intake of plant-based foods can therefore lead to improvements in both human health and sustainability (Röös et al. 2017; Mozaffarian 2016). Moreover, dietary diversity with the inclusion of fruits and vegetables is not only crucial for maintaining a healthy diet but can also help optimize the consumption of locally sourced product (Sultanbawa and Sivakumar 2022). It contributes also to the achievement of the Millennium Development Goals and aligns with the EU's policies and action plans, such as the Farm-to-Fork (F2F) strategy, which is part of the European Green Deal.

Additionally, fruits and vegetables play a central role in the Mediterranean diet, which is renowned for its numerous health benefits (Hamam et al. 2022; Le Turc et al. 2024). In countries like Italy and Spain, where this diet is prevalent, consumption of these foods is typically higher (Camanzi et al. 2024).

The sweet pepper (*Capsicum annuum* L.) is one of the most widely consumed vegetables globally, valued for its high nutritional content (Mendes et al. 2016) and remarkable versatility. It can be consumed fresh, dehydrated, ready-to-use, pickled, grilled, or incorporated into sweet-and-sour condiments and salted preparations (Greco et al. 2007). Additionally, sweet peppers are available in a wide range of varieties (Boyhan et al., 2019) and colours (Di Vita et al. 2024; De Cianni et al. 2024; Massaglia et al. 2019), which can significantly influence consumer preferences.

Beyond their culinary versatility, sweet peppers are also highly regarded for their chemical and nutritional properties. They are rich in vitamins A, B, C, and E, as well as bioactive compounds like carotenoids and phenolic compounds, which possess antioxidant properties (Phillips et al. 2006; Wahyuni et al. 2011). The growing consumer demand for nutrient-dense foods further highlights the importance of sweet peppers in contemporary diets. Studies indicate a rising preference for foods rich in vitamins, fibre, and antioxidants, as health-conscious consumers increasingly prioritize functional nutrition (Schuldt et al. 2024). These attributes make sweet peppers a highly desirable vegetable, driving their rising consumption and production (Mendes et al. 2016; Samtiya et al. 2021). Notably, sweet peppers offer several nutritional advantages over other vegetables, such as tomatoes and lettuce, making them a valuable component of a health-conscious diet. They are an exceptional source of vitamin C, providing amounts that are significantly higher than those found in tomatoes and lettuce. This abundant vitamin C content enhances their antioxidant capacity and supports immune function. Sweet peppers also stand out for their richness in potassium, supplying more than lettuce and contributing to cardiovascular health and proper electrolyte balance. In addition, their moderate fibre content supports digestive well-being (FDA 2024). Combined with their vibrant colours and crisp texture, sweet peppers offer both nutritional benefits and culinary versatility.

As in much of Southern Europe, sweet peppers are widely produced and consumed in Italy (Greco et al. 2007). According to the latest ISTAT data, Italian sweet pepper

production increased from 227,506 tonnes in 2023 to 234,832 tonnes in 2024, reflecting a 3.23% rise. Sicily and Campania are among Italy's leading producers, accounting for 38.7% of the country's total sweet pepper harvest. These regions benefit from favourable growing conditions, as *Capsicum* plants thrive in warm climates, making the Mediterranean basin particularly well suited for cultivation (Penella and Calatayud 2018).

However, despite the widespread popularity of sweet peppers, there is limited information available regarding consumption patterns and the characteristics of consumers who prefer this variety. While the literature has explored the behaviours and preferences of fruit and vegetable consumers broadly, specific studies on sweet peppers remain scarce. For instance, Frank et al. (2001) examined consumer preferences for sweet peppers by analysing factors such as colour, price, and vitamin C content. Similarly, Danojević et al. (2021) studied consumer preferences for both sweet and spicy peppers, focusing on different types, colours, and levels of spiciness in the Serbian market. De Cianni et al. (2023) investigated the factors influencing consumers' perceptions of food digestibility, particularly in relation to sweet peppers. Di Vita et al. (2024) further explored consumer preferences for sweet peppers, assessing the role of colour and sustainable production methods. However, there remains a lack of comprehensive research on sweet pepper consumption trends and consumer profiles.

Conceptual framework, objective, and research questions

Food choices, lifestyles, and consumers' intentions evolve over time, influenced by factors such as culture, health, dietary habits, and environmental concerns (Monterrosa et al. 2020).

In the case of food products, several categories of attributes influencing consumer preferences have been identified in the literature. The first category includes *credence and environmental factors*, such as sustainable packaging, social responsibility, organic production, geographical origin, and environmental certifications. These attributes play a significant role in shaping consumer preferences, as highlighted by Rossi et al. (2024) and Mora et al. (2020). Another key category is *sensory attributes*, encompassing characteristics like colour, sweetness, texture, and skin perception. These factors are central to consumer acceptance, as demonstrated by Casals et al. (2024), Appiani et al. (2023), and Mora et al. (2020). Additionally, *health benefits*, such as antioxidant content, vitamin levels, and suitability for raw consumption, have been found to be strong determinants of consumer preferences. This is supported by findings from Zanchini et al. (2022), Mora et al. (2020), and Kim et al. (2016).

To effectively analyse consumer preferences in the sweet pepper market, this study proposes a comprehensive conceptual framework that integrates these multiple key dimensions. The selection of variables within these dimensions was carefully informed by an extensive review of the broader literature on consumer food preferences (see Table 1). This approach ensures that the analysis captures a wide range of relevant factors, providing a nuanced and well-rounded understanding of consumer behaviour in this specific product category.

To better understand and target consumer segments, researchers often use segmentation techniques that incorporate socio-demographic and attitudinal differences (Jang et al. 2011).

Table 1 List of variables used for consumer segmentation in the sweet pepper market

Variables	References
Large-retail stores	Nuthalapati et al. (2020), Asioli et al. (2017)
Local producers	Moser et al. (2011), Thilmany (2008), Aprile et al. (2015), Denver et al. (2019)
Small-retail shops	Campos et al. (2024)
Antioxidant content	Di Vita et al. (2024)
Vitamin content	Frank et al. (2001)
Raw consumption	Hoppu et al. (2021)
Ingredient for sauces	Suryani et al. (2024), da Silva et al. (2021), Fernqvist and Göransson (2020), Asioli et al. (2017)
Cooked	Suryani et al. (2024), Testa et al. (2021), Nuthalapati et al. (2020), Rodriguez-Lozada et al. (2024)
Recyclable packaging	Otto et al. (2021)
Social involvement	Moser et al. (2011), Suryandari et al. (2024)
Organic certification	Di Vita et al. (2024), Janssen and Hamm (2012)
"Integrated Pest Management" certification (IPM)	Moser et al. (2011), Mancuso et al. (2024)
"Geographical indications" (GI)	Ingrassia et al. (2017), Mascarello et al. (2015)
Colour	Di Vita et al. (2024), De Cianni et al. (2024)
Sweetness	Hoppu et al. (2021)
Consistency	Massaglia et al. (2019), Hoppu et al. (2021)
Crunchiness	Massaglia et al. (2019), De Cianni et al. (2024)

Building on this foundation, the study specifically addresses the limited research on sweet pepper consumers by segmenting them based on self-reported consumption patterns. Socio-demographic characteristics and consumer traits were examined within each cluster and compared across groups. The objective is to investigate consumer preferences for sweet peppers, focusing on social and environmental concerns, intrinsic product attributes, health consciousness, and local sourcing. Through multivariate exploratory analysis, the study explores how these factors interact to shape consumption patterns and their relationship to specific consumer demographics and behaviours. The findings aim to identify distinct consumer segments, offering valuable insights for targeted marketing strategies and policy recommendations.

More specifically, the study is guided by the following research questions:

(a) How do social and environmental factors influence consumer preferences for sweet peppers?
(b) How do sensory qualities of sweet peppers affect consumer purchase decisions?
(c) What is the role of perceived health benefits in consumer choice between fresh and minimally processed sweet peppers?
(d) What are the distinct consumer segments based on preferences for sweet peppers, and how do these segments differ in their values (e.g. sustainability, health, price sensitivity)?
(e) How do factors such as age, income, and education influence consumer preferences for sweet peppers, and how can marketers effectively target these segments?

Methodology

Data collection

The data were collected in Italy in 2023 through an online survey developed using Google Forms, resulting in 1053 valid responses. To ensure an adequate sample dimension and the reliability of the estimates, the analysis of sample size adequacy was conducted (De Cianni et al. 2023). The equation for calculating the appropriate sample size is derived from the formula suggested by Bartlett et al. 2001 and can be easily implemented using the conjointly online tool (Conjointly 2024). The sample size (n) was computed from the conjointly tool as indicated in Eq. 1 with the following parameters: population size (N) of 60,000,000, confidence level (z) of 95%, margin of error (e) of 5%, and sample proportion (p) of 0.5. Based on these parameters, the recommended sample size was 385 respondents, confirming the adequacy of the sample for statistical analyses.

$$\frac{N\frac{z^2p(1-p)}{e^2}}{\frac{z^2p(1-p)}{e^2}+N-1} \tag{1}$$

The sample size is larger than the estimated minimum sample size to improve the representativeness of statistical analyses considering also that k-means clustering doesn't show rigid rules for the estimation of the sample size (Zakharov 2016). In particular, inferential tests such as Chi-square (Lin 2001) and the evaluation of the best cluster solution index (Caliński and Harabasz 1974) improve their reliability as the sample size increases.

The final version of the questionnaire was refined from a pilot survey involving 40 participants, which led to minor adjustments and reformulations to enhance clarity and ensure the reliability of responses.

The finalized questionnaire was structured as a multi-section survey, divided into four sections: (1) general characteristics of sweet pepper consumption, (2) importance of intrinsic attributes for sweet pepper consumption, (3) importance of extrinsic attributes for sweet pepper consumption, and (4) socio-demographic characteristics of the sample.

Sections"Introduction"to"Results"included questions based on 7-point Likert scales, allowing for quantitative analysis and aiding respondents during survey completion, while ensuring response accuracy (Taherdoost 2019). Example questions from these sections include:

- How often do you purchase sweet peppers from large-retail stores? (1 = never, 7 = very often)
- How often do you purchase sweet peppers from local producers? (1 = never, 7 = very often)
- How important do you consider the following intrinsic/extrinsic attributes for sweet pepper consumption? Please indicate your opinion on a scale from 1 (not important) to 7 (very important).

The items collected in the questionnaire can be considered as exploratory items, mainly requested to identify trough a market segmentation the direction of consumers' preferences.

In the socio-demographic section, open-ended questions were used for variables such as height and weight, allowing these to be collected as continuous variables. This information was used in the data cleaning process to calculate body mass index (BMI). Other socio-demographic variables, such as age, income, and gender, were collected via multiple-choice questions, resulting in ordinal categorical variables for analysis. Age cohorts were categorized based on the study by Brosdahl and Carpenter (2011), distinguishing the following groups: Silent Generation (1925–1942), Baby Boomers (1943–1960), Generation X (1961–1981), Millennials (1982–2000), and Generation Z (born after 2000).

The characteristics of the respondents are indicated in Table 2.

Data analysis

Data analysis was conducted in three steps involving the dimensional reduction of variables into new orthogonal factors. The second step consisted of clustering these new variables to obtain groups with high intra-group homogeneity and high inter-group separation. Finally, differences between socio-demographic were assessed for the identified groups by means of inferential tests (Iofrida et al. 2022). The first step, related to the exploratory factor analysis (EFA), contributed to developing the first research question, while clustering was necessary to address the second research question. Finally, inferential statistics were employed to answer the third research question. The analysis described below was conducted using Stata$^{(R)}$ software 15.

Table 2 Descriptive statistics of the sample ($n = 1053$)

Variables	Categories	Frequency	Per cent
Education	Elementary and middle schools	55	5.22
	High school	430	40.84
	University degree	440	41.78
	Higher education	128	12.16
Age Cohort	Generation Z	78	7.41
	Millennials	356	33.81
	Generation X	278	26.40
	Baby Boomers	269	25.54
	Silent Generation	72	6.84
Family members number	1–2	451	42.83
	3–4	550	52.23
	More than 4	52	4.94
Net monthly family income ($n = 830$)	Lower than 1000	50	6.02
	1001–2000	333	40.12
	2001–3000	246	29.24
	3001–4000	114	13.74
	Beyond 4000	87	10.48
Gender	Male	447	42.45
	Female	606	57.55
BMI	Mean (sd)	23.66 (3.98)	
Product seasonality*	Mean (sd)	4.75 (1.83)	

*Seasonality reflects the importance consumers place on this factor when purchasing food, and is captured as a single exploratory item

Exploratory factor analysis (EFA)

The EFA was conducted using the principal component method allowing the new factorial dimension to be considered orthogonal (Capitello et al. 2016). This analysis is particularly important to reduce the number of the several variables, according to the correlation matrix, into a new pull of factorial dimensions saving the highest amount of variability of the original system of vectors (Di Vita et al. 2019; Gewers et al. 2021). The relations between the factorial dimensions (q) and the original variables (p) can be formalized as follow in Eq. 2 being the q usable to linearly reconstruct p (StataCorp 2007):

$$y_{ij} = z_{i1}b_{1j} + z_{i2}b_{2j} + \cdots + z_{iq}b_{qj} + e_{ij} \quad (2)$$

where y_{ij} represent the value of the i_{th} record on the j_{th} variable. In the right side of the equation are indicated the factorial dimension where z_{ik} is the i_{th} observation on a specific factor that can be indicated as k_{th}. The regression coefficients in model are represented by the linear factor loading b_{kj}, also useful for the interpretation of the results and to highlight pattern of consumption in consumers analyses (Victor et al. 2018). The term e_{ij} is the error of the model, similar to the residual term but in factorial analysis is called j_{th} variable's unique factor (StataCorp 2007). The factor loadings obtained from the principal component method were rotated to improve the interpretation of the factorial dimensions (Abdi and Williams 2010). The number of the factors q, where assessed using the rule of eigenvalues. The number of the factors q was evaluated using the eigenvalue rule by setting 1 as a parameter (Kaiser 1960), while in order to ensure a robust reading of the coefficients and consequently a valid interpretation of the results, loadings with an absolute value below 0.4 were omitted (McNamara and Kirakowski 2011). The goodness of fit of the EFA was evaluated using two tests: Kaiser–Meyer–Olkin (KMO) and Bartlett's test. KMO test generate an absolute value from 0 to 1 where values closer to 1 indicates that the sample dimension is adequate to perform factor analysis, and the original variables are correlated allowing the identification of latent dimensions. When the value is higher than 0.7 the sample can be considered adequate, while value lower than 0.6 suggests that other strategies should be pursued to analyse data (Kaiser and Rice 1974). Finally, Bartlett's test of sphericity should be significant because it tests the null hypothesis that the correlation matrix coincides with the identity matrix. If the test is significant these matrices are not equal and significant correlations exist among variables suggesting that factorial analyses can be performed (Kumara and Canhua 2010).

Cluster analysis and inferential tests

Once the factorial dimensions have been generated, the factor scores can be used for further analysis, as they represent the scores or the distribution of records in the new factorial dimension. Furthermore, since a regression approach was used, the scores can be considered correlated only with their own factor, being orthogonal to the others (Yong and Pearce 2013). A non-hierarchical classification was adopted to group consumers. In particular, the k-means method allowing the identification of homogeneous groups that have been produced by minimizing the Euclidean distance between cluster's centroids (Steinley 2006).

The analysis of the best cluster solution can be considered a fundamental step when a dataset is processed to generate clusters. This analysis is required to minimize the role of researchers'subjectivity by identifying the number of groups based on quantitative criteria. In particular, this analysis should be conducted when a non-hierarchical method is selected, as it is not possible to conduct visual analyses using dendrograms (Rousseeuw 1987). To deal with this issue, the cluster stop solution indicating the number of cluster where the agglomeration should be stopped was evaluated using the Calinski–Harabasz pseudo-F (Milligan and Cooper 1985). The Calinski–Harabasz index can be obtained by an iterative process that evaluates the dispersion within and between clusters representing the sums of the squares of the clusters. This method is combined with k-means clustering, which provides a pseudo-F for each cluster solution. The optimal cluster solution should correspond to the highest value of the index, as higher values indicate better separation and more distinct clusters (Schepers et al. 2008). In this study, the Caliński–Harabasz pseudo-*F* stopping-rule index is used to guide the selection. As formalized in Eq. 3 (Caliński and Harabasz 1974), the index is based on the ratio of the between cluster sum of squares (B) to the within-cluster sum of squares (W), adjusted for the number of groups (g), and total observations (N):

$$\frac{\text{trace}(B)/(g-1)}{\text{trace}(W)/(N-g)} \tag{3}$$

Once the cluster solution was selected, it was assessed whether the distribution of the factorial scores was random or whether there were significant differences among the clusters by means of the one-way ANOVA tests (Thorpe et al. 2016). This test was conducted to further assess cluster separation by evaluating the null hypothesis (H_0) that the mean scores of the factors are equal across clusters. A significant result leads to the rejection of H_0, supporting the alternative hypothesis (H_1) that the mean value of the factors differs significantly among clusters (Iofrida et al. 2022). Moreover, to gain a better understanding of the differences between clusters coefficients, Bonferroni's Post-Hoc tests were performed (Thorpe et al. 2016).

Finally, socio-demographic and consumer characteristics can be assessed within clusters and subsequently compared across them. This analysis is particularly important to characterize the clusters and to associate consumer characteristics with the group characteristics derived from the factorial scores. Considering the variables were not in continuous scale, to assess significant differences between the respondents' characteristics in clusters, non-parametric ANOVA (Spoerr 2021) and Chi-square test (Franke et al. 2012; Jaiswal et al. 2021) were performed. The only exception was BMI collected on a continuous scale which required parametric ANOVA to test differences among groups.

Results

Factor analysis

The exploratory factor analysis conducted on the original set of variables, as detailed in Appendix, identified 5 latent variables related to different consumption patterns. The total amount of variability explained by EFA is good, being 69.6%, suggesting that the variables were intercorrelated and the model effectively captured the original variability of the set of vectors. Considering the goodness of fit, the model meets the

Table 3 Rotated factor loading (threshold 0.4)

Variables	Factor 1 Social and environmental care	Factor 2 Sensory properties awareness	Factor 3 Health-driven choices	Factor 4 Local purchase preference	Factor 5 Large-retail and minimally processed peppers
Large-retail stores				−0.530	0.506
Local producers				0.801	
Small-retail shops				0.523	
Antioxidant content			0.912		
Vitamin content			0.909		
Raw consumption			0.426		
Ingredient for sauces					0.673
Cooked					0.494
Recyclable packaging	0.702				
Social involvement	0.810				
Organic	0.861				
IPM	0.885				
GI	0.798				
Colour		0.720			
Sweetness		0.809			
Consistency		0.827			
Crunchiness		0.825			
Variance explained	0.212	0.177	0.156	0.078	0.073
Bartlett test of sphericity	8505.364***				
KMO test	0.838				

*** = significant p value < 0.01

requirements both from Barlett test of sphericity, which is significant, and from KM0 that is higher than 0.7. The results of the EFA are presented in Table 3.

The first factor labelled "Social and environmental care", groups a sub-set of variables related to environmental, social, and geographical origin explaining 21.2% of variance. This factor reflects concerns about sustainability, fair practices, and environmental responsibility and is positively related with "Recyclable packaging" (0.702), "Social involvement" of the firm (0.810), "Organic" certification (0.861), "IPM" certification (0.885) and "GI" (0.798).

The second latent dimension describes a consumption pattern mainly focused on the intrinsic attributes of the product. This factor explains 17.7% of the variance and encompasses the variable "Colour" (0.720), "Sweetness" (0.809), "Consistency" (0.827), and "Crunchiness" (0.825) justifying its designation as "Sensory properties awareness".

The third factor is associated with the desire for nutritious or health-focused peppers. Its dimension explains 15.6% of the total variance, collecting variables related to healthy properties of sweet peppers such as "Antioxidant content" (0.912), "Vitamin content" (0.909), and "Raw consumption" (0.426). This consumption pattern also suggests that aspects related to the healthiness of the food may be linked to the type of preparation, in particular raw peppers, probably because the absence of cooking is perceived as preserving the food's properties. This factor has been named "Health-driven choices".

The fourth factor emphasizes the preference for buying local, supporting local farmers or markets. It groups and positively correlates variables such as "Local producers" (0.801) and "Small-retail shops" (0.523). Furthermore, purchasing products from these establishments is negatively correlated with purchasing from large retailers (−0.530). Based on these considerations, this factor has been named "Local purchase preference". It explains 7.8% of the total variance carried by the variables adopted in the analysis.

The last factor explains 7.3% of the variance and has been named "Large-retail and minimally processed peppers". The results of the factor analysis indicate a positive relationship between consumers who prefer purchasing sweet peppers from "Large-retail stores" (0.506), and those who are more inclined to use peppers as an "Ingredient for sauces" (0.673), and in Cooked dishes (0.494). These relations suggest that consumers not only prefer buying peppers at larger retailers' outlet but also have a strong interest in processed peppers (pre-portioned, fresh-cut or minimally processed sweet peppers), either by using them in home-cooked meals or as ingredients in sauces, potentially indicating a preference for convenience-oriented or industrial uses.

Cluster analysis and inferential tests

Factorial scores were collected and used for the non-hierarchical cluster analysis employing the k-means method, as presented in Table 4. The table shows the five-cluster solution based on the best cluster solution analysis. The cluster stop solution has been evaluated using the Calinski–Harabasz pseudo-F index, which reached its highest value (199.55) for the five-cluster solution. In addition, ANOVA models were run using clusters as the categorical grouping variable and factor scores as the independent variable. These tests were significant for all variables, suggesting the good separation of the variables across these groups. Moreover, the Bonferroni's post-hoc test confirmed through multiple pairwise comparisons the high separation among the variables within the clusters in terms of the difference between the average values. Based on the factor values within each cluster, the groups were interpreted and named according to their most important characteristics.

Table 4 K-means cluster analysis results with one-way ANOVA and Bonferroni's post-hoc test

Factors	Cluster1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	*F* value
	Local loyalty shoppers	Health-conscious consumers	Sustainability-conscious seekers	Flavour-driven convenience seekers	Low-interest consumers	
Social and environmental care	0.163 a	0.275 a	0.967 b	− 1.015 c	− 0.523 d	228.21***
Sensory properties awareness	0.274 a	0.136 a	0.306 b	0.710 c	− 1.413 d	287.42***
Health-driven choices	0.357 a	1.101 b	− 0.780 c	− 0.449 d	− 0.387 d	267.19***
Local purchase preference	1.615 a	− 0.572 b	− 0.339 c	− 0.360 c	0.010 d	344.36***
Large-retail and minimally processed peppers	0.261 a	− 0.112 b	− 0.166 bc	0.506 a	− 0.402 c	29.20***

*** = significant *p* value < 0.01. The letters in the table indicate differences among the variables in the clusters at *p* value 0.1. Differences should be interpreted row by row

Finally, family members, income and BMI were found to be not significant according to the Chi-square and one-way ANOVA tests. As a result, these variables were not used to further characterize the clusters.

The first group, labelled "Local Loyalty Shoppers", is characterized by a very high interest in local product consumption (1.615), which serves as their primary driver for sweet pepper consumption; however, an interesting correlation with health consumption can be observed (0.357). This group is predominantly composed of Baby Boomers generation, with medium to high level of education, and places significant importance on the seasonality of the products.

The second cluster has been named "Health-Conscious Consumers" since in this group are located consumers who prioritize the health-related aspects of sweet peppers (1.101). Concerning the socioeconomic and consumers characteristics, this group is characterized by high levels of education and a predominance of Millennials consumers and woman. Finally, these consumers attach high importance to the seasonality of products, less than the 'local' consumer group but higher than the others suggesting a relation between these aspects.

The third cluster included consumers primarily interested in the social, environmental, and geographical origin of products (0.967), consequently it was named "Sustainability-Conscious Seekers". Based on socio-demographic characteristics, this group is characterized especially by highly educated consumers within the Baby Boomers generation.

The fourth group was called "Flavour-Driven Convenience Seekers" since it includes consumers with a particular interest in the intrinsic attributes of the products (0.710). These individuals primarily purchase from large-scale retailers and show a preference for ready-to-use products (pre-portioned, fresh-cut, or minimally processed sweet peppers) (0.506). They seek high-quality foods that deliver distinct flavours and satisfying sensory experiences. For this cluster, the concept of convenience aligns more closely with the definition provided by Fibri and Frøst (2019), which describes convenience as the ease of food preparation and cooking or the ability to consume food with minimal preparation time.

In term of socio-demographic characteristics, this cluster is mainly characterized by female and mid-educated consumers. Moreover, in this group, Generations Z, Millennials, and Generation X are well represented. Consumers in this cluster also place the least importance on the seasonality of products, reflecting their preference for ready-to-use peppers.

The last cluster is characterized by consumers who place a low positive importance (0.010) on purchasing local products while being indifferent to other aspects. As a result, this group has been labelled "Low-Interest Consumers". In terms of socio-demographic characteristics, it mainly consists of men with a low level of education. In addition, in this group, the Silent Generation shows the highest relative frequency, followed by Generation Z, which exhibits the second highest representation compared to the other clusters (Table 5).

Discussion

The findings of this study provide significant insights into the various factors that influence consumer preferences for sweet peppers, while also differentiating consumer segments based on socio-demographic characteristics. One of the main aims of this

Table 5 Consumers characterization from the k-means cluster analysis using inferential tests

Variables	Categories	Cluster 1 (*n* = 178)	Cluster 2 (*n* = 251)	Cluster 3 (*n* = 219)	Cluster 4 (*n* = 199)	Cluster 5 (*n* = 206)	Chi-square and *F* statistics
Education	1	5.06	2.79	6.39	3.02	9.22	20.56**
	2	43.82	36.65	39.27	40.70	45.15	
	3	39.89	47.41	41.10	45.23	33.98	
	4	11.24	13.15	13.24	11.06	11.65	
Family members	1–2	41.57	46.22	45.21	36.68	44.17	9.40
	3–4	53.93	51.00	48.86	58.29	50.00	
	More than 4	4.49	2.79	5.94	6.03	5.83	
Age Cohort	Generation Z	5.62	6.77	5.02	11.06	8.74	38.03***
	Millennials	26.97	34.26	25.62	40.20	31.07	
	Generation X	29.21	29.48	21.00	30.15	22.33	
	Baby Boomers	30.90	23.90	30.59	13.57	29.13	
	Silent Generation	7.30	5.58	7.76	5.03	8.74	
Net monthly family income	Lower than 1000	6.25	3.50	8.38	5.23	7.23	17.06
	1001–2000	42.36	36.50	39.52	45.10	38.55	
	2001–3000	27.08	35.50	32.93	24.84	25.90	
	3001–4000	13.19	13.50	10.78	12.42	18.67	
	Beyond 4000	11.11	11.00	8.38	12.42	9.64	
Gender	Male	43.82	41.43	42.47	35.18	49.51	8.76*
	Female	56.18	58.57	57.53	64.82	50.49	
BMI	Mean (sd)	24.07 (3.92)	23.53 (3.76)	23.55 (4.23)	23.46 (3.77)	23.76 (4.20)	0.73
Product seasonality	Mean (sd)	5.87 (1.25)	4.96 (1.68)	4.71 (1.72)	3.75 (1.88)	4.54 (1.92)	127.63***

***'**'* = significant *p* value: < 0.01, < 0.05 and < 0.1

research was to examine the influence of social and environmental factors on consumer choices. The findings indicate that attributes related to environmental and social responsibility, such as recyclable packaging, organic certification, and IPM labelling, are particularly valued by consumers who prioritize sustainability, as also noted by Verain et al. (2016). While the study does not assess the direct impact of these certifications on purchasing decisions, their strong association with the "Social and Environmental Care" factor suggests they play a role in shaping consumer intentions. These results align with previous research by Asioli et al. (2017), Camanzi et al. (2024), and Remize and Garcia (2024), which highlight growing consumer trust in environmentally responsible and pesticide-free products.

A second objective of the study was to evaluate how the sensory qualities of sweet peppers influence consumers' purchasing decisions. The findings reveal that sensory attributes such as colour, sweetness, crunchiness, and texture are highly valued and play a central role in determining consumer satisfaction, and consequently, their purchasing decisions. These results are consistent with other studies (Hoppu et al.2021; Massaglia et al. 2019), which demonstrate that taste, texture, and appearance are key factors in shaping preferences for fruits and vegetables. Consumers not only seek a product that is nutritious but also one that is enjoyable to eat, with particular

emphasis on the multisensory experience. Sensory attributes take on even greater significance when peppers are purchased in ready-to-use (pre-portioned or fresh-cut vegetables) forms, particularly from large retailers. The convenience and ease of preparation of these products make them appealing to those with busy lifestyles, as noted by Asioli et al. (2017).

Health benefits emerged as another critical factor influencing consumer decisions. The study revealed that perceived health benefits, particularly the presence of vitamins and antioxidants, significantly shape consumer preferences between fresh and ready-to-use peppers. The health-conscious consumer cluster associated fresh vegetables with superior nutritional advantages and reduced preservative use, as confirmed by Slavin and Lloyd (2012). The consumption of raw peppers is often linked to greater naturalness and overall well-being, a trend that reflects the association between freshness and sustainable agriculture observed by Hauser et al. (2011). The segmentation approach employed in this study identified five distinct clusters of sweet pepper consumers, each with varying demographic profiles and purchasing priorities. Local production and seasonality emerged as the most valued factors, particularly in clusters 1 and 2. In contrast, for cluster 5, local product sourcing is the only factor consumers consider significant. These findings align with Campos et al. (2024), who emphasized the importance of local and seasonal factors in fruit and vegetable purchasing decisions. Notably, consumers in the "Local Loyalty Shoppers" cluster prioritize purchasing from local producers, a preference supported by several motivations in existing literature. Local products are often perceived as fresher, safer, and healthier, as well as environmentally beneficial, as noted by Feldmann and Hamm (2015). Additionally, local foods carry symbolic value, representing authenticity and tradition, according to Riefler (2020). Other studies, such as González-Azcárate et al. (2021), emphasize the perception that local products are of higher quality, tastier, and allow direct interaction with producers. This cluster's preference for shopping at small-retail shops mirrors Campos et al. (2024), who highlighted the belief that products from small local players are perceived as healthier and safer. The prominence of Baby Boomer consumers in this group supports Costa and Jongen's (2010) finding that this generation values freshness and health-conscious food choices. Consequently, seasonality also plays a significant role for these consumers.

The "Health-Conscious Consumers" cluster is similarly characterized by a strong focus on seasonality but primarily prioritizes the health-related attributes of sweet peppers. The emphasis on raw consumption underscores the importance of naturalness as a bridge between health and taste, as observed by Binninger (2015) and Dubé et al. (2016). From a socio-demographic perspective, the higher proportion of females in this group aligns with Aertsens et al. (2009) and Hamam et al. (2024), who found that females tend to be more health-conscious in their food choices, likely due to their role in managing household purchases.

The emphasis on "seasonality" across these two clusters introduces an underexplored dimension in previous analyses of fruit and vegetable consumption, particularly for sweet peppers. This indicates a link between food (GI), seasonality and perceived health benefits. In other words, consumers who prioritize food origin and seasonal sweet peppers are more likely to consider the health impact of their food

choices. This aligns with research by Aviles et al. (2024) and Sultanbawa and Sivakumar (2022), which highlights the importance of food diversity in maintaining a healthy diet and promoting the consumption of high-quality, geographically certified products.

Among "Sustainability-Conscious Seekers" there is a heightened awareness of sustainability-related attributes, particularly regarding certifications and labelling. While the study does not measure the direct influence of certifications on purchasing behaviour, the results suggest that consumers in this segment place greater emphasis on attributes like organic and IPM labelling, which they associate with environmental responsibility and product safety. This aligns with Campos et al. (2024), who found that pesticide-free products enhance consumer confidence in fresh produce. Furthermore, the high level of education in consistent with recent literature (Di Vita et al. 2023), where higher education levels can be associated with greater interest in environmental attributes of food products. This correlation suggests a more sustainability-responsive approach among more educated consumers, who show a clear preference for products that align with ethical and environmental values. The cluster labelled "Flavour-Driven Convenience Seekers" consists predominantly of female consumers who prioritize convenience, flavour, and product quality in their purchasing decisions. They tend to purchase sweet peppers from large-retail stores, favouring ready-to-use formats such as fresh-cut or minimally processed products. These options offer the ideal balance between health and practicality, allowing for quick, flavourful meal preparation with minimal effort, while maintaining nutritional benefits. As highlighted by Testa et al. (2021), fresh-cut fruits and vegetables represent a compromise between convenience and health, making them especially appealing to time-constrained consumers. Furthermore, such options not only cater to consumers' demand for convenience but also contribute to reducing food waste, as evidenced by Suryani et al. (2024), Testa et al. (2021), and da Silva et al. (2021). The preference for large-retail stores in this group can be attributed to both the adaptability of these outlets to busy lifestyles and the conveniences they offer. These include spacious environments, promotional discounts (Nuthalapati et al. 2020), credit and debit card payment options, self-service for enhanced product selection (Rodriguez-Lozada et al. 2024) and extended opening hours, all of which facilitate easier shopping, particularly for women balancing work and household responsibilities (Purnomo 2018). Beyond practicality, this group places significant emphasis on the intrinsic attributes of sweet peppers, such as colour, firmness, and freshness, which can be visually assessed in-store (Jürkenbeck & Spiller 2021). Unlike other consumer profiles, they are less influenced by seasonality, focusing instead on what they can directly verify. In an information-rich environment, the ability to personally inspect products before purchase is crucial (Mick et al. 2004), and the extensive variety offered by large-retail stores enhances this decision-making process. This purchasing flexibility, in the authors' opinion, makes large-retail outlets especially appealing to a broad generational base. Moreover, this group often selects pre-chopped vegetables and complementary components such as spice blends, facilitating the preparation of sauces and cooked dishes while minimizing kitchen time. Altogether, this cluster reflects a growing consumer trend towards products that seamlessly combine convenience, quality, and sensory appeal. For this cluster the popularity of large-retail stores can be attributed to both adaptation to consumers' daily routines

and busy lifestyles, as well as the stores' convenience (Glanz and Yaroch 2004). Large-retail stores offer not only spacious environments, but also discounts and promotions (Nuthalapati et al. 2020), credit or debit card payment options, self-service for greater choice (Rodriguez-Lozada et al. 2024) and extended opening hours, making it easier for consumers especially females to balance work and shopping obligations (Purnomo 2018). Indeed, this cluster predominantly consists of female consumers. Moreover, since customers in large-retail stores personally select the products, they wish to purchase, this cluster places less emphasis on seasonality in their decision-making process, focusing instead on the product's visual appearance attributes they can directly verify. This is especially relevant in an information-rich environment, where the ability to inspect products is critical before purchase, as noted by Mick et al. (2004). In this context, the wide range of products offered by large-retail stores provides consumers with ample opportunity to examine sweet peppers, particularly regarding their intrinsic attributes, which help guide consumers towards products that align with their expectations for freshness, quality, and overall satisfaction (Jürkenbeck and Spiller 2021). Additionally, in the authors' opinion, the purchasing flexibility offered by large-retail stores better meets the needs of a broader range of generational cohorts, compared to small-retail shops. The "Low-Interest Consumers" shows a limited focus on factors beyond local product sourcing. This group, comprising both older and younger individuals, is likely influenced by lower income levels, making regular purchases of organic food less practical. Additionally, their lower education levels may contribute to reduced awareness of environmental issues, organic farming practices (Di Vita et al. 2023), and the links between diet and health as well (Zanchini et al. 2022). Their preference for local sweet peppers may also be driven by the convenience of nearby farmers' markets, which provide easy access to local produce, consistent with findings by Nie and Zepeda (2011). The higher representation of male consumers in this cluster aligns with Mia et al. (2005), who found that men typically prioritize convenience in their shopping habits.

Age, income, and education levels play a significant role in shaping consumer preferences for sweet peppers. Younger consumers (Generation Z and Millennials) are more inclined to choose convenient, ready-to-use products, in line with fast-paced lifestyles and routines that prioritize convenience (Cavaliere and Ventura, 2018). In contrast, older consumers, particularly Baby Boomers, tend to prioritize sustainability and local sourcing, consistent with more traditional and responsible shopping behaviours, as indicated by other studies (Costa and Jongen 2010; Ureña, et al. 2007).

Income levels also influence purchasing choices. Consumers with higher incomes and higher education levels are more willing to pay for organic and certified products, demonstrating greater awareness of health and environmental benefits, as observed by Di Vita et al. (2021).

Conclusions

Main outcomes

This study linked general fruit and vegetable consumption behaviours to specific patterns associated with sweet pepper consumption, providing valuable insights into sweet pepper consumers. By analysing distinct consumer groups, the study shed light on the influence of various demographic and behavioural factors that shape sweet pepper

consumption. The findings highlight key consumption patterns, the characteristics of the different consumer segments, and the drivers behind their purchasing decisions, contributing to a deeper understanding of sweet pepper consumption trends. In response to the first research question, five distinct consumer segments for sweet peppers were identified. These patterns reflect preferences for environmental factors, intrinsic product attributes, health-related aspects, local product consumption, and shopping behaviours. In response to the second e third research questions, the analysis revealed varying levels of involvement in sweet pepper consumption across different consumer segments. The "Local Consumers" cluster, which represents 17% of the sample, is the smallest group. Their primary motivation is the consumption of locally sourced sweet peppers, which they highly value for their health benefits and seasonal availability. This group places significant importance on local markets -and are predominantly well-educated individuals aged between 64 and 81. The "Health-Conscious Consumers" represent the largest group (24%) and prioritize attributes such as "Antioxidant Content", "Vitamin Content", as well as "Raw Consumption", while also valuing seasonality. This cluster is composed mostly of highly educated females aged 24–42. The "In the "Sustainability-Conscious Seekers" emerges a heightened awareness of sustainability-related attributes, particularly in relation to certifications and labelling." cluster (21% of the sample) focuses on sustainability attributes, including "Organic" certification, "Recyclable Packaging", "Social Involvement", "IPM", and "GI" certifications. These consumers are highly educated Baby Boomers. The "Flavour-Driven Convenience Seekers" (19%) prioritize convenience, often purchasing pre-portioned, fresh-cut or minimally processed sweet peppers. Probably, these consumers are the most engaged in cooking at home, focusing on the product's intrinsic attributes and shopping primarily at large-retail stores. This group spans multiple generations. Finally, the "Low-Interest Consumers" cluster (20%) shows little interest in sweet pepper attributes like healthiness or environmental impact, caring only about local product. They are mostly male and belong to the Silent Generation or Generation Z.

The study highlights specific aspects of sweet pepper consumption that may not necessarily align with findings related to other product categories or fruits and vegetables in general. For instance, the analysis of consumers' socio-demographic profiles and their preference for "local producers" or "seasonality" offers insight into purchasing behaviours, given the influence of these factors on interest in local products and local markets. Furthermore, environmental considerations play a significant role in sweet pepper purchasing decisions.

Consumer preferences are shaped by multiple, sometimes conflicting, motivations, with individuals making trade-offs based on their specific needs and priorities. While sustainability, local production, health consciousness, seasonality, and convenience all influence purchasing decisions, their relative importance varies across consumer segments. For instance, health-conscious consumers not only value the nutritional properties of sweet peppers but also prioritize their seasonality, aligning with both sustainability and health values. Conversely, convenience-driven consumers prioritize ease of preparation, often opting for fresh-cut or minimally processed sweet peppers, which retain their nutritional benefits. Additionally, ready-to-use products (e.g. pre-portioned options for sauces or cooking) appeal to consumers seeking convenience while also aiming to reduce

food waste. This aligns with studies suggesting that fresh-cut or pre-portioned vegetables offer a balance between health, convenience, and sustainability, making them attractive to consumers who prioritize quick, nutritious, and flavourful options.

The findings from the consumer segmentation proposed in this study help explain why both fresh, locally sourced products and ready-to-use options coexist in the market, as they cater to distinct consumer motivations.

Implications

The results of this study offer valuable insights for agri-food firms, particularly Mediterranean SMEs, as they evaluate the market potential for seasonal, locally sourced, and health-oriented products. Environmental factors, such as certifications, play a key role in consumer decisions, reflecting a growing demand for organic, natural, and pesticide-free. These insights can guide the development of effective business strategies. Producers and retailers can attract consumers by emphasizing the connections between health, sustainability, seasonality, and organic/local products. Additionally, businesses should consider the preferences of both older and younger generations, who tend to be "Marginal Consumers", when developing new offerings. Large-retail store could increase product appeal by focusing on attributes like colour, sweetness, consistency, and crunchiness—key factors for consumers. Market players and policymakers should integrate these preferences into their strategies, potentially influencing supply chains, sustainable cultivation methods, and marketing practices to align with this consumer demand.

Limitations and future research

One limitation of this study is the exclusion of price as a factor influencing consumer behaviour regarding sweet peppers. The role of price remains debated in the literature, with some studies suggesting it can act as a barrier to purchasing local foods. Additionally, this research did not consider motivations such as adherence to specific diets when buying sweet peppers or confirmatory psychometric scales. Indeed, the analysis conducted in the study can be considered as an explorative analysis requested to identify the general trend of consumers' preferences for sweet peppers. For the same reason no statistical weights were used to rebalance the proportion of the sample in the inferential tests. Finally, the main limitations of the online data collection should be reported such as the selection bias arising from the fact that only the population with digital skills can respond to the survey. Another limitation concerns possible errors due to misunderstandings of the questions and the risk of self-selection of respondents where only those motivated and interested in the topic could provide reliable answers.

Future studies could explore consumer preferences by including in the multivariate models factors related to validated psychometric scales to offer clearer insights and enhance understanding of consumer preferences.

Appendix

See Table 6.

Table 6 Descriptive statistics of the variables employed in the factor analysis

Variables	Mean	Standard deviation (SD)
Large-retail stores	4.24	2.31
Local producers	2.26	1.95
Small-retail shops	3.44	2.20
Antioxidant content	3.71	1.91
Vitamin content	3.91	1.90
Raw consumption	3.09	2.20
Ingredient for sauces	3.87	2.15
Cooked	4.57	2.04
Recyclable packaging	4.47	2.06
Social involvement	4.08	2.02
Organic	4.19	1.97
IPM	4.09	1.95
GI	4.04	1.97
Colour	5.30	1.83
Sweetness	5.23	1.72
Consistency	5.28	1.75
Crunchiness	5.33	1.80

Abbreviations

BMI Body Mass Index
EFA Exploratory factor analysis
GI Geographical indications
IPM Integrated pest management
KMO Kaiser–Meyer–Olkin
SMEs Small-medium enterprises

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GDV and RZ contributed to conceptualization, investigation, methodology, and validation; RZ developed software; GDV; RZ; ADP; DS were involved in formal analysis; DS; ADP helped in data curation; GDV and RZ; DS; ADP helped in writing—review & editing and writing—original draft preparation; MDA; ML; CG helped in visualization; GDV; ML; MDA helped in supervision; GDV; CG, MDA; ML were involved in project administration.

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Data availability
The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Competing interests
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