



## Unveiling the exotic fascination of tropical fruits: The role of food values on consumer behavior towards mangoes

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### ABSTRACT

Mango is one of the most traded, exported, and consumed tropical fruits worldwide. However, little is known about Italian consumers' preferences for mango. This study empirically explores the factors that influence the consumption of mango in Italy. Food values, subjective and objective knowledge, and socio-demographic aspects were considered. An online survey was administered, resulting in an overall sample of 487 Italian participants. The data were statistically analysed through an ordered probit model. The results show that mango is more likely to be consumed by individuals who are more concerned with the naturalness of the product. Moreover, both subjective and objective knowledge positively affect the probability of consuming mango. The findings also show that socio-demographic traits, particularly gender and undertaking sports activities, significantly influence the probability of consuming mango. Practical implications are proposed based on the study findings.

### 1. Introduction

The extensive variety of food products in today's market landscape adds layers of complexity to consumer choice, a phenomenon that has engaged scholars from diverse academic spheres, notably food economics, consumer sciences, and marketing [1]. Unpacking the utility functions and decision heuristics that consumers employ when evaluating food attributes is extremely relevant. This complexity is further amplified because food consumption fulfils not just basic nutritional needs but also serves as a provider of various consumer beliefs and values, including lifestyle motivations and ethical considerations [2]. Consumer values, central in shaping purchasing behavior [3], offer critical insights into determinants of food choice. Consumers frequently pursue specific product attributes like nutritional quality, provenance, and sustainability as avenues to satisfy broader life values or ethical orientations [4]. Hence, understanding the evaluative criteria used by consumers in making food choices is relevant for a comprehensive view of market dynamics. The pertinence of this approach is accentuated when considering its applicability to tropical fruits, particularly given the upsurge in consumer demand for such products. This rise in consumer engagement with tropical fruits can be attributed to a confluence

of factors including health consciousness, demographic diversification in Europe, and the food industry's strategic deployment of tropical ingredients to satiate consumer desires for product novelty and diversity [5]. Tropical fruits offer a compelling sensory profile, marked by vibrant hues, distinct flavors, and nutritionally dense compositions [6,7].

Over the past decade, this burgeoning interest has been corroborated by a spike in global cultivation metrics for tropical fruits [8]. Even within the European Union, there has been an uptick in market receptivity towards foodstuffs of exotic provenance [9].

Mango is one of the most widely grown, traded, exported, and consumed tropical fruits in the world, due to its high nutritional and bioactive properties [10–12]. It is rich in micronutrients, including iron, potassium, magnesium, calcium, vitamin C and beta-carotene [13], and provides all the nutrients needed by the human body every day [12,14].

Today, mangoes can be found in more than 100 countries, with India leading the way with a production of 24 million tonnes in 2020 [15], followed by Thailand and China [16], and has established itself as a fresh fruit and processed product in the global market.

However, global demand for mangoes is increasing in major producing countries, such as Asia, Africa, Central and South America, as well as in less traditional areas [17].

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The tropical fruit phenomenon in Mediterranean countries arose because of climate change-induced warming and is destined to profoundly change not only consumption behavior but also the production choices of farms in the coming years. Indeed, some areas of the country are particularly suited to the cultivation of tropical species, which are extremely rich in beneficial properties.

Its popularity in mild climate countries is also due to its association with oriental cuisine dishes, including poké, which is the trend in recent years, followed by mango ice cream, mango salad, mango fruit salad, smoothies, and milkshakes [18]. According to the FAO [8], mangoes account for 90 % of the world's tropical fruit shipments, and the main importers are the United States and the European Union, with shares of 26 % and 19 %, respectively.

However, even though European consumption remains lower than that of the United States, EU mango imports are steadily increasing, having surpassed the 300,000 tonnes mark in 2016 [8], and are largely dependent on developing countries, which are responsible for 88 % of total mango trade in the European Union and 94 % of EU imports [8].

Mangoes are gaining ground in Italy, as indicated by Eurostat data. Over the four-year span from 2017 to 2021, there has been a substantial surge in the popularity of tropical fruits in Italy, with a growth rate ranging between 45 % and 50 %. This surge has led to a noteworthy upswing in the average price of imported mangoes, witnessing an increase of nearly 70 %.

In light of this context, the application of the Food Value Scale, as described in the seminal work by Lusk and Briggeman [19], provides an innovative tool to explore the consumption of mangoes in Italy. This framework moves beyond traditional attribute-based evaluations, suggesting that consumers navigate their foodscapes through a value-oriented lens, using a personalized set of criteria to inform their purchase decisions. Predicated on this notion, our preliminary hypothesis contends that varying value drivers could exert differential impacts on the consumption frequency of exotic fruits, specifically mango.

However, recognizing the multi-dimensionality of consumer food behaviors [20], our study also incorporates objective and subjective consumer knowledge, socio-demographic profiles, and lifestyle factors as additional drivers influencing mango consumption.

In summary, this study represents, to the best of our knowledge, the first empirical exploration of Italian consumer's preferences for mango. The outcomes will enhance comprehension of consumer's preferences for this popular and consumed product. The results could offer valuable insights for producers in crafting tailored strategies to meet consumers' expectations effectively.

### 1.1. Conceptual framework and research objectives

In this study the Food Value Scale (FVS), developed by Lusk and Briggeman [19], was adopted. It represents a landmark in the field of agricultural economics, as it has begun to identify other relevant aspects of foods and emphasizes personal values, explaining how these shape food choices. This is a best-worst scale for measuring successions of certain values, based on the idea that individuals' values are more stable than preferences.

Accordingly, the eleven food values examined in our research were the following: naturalness (degree to which food is produced without modern technologies); taste (degree to which food consumption is appealing to the senses); price (the price paid for food); safety (the degree to which food consumption will not cause illness); practicality of use (ease of cooking and/or consuming food); quantity (nutrition and type of fats, proteins, vitamins, etc.); tradition (preservation of traditional consumption patterns); origin (where agricultural products were grown); equity (the extent to which all parties involved in food production benefit equally); appearance (the degree to which food is attractive); and environmental impact (the effect of food production on the environment).

Food values have been investigated in prior studies as a means to discern consistent constructs of consumer preference [21–23]. In addition, a recent study by Bazzani et al. [24] underscores that food values are shaped by experiential, credence, and price attributes. According to the authors, credence attributes, like safety and sustainability, often require label information. Sustainability covers environmental impact, origin, and equity. Nutrition is a key credence attribute. Experiential attributes encompass taste, appearance, and convenience, influencing consumer choices.

However, a noticeable paucity of studies investigating their application in understanding consumer preferences for tropical fruits persists. The distinctiveness of this paper emerges from the unexplored territory: while the existing literature has recently delved into the influence of food values on consumer preferences for imported fruits and vegetables [25], no previous study has delved into their impact specifically on tropical fruits.

The aim of the present study is to ascertain the predominant factors influencing the demand for mangoes and understand the role of food values in this context. To achieve this goal, various drivers and attributes were meticulously examined to categorize homogeneous market segments for tropical fruit, based on consumers' attitudes and lifestyles.

In light of this general objective, the following five research questions were identified.

**RQ1.** Which food values are deemed more or less significant among consumers of mangoes?

**RQ2.** Are there distinct and homogeneous classes of consumers based on food values?

**RQ3.** Which market segment exhibits the highest frequency of mango consumption?

**RQ4.** To what extent does consumer subjective and objective knowledge impact mango consumption?

**RQ5.** How do individual socio-demographic characteristics and lifestyles shape mango consumption patterns and preferences among potential mango consumers?

## 2. Material and methods

### 2.1. Data description

To address the research questions, we developed an online multi-section survey using Google Forms, which was subsequently administered from June to September 2022 via social networks in Italy. The sections of the survey comprise: general characteristics of mango consumption; food values [4]; subjective and objective knowledge [26] and socio-demographic and lifestyle characteristics of the sample.

The 11 food values examined in this research are: naturalness, taste, price, safety, practicality of use, quantity, tradition, origin, equity, appearance, environmental impact.

The questions related to the general characteristics of consumption, food values, and subjective knowledge were presented using five-point Likert scales, where 1 means strongly disagree and 5 means strongly agree. Regarding the objective knowledge, binary questions were adopted, while binary and discrete questions were used to capture socio-demographic information. As for subjective knowledge, three items were submitted to respondents, with the mean of the answers representing the score for subjective knowledge to be used as a regressor [26, 27]. Objective knowledge was measured using four true–false questions. Each correct response added one to the score, and the sum of these scores was used to represent objective knowledge [26,27] used for the econometric analysis. A pilot test involving 40 consumers was conducted prior to distributing the questionnaire. In total, 689 urban consumer responses were gathered. However, as 202 respondents indicated

that they did not consume mangoes, the final sample consisted of 487 observations.

### 2.2. Statistical analysis

To aggregate highly correlated food values, the first step of the statistical analysis involved an exploratory factor analysis (EFA) using the principal component method, which groups the original variables into orthogonal factorial dimensions [28]. The number of components was determined using the eigenvalue rule using the cut-off point value of 1 [29]. The final components were rotated using varimax rotation to obtain clearer definitions and interpretations of the factorial dimensions [30]. To strengthen the interpretation of factors, loadings below 0.4 were omitted in the final representation of the factorial dimensions [31].

Subsequently, to group mango consumers based on food values, a non-hierarchical cluster analysis using factors obtained in the first step was performed using the *k*-means method. This method consists of an iterative process that minimises the Euclidean distances among groups' centroids [32]. A silhouette index was adopted as an instrument to assess cluster adequacy [33], providing the index for the identification of the fit for each respondent included in a particular cluster [34]. A silhouette index ranges from -1 to +1, with higher scores indicating the better adequacy/fit of individuals [35]. The results of the evaluation using this index are obtained by comparing, for each individual, the mean distance between individuals within the same group and the mean distance to the nearest cluster [35]. Different cluster solutions were tested and compared and, using the graphs, the four-cluster solution was considered the most suitable. Once the cluster analysis was performed, to analyse the determinants of the frequency of mango consumption in Italy (thus answering the three research questions), an ordered probit model (OPM) was used. The latter approach was selected considering that the dependent variable, representing the frequency of mango consumption, is ordinal [36]. The OPM is described in equation (1):

$$y_i^* = x_i \beta + e_i, \tag{1}$$

where:  $x_i$  is a vector of independent variables including cluster membership, subjective and objective knowledge, and socio-demographics characteristics; and  $\beta$  is the vector of unknown parameters. The model assumes a latent unobserved continuous process, as shown in equation (2):

$$E[e_i|X_i] = 0, e_i \text{ i.i.d. Normal } (0, 1) \text{ with } i = 1, \dots, I. \tag{2}$$

This underlies the ordinal observed outcome  $y_i$ , as shown in equation (3):

$$y_i = \begin{cases} 1 & \text{if } k_0 < y_i^* \leq k_1 \\ 2 & \text{if } k_1 < y_i^* \leq k_2 \\ 3 & \text{if } k_2 < y_i^* \leq k_3 \end{cases} \tag{3}$$

where:  $y_i$  is the dependent variable, which is measured by three categories of the frequency of mango consumption (1st level: "I consume mango rarely"; 2nd level: "I consume mango weekly"; 3rd level: "I consume mango more than once a week");  $k_0 = -\infty$  and  $k_3 = \infty$ ; and  $k_1$ ,  $k_2$ , and  $k_3$  are unknown threshold parameters to be estimated in order to indicate the range of the normal distribution associated with specific values of the stated response variable  $y_i^*$ . The parameters are obtained by maximising the log likelihood; for example, the probability that  $y_i = 1$  is equal to:

$$\begin{aligned} \pi_{-}(i1) &= P(y_{-}(i) = 1 | x_{-}(i)) = F(k_{-}(1) - x_{-}(i) \beta) - F(k_{-}(0) - x_{-}(i) \beta) \\ &= F(k_{-}(1) - x_{-}(i) \beta) - F(k_{-}(0) - x_{-}(i) \beta) \end{aligned} \tag{4}$$

where  $F$  is the cumulative distribution function (CDF) of  $e_i$ .

## 3. Results

### 3.1. Descriptive statistics

The socio-demographic characteristics (Table 1) show that most of the participants are female (66 %) with an average age of 36 years. A total of 68 % declared having a university degree, while 29 % stated receiving an annual income ranging from 10,001 to 20,000 euros. Of the 487 respondents, 270 (55 %) declared undertaking sports activities.

Table 2 shows the descriptive statistics for food values and subjective and objective knowledge, reporting the mean and standard deviation of each within a range from 1 to 5.

### 3.2. Exploratory factor analysis (EFA) results

An EFA was conducted on food values to reduce them. The EFA identified five main latent constructs, as shown by the factor loadings in Table 3. The first factor, named "safe and healthy", shows a positive relationship with food safety (0.6) and nutritional properties (0.42), while tradition (-0.77) and equity (-0.68) are negatively correlated. This suggests that some consumers are particularly interested in characteristics related to the quality of the product, paying less attention to tradition and equity. In the context of our study, equity refers to the perceived fairness or social justice aspects associated with food production and distribution [37]. This is reflective of a broader trend, as consumers are increasingly interested not only in understanding the production methods but also in discerning who benefits from their food purchases. The second factor was named "origin and sustainable" due to the positive correlation with the origin of the product (0.79) and with the environmental impact of the production (0.78). Moreover, a negative relationship can be seen with practicality (-0.41), suggesting that consumers concerned for the environment perceive ready-to-use foods as potentially more impactful on the environment. The third factor, "naturalness", is positively associated with the naturalness of the product (0.69), while showing a negative relationship with appearance (-0.82). This suggests that consumers may prioritize the recognition of a product's natural attributes over its visual appeal. This phenomenon can be likened to consumer preferences observed in the organic food market, where consumers, upon recognizing the naturalness of a product, are willing to overlook visual imperfections [38]. The fourth factor was found to be positively related to the practicality of use (0.55) and negatively to taste (-0.85); thus, this factor was named "practicality". This association of values indicates that some consumers may be strongly interested in eating ready-to-eat food even if it is not so good. Finally, the last factor of the EFA was named "functional, price irrelevant" since this dimension is positively related to nutritional properties (0.51) but negatively to price (-0.87). This combination

**Table 1**  
Descriptive statistics for socio-demographics characteristics.

	Freq.	Percent (%)
<b>Gender</b>		
Male	168	34.50
Female	319	65.50
<b>Education</b>		
Elementary and middle school	25	5.13
High School	129	26.49
Degree	333	68.38
<b>Income</b>		
Up to 10,000 €	98	20.12 %
11,000-20000 €	140	28.75
21,000-30000 €	118	24.23
31,000-40000 €	61	12.53
>400,000 €	70	14.37
<b>Sport activities</b>		
No	217	44.56
Yes	270	55.44
<b>Age</b>	487	36.11 (mean) 12.70 (st.d.)

**Table 2**  
Summary statistics of Food Values and knowledge.

	Mean	Std. Dev.	Min.	Max.
Naturalness	3.54	1.29	1	5
Taste	3.96	1.19	1	5
Price	2.70	1.25	1	5
Food safety	3.46	1.36	1	5
Practicality of use	2.87	1.29	1	5
Nutritional properties	3.65	1.24	1	5
Origin	3.16	1.30	1	5
Appearance	2.98	1.23	1	5
Environmental impact	3.02	1.32	1	5
Tradition	1.86	1.25	1	5
Equity	3.89	1.07	1	5
Subjective knowledge	3.32	1.10	1	5
Objective knowledge	3.37	0.85	0	4

suggests that some consumers may be interested in high-quality products based on nutritional properties, regardless of the price.

**3.3. Cluster analysis results**

Once the food values were reduced through the EFA, the obtained factors were used to perform consumer segmentation by adopting a cluster analysis. The results from the cluster analysis are shown in Table 4. Overall, four clusters were obtained. Cluster 1 ( $n = 127$ ) comprises consumers who attach more importance to the practicality of use and ready-to-eat foods, without paying attention to the food’s naturalness, origin, or nutritional aspects. Therefore, this group was called named “practical consumers”. Consumers in cluster 2 ( $n = 81$ ), termed “sustainable consumers”, are individuals that pay attention to the origins of mango and prefer an environmentally friendly production process. Unlike “practical consumers”, they are not at all interested in ready-to-eat food, nor are they interested in healthy, genuine, and functional food. Cluster 3 ( $n = 164$ ) includes consumers particularly interested in the nutritional properties of the food product, termed “healthy consumers”. This cluster includes consumers interested in safe and healthy mangoes, without paying attention to the naturalness. Conversely, the last group (cluster 4,  $n = 115$ ) includes consumers who pay more attention to naturalness, without neglecting the functional and healthy properties of the product. Therefore, the last cluster was called “natural consumers”.

**Table 3**  
Exploratory factor analysis (EFA) performed on food values.

	Factor 1 Safe and healthy	Factor 2 Origin and sustainable	Factor 3 Naturalness	Factor 4 Practicality	Factor 5 Functional, price irrelevant
Naturalness			0.69		
Taste				-0.85	
Price					-0.87
Food safety	0.60				
Practicality of use		-0.41		0.55	
Nutritional properties	0.42				0.51
Origin		0.79			
Appearance			-0.82		
Environmental impact		0.78			
Tradition	-0.77				
Equity	-0.68				

Rotated factor loading varimax blank (0.4).

**Table 4**  
Non-hierarchical cluster analysis.

Cluster	Safe and healthy	Origin and sustainable	Naturalness	Practicality	Functional, price irrelevant
<b>Practical consumers</b>	-0.97	0.12	-0.00	0.83	-0.31
<b>Sustainable consumers</b>	-0.52	0.51	-0.18	-1.40	-0.04
<b>Healthy consumers</b>	0.83	0.37	-0.25	0.25	0.11
<b>Natural consumers</b>	0.26	-1.02	0.37	-0.29	0.22

**3.4. Ordered probit model (OPM) results**

To address the research questions, an OPM was employed, and the results are presented in Table 5. The exclusion of the first group was necessary to avoid the dummy trap that consists of perfect collinearity among the levels of the categorical variable [39]. Consumers who are considered “natural”, “healthy” and “sustainable” are more likely to eat mango than “practical” consumers. In particular, the probability of consuming mango increases to a greater extent if consumers belong to the “natural” group ( $\beta = 0.51, p\text{-value} = 0.001$ ), followed by “healthy consumers” ( $\beta = 0.44, p\text{-value} = 0.003$ ) and “sustainable consumers” ( $\beta = 0.32, p\text{-value} = 0.068$ ). The results also show that objective ( $\beta = 0.11, p\text{-value} = 0.098$ ) and subjective ( $\beta = 0.13, p\text{-value} = 0.018$ ) knowledge increase the probability of consuming mango more frequently, thus answering RQ2. Regarding the socio-demographic characteristics of individuals (RQ3), gender has a negative effect on the probability of consuming mango frequently ( $\beta = -0.20, p\text{-value} = 0.074$ ), showing that the probability of consuming mango is higher for men. On the other hand, the results show that the probability of consuming mango more frequently increases if respondents undertake sports activities ( $\beta = 0.27, p\text{-value} = 0.016$ ).

**Table 5**  
Ordered probit regression on mango consumption frequency.

Variables	Coeff.	Std. Err.	p-value
Practical consumers			
Sustainable consumers	0.32	0.18	0.068*
Healthy consumers	0.43	0.15	0.003**
Natural consumers	0.51	0.16	0.001***
Subjective knowledge	0.13	0.05	0.018**
Objective knowledge	0.11	0.07	0.098*
Gender	-0.20	0.11	0.074*
Age	0.00	0.00	0.328
Education	-0.11	0.10	0.269
Income	0.00	0.04	0.913
Sport activities	0.27	0.11	0.016**
/cut1	1.17	0.41	
/cut2	2.17	0.41	

\*\*\*, \*\*, \* Indicate significance at the 0.01, 0.05, and 0.10 levels, respectively.



#### 4. Discussion

Based on the results and analysis presented, we can address the research questions of our study. In response to *RQ1*, it is evident that different food values hold varying degrees of significance among consumers of mangoes. Taste emerged as the most influential food value, boasting a mean score of 3.96, closely followed by equity at 3.89, and nutritional properties at 3.65. Notably, previous research has highlighted the relationship between taste and nutritional characteristics, emphasizing how perceptions regarding health and nutritional excellence can profoundly impact one's taste experience [40–42]. Conversely, tradition received the lowest score, standing at 1.86. This outcome is possibly attributable to the limited tradition of mango consumption in Italy. Interestingly, the absence of a dominant focus on price in the decision to purchase mangoes could be attributed to the perceived intrinsic value of the fruit in contributing to well-being. This is underscored by the mean subjective knowledge score of 3.32 and the objective knowledge score ranging from 0 to 4, which averaged at 3.37.

Addressing *RQ2*, non-hierarchical cluster analysis has revealed distinct and homogeneous consumer classes based on their ranking of food values. The first cluster, termed “practical consumers”, emphasizes the importance of practicality in food choices. These individuals prioritize convenience, which aligns with previous studies highlighting the significance of practicality in food selection [43–45]. It's noteworthy that these consumers may not heavily factor in flavor when making choices, as they prioritize time and effort efficiency in their food selections. However, it's essential to note that while ease of use is pivotal, fruits like mango may not be regarded as convenience foods due to their limited suitability for consumption in work or school contexts without significant processing [46].

The second cluster, “sustainable consumers”, demonstrates that the origin of mangoes plays a crucial role in purchasing decisions. This aligns with previous studies emphasizing the significance of product origin and environmental considerations in consumer choices [47–49]. The increasing demand for environmentally friendly food products in developed countries confirms that a segment of the sample places high importance on product origin and environmental concerns [50].

The third cluster, “healthy consumers”, corroborates findings from the literature that consumers are inclined to purchase mangoes due to their intrinsic attributes such as taste and nutritional content, which are closely associated with health and well-being [51]. These attributes are highly sought after by contemporary consumers [52,53].

The fourth cluster, “natural consumers”, underscores that perceived naturalness significantly impacts food acceptability. Naturalness, often associated with the absence of additives, is a fundamental determinant of food acceptability [54,55]. It's worth noting that naturalness is a commonly used claim in food marketing as it enhances consumer perceptions of food quality [56–58]. Moreover, the method of food production plays a crucial role in determining naturalness, with genetically modified or chemically modified products being perceived as less natural [59]. Empirical research has also demonstrated that perceived naturalness affects consumer attitudes and acceptance of foods, often linked to environmental concerns and ethical judgments [60–62].

Moving on to *RQ3*, the results from the Ordered Probit Model (OPM) shed light on the frequency of mango consumption across different consumer segments. Notably, mango consumption is more frequent among “natural consumers” when compared to “practical consumers”, followed by “healthy consumers” and “sustainable consumers”. This finding corroborates previous research indicating that naturalness, particularly the absence of additives, is a highly valued attribute among consumers of dried mango [51]. The preference for naturalness is driven by its association with health and nutritional benefits [52,53,55] and its positive impact on perceived food quality [56–58].

Additionally, the OPM results indicate an increased likelihood of mango consumption among “sustainable” and “healthy” consumers. “Sustainable” consumers are characterized by their interest in the origin of mangoes and their concern for the environmental impact of mango production. This aligns with prior studies highlighting the significance of product origin in consumer choices [48,49] and the growing demand for environmentally friendly food products [50]. Furthermore, “healthy consumers” display an increased frequency of mango consumption, which is consistent with research indicating that consumers choose mangoes for their perceived health and nutritional benefits [63].

Lastly, while “practical consumers” may exhibit a lower probability of consuming mangoes, it's essential to recognize the influence of practicality in food consumption, especially in metropolitan settings where time constraints often shape consumers' choices [64,65].

Concerning *RQ4*, the results suggest that both subjective and objective knowledge have a positive impact on the likelihood of consuming mango more frequently. Both are statistically significant; however, objective knowledge exhibits a higher coefficient. This implies that the surveyed sample may lack confidence in their nutritional knowledge, even though the results indicate that they possess moderate to high levels of knowledge. In contrast to other studies, which have found that objective knowledge negatively [66] and indirectly affects [26] organic food consumption, we found that objective knowledge regarding mango directly affects the probability of consuming it frequently. Regarding subjective knowledge, the literature has evidenced that this is a stronger motivator than objective knowledge for purchase-related behaviours [67–69]. Several empirical evidence [70–73] have pointed out that a higher level of subjective knowledge positively influences the intention to purchase organic food. Supporting these previous studies, even our findings confirm the strong effect of subjective knowledge in consuming mango fruit.

Finally, with regard to the socio-demographic and lifestyle variables (*RQ5*), this study reveals that gender and engagement in sports activities significantly influence mango consumption.

In particular, it was found that men and individuals who have declared undertaking sports activities are more likely to consume mango. This finding appears to diverge from previous research, which has produced contradictory results. While Migliore et al. [5] indicated that females exhibit a higher likelihood of consuming avocado fruit, Sabbe et al. [74] did not identify any gender-based differences in tropical fruit consumption. Given this inconsistency, further comprehensive investigations are needed to delve into the role of gender in tropical fruit consumption.

In relation to sports activities, the outcomes align with those of Badri et al. [75], who recently established a positive correlation between people engaged in sports activities and a healthy dietary pattern. This correlation is likely due to the fact that consumers who engage in sports tend to associate mangoes with healthiness and possess heightened awareness of the antioxidant properties inherent in this fruit.

#### 5. Conclusion

Mango production and consumption is gaining momentum all over the world, although little is yet known about factors affecting mango consumption. In this study, we employed a comprehensive methodology, beginning with a statistical analysis that included an EFA to condense food values, a non-hierarchical cluster analysis to categorize mango consumers, and the use of an Order Probit Model to examine relationships. This multifaceted approach facilitated our exploration of the predominant food value influencing mango consumption and provided insights into the extent to which food values, subjective and objective knowledge, socio-demographic factors, and lifestyles influence the frequency of mango consumption.

This research contributes valuable insights both in theoretical and marketing realms. From a theoretical standpoint, the study enhances the growing body of empirical evidence in the field of consumer preferences by pioneering an exploration of the impact of food values on the purchasing behavior of tropical fruits, specifically mangoes.

Furthermore, the findings carry actionable implications for marketing strategies. For instance, the study suggests that both subjective and objective knowledge can be effectively enhanced through well-crafted informational campaigns detailing mango's characteristics.

In addition, it becomes evident that emphasizing the fruit's health benefits could be particularly resonate with people engaged in sports activities. Moreover, since consumers are more interested in the naturalness, nutritional aspects, and origin of the product, rather than its utilitarian use, product labels should incorporate such information to stimulate mango consumption.

Despite its contributions, this study has some limitations. Firstly, the survey's reliance on a convenience sample restricts its generalizability, preventing far-reaching inferences. Moreover, the research scope based on food values encompasses variables as subjective and objective knowledge, and socio-demographic aspects, which overlook other potential drivers (e.g. socio-psychological factors) that could motivate mango consumption choices.

Hence, to address these limitations, future research avenues can be considered. For instance, investigating the underlying determinants of mango consumption through a targeted theoretical framework would provide a more comprehensive understanding. Furthermore, the adoption of alternative methodological techniques, such as choice experiments or joint experiments, could offer deeper insights into consumer preferences.

Expanding the study's purview to include consumers from a wider range of European countries would also be beneficial, potentially uncovering nuanced differences in dietary habits across various cultural contexts.

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## CRediT authorship contribution statement

**Daniela Spina:** Writing – review & editing, Writing – original draft, Resources, Methodology, Investigation, Conceptualization. **Raffaele Zanchini:** Writing – review & editing, Writing – original draft, Software, Methodology, Formal analysis, Data curation. **Manal Hamam:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Data curation, Conceptualization. **Giuseppe Di Vita:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Methodology, Formal analysis, Data curation, Conceptualization. **Gaetano Chinnici:** Writing – review & editing, Visualization, Validation, Supervision. **Maria Raimondo:** Writing – review & editing, Writing – original draft, Visualization, Data curation. **Francesco Caracciolo:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Methodology, Formal analysis, Data curation, Conceptualization. **Mario D'Amico:** Visualization, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Conceptualization.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Data availability

Data will be made available on request.

## References

- [1] D. Marin, Research regarding the purchase decision process of consumer of food products, *Scientific Papers: Animal Science & Biotechnologies/Lucrari Stiintifice: Zootehnie si Biotehnologii* 48 (2015) 1.
- [2] M. Connors, C.A. Bisogni, J. Sobal, C.M. Devine, Managing values in personal food systems, *Appetite* 36 (2001) 189–200, <https://doi.org/10.1006/appe.2001.0400>.
- [3] M. Rokeach, *The Nature of Human Values*, Free Press, New York, 1973.
- [4] J. Lusk, External validity of the food values scale, *Food Qual. Prefer.* 22 (2011) 452–462, <https://doi.org/10.1016/j.foodqual.2011.02.009>.
- [5] G. Migliore, V. Farina, S. Tinervia, G. Matranga, G. Schifani, Consumer interest towards tropical fruit: factors affecting avocado fruit consumption in Italy, *Agric Food Econ* 5 (2017) 1–12, <https://doi.org/10.1186/s40100-017-0095-8>.
- [6] S. Gorinstein, S. Poovarodom, H. Leontowicz, M. Leontowicz, J. Namiesnik, S. Vearasilp, Z. Tashma, Antioxidant properties and bioactive constituents of some rare exotic Thai fruits and comparison with conventional fruits: in vitro and in vivo studies, *Food Res. Int.* 44 (2011) 2222–2232, <https://doi.org/10.1016/j.foodres.2010.10.009>.
- [7] S. Poovarodom, S. Yingjajaval, VII international symposium on mineral nutrition of fruit crops, Chanthaburi, Thailand, *Acta Hort.* (2013) 984.
- [8] FAO, *Major Tropical Fruits: Market Review*, Rome, 2021, p. 2020.
- [9] L. Cornara, J. Xiao, A. Smeriglio, D. Trombetta, B. Burlando, Emerging exotic fruits: new functional foods in the European market, *EFood* 1 (2020) 126–139, <https://doi.org/10.2991/efood.k.200406.001>.
- [10] E.A. Evans, F.H. Ballen, M. Siddiq, Mango production, global trade, consumption trends, and postharvest processing and nutrition, *Handbook of mango fruit: production, postharvest science, processing technology and nutrition* (2017) 1–16, <https://doi.org/10.1002/9781119014362.ch1>.
- [11] M. Alam, Mango supply chain and value chain analysis from farm to market, *Int. J. Supply Chain Manag.* 7 (2018) 7–12, <https://doi.org/10.59160/ijscm.v7i4.2179>.
- [12] P.E. Akin-Idowu, U.G. Adebo, K.O. Egbekunle, Y.O. Olagunju, O.I. Aderonmu, A. O. Aduloju, Diversity of mango (*Mangifera indica* L.) cultivars based on physicochemical, nutritional, antioxidant, and phytochemical traits in South West Nigeria, *Int. J. Fruit Sci.* 20 (2020) 352–376, <https://doi.org/10.1080/15538362.2020.1735601>.
- [13] J.E. Bello-Lara, R. Balois-Morales, P. Juárez-López, I. Alia-Tejagal, C.B. Peña-Valdivia, J.O. Jiménez-Zurita, E.I. Jiménez-Ruiz, Coatings based on starch and pectin from 'Pear' banana (*Musa ABB*), and chitosan applied to postharvest 'Ataulfo' mango fruit, *Rev. Chapingo Ser. Hortic.* 22 (2016) 209–218, <https://doi.org/10.5154/r.rchsh.2015.09.037>.
- [14] M.H.A. Jahurul, I.S.M. Zaidul, K. Ghafoor, F.Y. Al-Juhaimi, K.L. Nyam, N.A. N. Norulaini, A.M. Omar, Mango (*Mangifera indica* L.) by-products and their valuable components: a review, *Food Chem.* 183 (2015) 173–180, <https://doi.org/10.1016/j.foodchem.2015.03.046>.
- [15] FAO, *Major Tropical Fruits Market Review – Preliminary Results 2022*. Rome, 2023.
- [16] S.K. Mitra, Mango production in the world—present situation and future prospect, XXIX International Horticultural Congress on Horticulture: Sustaining Lives 1111 (2014) 287–296. *Livelihoods and Landscapes (IHC2014): IV*.
- [17] S. Altendorf, Bananas and major tropical fruits in Latin America and the Caribbean, *Agric. Outlook* (2019) 73–76.
- [18] W.O. Owino, J.L. Ambuko, J.L. Ambuko, Mango fruit processing: options for small-scale processors in developing countries, *Agriculture* 11 (2021) 1105, <https://doi.org/10.3390/agriculture11111105>.
- [19] J. Lusk, B.C. Briggeman, Food values, *Am. J. Agric. Econ.* 91 (2009) 184–196.
- [20] C. Symmank, R. Mai, S. Hoffmann, F.M. Stok, B. Renner, N. Lien, H. Rohm, Predictors of food decision making: a systematic interdisciplinary mapping, (SIM) review, *Appetite* 110 (2017) 25–35, <https://doi.org/10.1016/j.appet.2016.11.023>.
- [21] A. Adalja, J. Hanson, C. Towe, E. Tselepidakis, An examination of consumer willingness to pay for local products, in: *Proceedings of the Agricultural and Applied Economics Association Annual Meeting*, Washington, DC, USA, 2013.
- [22] J.J. McCluskey, K.M. Grimsrud, H. Ouchi, T.I. Wahl, Bovine spongiform encephalopathy in Japan: consumers' food safety perceptions and willingness to pay for tested beef, *Aust. J. Agric. Resour. Econ.* 49 (2005) 197–209, <https://doi.org/10.1111/j.1467-8489.2005.00282.x>.
- [23] G. Pappalardo, J. Lusk, The role of beliefs in purchasing process of functional foods, *Food Qual. Prefer.* 53 (2016) 151–158, <https://doi.org/10.1016/j.foodqual.2016.06.009>.
- [24] C. Bazzani, G.W. Gustavsen, Nayga Jr., K. Rickertsen, A comparative study of food values between the United States and Norway, *Eur. Rev. Agric. Econ.* 45 (2018) 239–272, <https://doi.org/10.1093/erae/jbx033>.
- [25] S.H. Yang, B.P. Panjaitan, K. Ujiie, J.W. Wann, D. Chen, Comparison of food values for consumers' preferences on imported fruits and vegetables within Japan, Taiwan, and Indonesia, *Food Qual. Prefer.* 87 (2021) 104042, <https://doi.org/10.1016/j.foodqual.2020.104042>.
- [26] Z. Pieniak, W. Verbeke, F. Vanhonacker, L. Guerrero, M. Hersleth, Association between traditional food consumption and motives for food choice in six European countries, *Appetite* 53 (2009) 101–108, <https://doi.org/10.1016/j.appet.2009.05.019>.

- [27] R. Zanchini, G. Di Vita, D. Spina, A.I. De Luca, M. D'Amico, Eliciting consumers' health consciousness and price-related determinants for polyphenol-enriched olive oil, *NJAS - Wagening, J. Life Sci.* 94 (2022) 47–79, <https://doi.org/10.1080/27685241.2022.2108733>.
- [28] E. Mooi, M. Sarstedt, I. Mooi-Reci, *Principal Component and Factor Analysis, Market Research: the Process, Data, and Methods Using Stata*, Springer Texts in Business and Economics, 2018, pp. 265–311, <https://doi.org/10.1007/978-981-10-5218-7>.
- [29] H.F. Kaiser Hf, The application of electronic computers to factor analysis, *Educ. Psychol. Meas.* 20 (1960) 141–151, <https://doi.org/10.1177/001316446002000116>.
- [30] J.W. Osborne, What is rotating in exploratory factor analysis? *Practical Assess. Res. Eval.* 20 (2015) 2, <https://doi.org/10.7275/hb2g-m060>.
- [31] N. McNamara, J. Kirakowski, Measuring user-satisfaction with electronic consumer products: the Consumer Products Questionnaire, *Int J Hum Comput* 69 (2011) 375–386, <https://doi.org/10.1016/j.ijhcs.2011.01.00>.
- [32] D. Steinley D, K-means clustering: a half-century synthesis, *Br J Math Stat* 59 (2006) 1–34, <https://doi.org/10.1348/000711005X48266>.
- [33] N. Iofrida, A.I. De Luca, R. Zanchini, M. D'Amico, M. Ferretti, G. Gulisano, G. Di Vita, Italians' behavior when dining out: main drivers for restaurant selection and customers segmentation, *Int. J. Gastron. Food Sci.* 28 (2022) 100518, <https://doi.org/10.1016/j.ijgfs.2022.100518>.
- [34] B. Halpin B, *Cluster Analysis Stopping Rules in Stata*, 2016.
- [35] P.J. Rousseeuw, Silhouettes: a graphical aid to the interpretation and validation of cluster analysis, *J. Comput. Appl. Math.* 20 (1987) 53–65, [https://doi.org/10.1016/0377-0427\(87\)90125-7](https://doi.org/10.1016/0377-0427(87)90125-7).
- [36] J. Cantillo, J.C. Martín, C. Román, Analysis of the main determinants of away-from-home consumption of fishery and aquaculture products in the EU28, *Appetite* 163 (2021) 105216, <https://doi.org/10.1016/j.appet.2021.105216>.
- [37] B.C. Briggeman, J.L. Lusk, Preferences for fairness and equity in the food system, *Eur. Rev. Agric. Econ.* 38 (2011) 1–29, <https://doi.org/10.1093/erae/jbq033>.
- [38] M. Radman, Consumer consumption and perception of organic products in Croatia, *Br. Food J.* 107 (2005) 263–273, <https://doi.org/10.1108/00070700510589530>.
- [39] M. Venkataramana, M. Subbarayudu, M. Rajani, K.N. Sreenivasulu, Regression analysis with categorical variables, *Int. J. Stat. Manag. Syst.* 11 (2016) 135–143.
- [40] K. Kiesel, S.B. Villas-Boas, Can information costs affect consumer choice? Nutritional labels in a supermarket experiment, *Int. J. Ind. Organ.* 31 (2013) 153–163, <https://doi.org/10.1016/j.ijindorg.2010.11.002>.
- [41] R. Mai, S. Hoffmann, How to combat the unhealthy = tasty intuition: the influencing role of health consciousness, *J. Publ. Pol. Market.* 34 (2015) 63–83, <https://doi.org/10.1509/jppm.14.00>.
- [42] J. Jo, J.L. Lusk, If it's healthy, it's tasty and expensive: effects of nutritional labels on price and taste expectations, *Food Qual. Prefer.* 68 (2018) 332–341, <https://doi.org/10.1016/j.foodqual.2018.04.002>.
- [43] B.E.S. Bandara, D.A.M. De Silva, B.C.H. Maduwanthi, W.A.A.I. Warunasinghe, Impact of food labeling information on consumer purchasing decision: with special reference to faculty of Agricultural Sciences, *Procedia Food Sci* 6 (2016) 309–313, <https://doi.org/10.1016/j.profoo.2016.02.061>, 2016.
- [44] S.O. Olsen, H.H. Tuu, Time perspectives and convenience food consumption among teenagers in Vietnam: the dual role of hedonic and healthy eating values, *Food Res. Int.* 99 (2017) 98–105, <https://doi.org/10.1016/j.foodres.2017.05.008>.
- [45] N.T. Thong, H.S. Solgaard, Consumer's food motives and seafood consumption, *Food Qual. Prefer.* 56 (2017) 181–188, <https://doi.org/10.1016/j.foodqual.2016.10.008>.
- [46] H. Hartman, D.P. Wadsworth, S. Penny, P. van Assema, R. Page, Psychosocial determinants of fruit and vegetable consumption among students in a New Zealand university. Results of focus group interviews, *Appetite* 65 (2013) 35–42, <https://doi.org/10.1016/j.appet.2013.02.005>.
- [47] M.G. McEachern, G. Warnaby, Retail 'Quality Assurance' labels as a strategic marketing communication mechanism for fresh meat, *Int. Rev. Retail Distrib. Consum. Res.* 14 (2004) 255–271, <https://doi.org/10.1080/095939604200017819214>.
- [48] C. Bolliger, S. Reviron, Consumer Willingness to Pay for Swiss Chicken Meat: an In-Store Survey to Link Stated and Revealed Buying Behaviour, *European Association of Agricultural Economists*, 2008, pp. 725–2016, <https://doi.org/10.22004/agecon.44155>, 49563.
- [49] G. Di Vita, R. Zanchini, D. Spina, G. Maesano, G. La Via, M. D'Amico, Exploring purchasing determinants for a low-fat content salami: are consumers willing to pay for an additional premium, *Front. Sustain. Food Syst.* 6 (2022) 65, <https://doi.org/10.3389/fsufs.2022.794533>.
- [50] K. Nuttavuthisit, J. Thøgersen J, The importance of consumer trust for the emergence of a market for green products: the case of organic food, *J. Bus. Ethics* 140 (2017) 323–337, <https://doi.org/10.1007/s10551-015-2690-5>.
- [51] I. Sulistyawati, S. Sijtsema, M. Dekker, R. Verkerk, B. Steenbekkers, Exploring consumers' health perception across cultures in the early stages of new product development: dried mango as a case study, *Br. Food J.* 121 (2019), <https://doi.org/10.1108/BFJ-02-2019-0091>.
- [52] M. Hamam, G. Di Vita, R. Zanchini, D. Spina, M. Raimondo, M. Pilato, M. D'Amico, Consumers' attitudes and purchase intention for a vitamin-enriched extra virgin olive oil, *Nutrients* 14 (2022) 1658, <https://doi.org/10.3390/nu14081658>.
- [53] G. Di Vita, G. Maesano, R. Zanchini, C. Barbieri, D. Spina, F. Caracciolo, M. D'Amico, The thin line between tradition and well-being: consumer responds to health and typicality attributes for dry-cured ham, *J. Clean. Prod.* 364 (2022) 132680, <https://doi.org/10.1016/j.jclepro.2022.132680>.
- [54] H. Siipi, Is natural food healthy? *J. Agric. Environ. Ethics* 26 (2013) 797–812, <https://doi.org/10.1007/s10806-012-9406-y>.
- [55] K.C. Soylemez, 4W of user-generated content: why who we are and where we post influence what we post, *J Res Interact Mark* 15 (2021) 386–400, <https://doi.org/10.1108/JRIM-06-2019-0093>.
- [56] P. Rozin, M. Spranca, Z. Krieger, R. Neuhaus, D. Surillo, A. Swerdlin, K. Wood, Natural preference: instrumental and ideational/moral motivations, and the contrast between foods and medicines, *Appetite* 43 (2004) 147–154, <https://doi.org/10.1016/j.appet.2004.03.005>.
- [57] P. Rozin, The meaning of "natural" process more important than content, *Psychol. Sci.* 16 (2005) 652–658, <https://doi.org/10.1111/j.1467-9280.2005.01589.x>.
- [58] A. Coppola, F. Verneau, Naturalness and consumer choices: the case of microfiltered milk, *Proceedings in Food System Dynamics* (2010) 187–201, <https://doi.org/10.22004/ag.econ.100468>.
- [59] G. Vindigni, I. Peri, F. Consentino, R. Selvaggi, D. Spina, Exploring consumers' attitudes towards food products derived by new plant breeding techniques, *Sustainability* 14 (2022) 5995, <https://doi.org/10.3390/su14105995>.
- [60] M. Agovino, A. Crociata, D. Quaglione, P. Sacco, A. Sarra, Good taste tastes good. Cultural capital as a determinant of organic food purchase by Italian consumers: evidence and policy implications, *Ecol. Econ.* 141 (2017) 66–75, <https://doi.org/10.1016/j.ecolecon.2017.05.029>.
- [61] M. Siegrist, C. C. Hartmann, Perceived naturalness, disgust, trust and food neophobia as predictors of cultured meat acceptance in ten countries, *Appetite* 155 (2020) 104814, <https://doi.org/10.1016/j.appet.2020.104814>.
- [62] C. Hartmann, M. Siegrist, Our daily meat: justification, moral evaluation and willingness to substitute, *Food Qual. Prefer.* 80 (2020) 103799, <https://doi.org/10.1016/j.foodqual.2019.103799>.
- [63] H. Badar, A. Ariyawardana, R. Collins, Capturing consumer preferences for value chain improvements in the mango industry of Pakistan, *Int. Food Agribus. Manag. Rev.* 18 (2015) 131–148, <https://doi.org/10.22004/ag.econ.208498>.
- [64] K.G. Grunert, Trends in food choice and nutrition, in: M. Klopčič, A. Kuipers, J. F. Hocquette (Eds.), *Consumer Attitudes to Food Quality Products*. EAAP – European Federation of Animal Science, Wageningen Academic Publishers, Wageningen, 2013, p. 133, <https://doi.org/10.3920/978-90-8686-762-2.2>.
- [65] S. Meredith, H. Willer, *Organic in Europe-Prospects and Developments*, IFOAM EU Group, 2016.
- [66] J. Aertsens, K. Mondelaers, W. Verbeke, J. Buysse, G. Van Huylenbroeck, The influence of subjective and objective knowledge on attitude, motivations and consumption of organic food, *Br. Food J.* (2011), <https://doi.org/10.1108/00070701111179988>.
- [67] F. Selnes, K. Gronhaug, Subjective and objective measures of product knowledge contrasted, *Adv. Consum. Res.* 13 (1986) 67–71.
- [68] L. Feick, C.W. Park, D.L. Mothersbaugh, Knowledge and knowledge of knowledge: what we know, what we think we know and why the difference makes a difference, *Adv. Consum. Res.* 9 (1992) 190–192.
- [69] R. De Cianni, L. Pippinato, R. Zanchini, F. Brun, G. Di Vita, T. Mancuso, Parental behaviour in choosing snacks for children aged six to ten: the role of mothers' nutritional awareness, *Br. Food J.* 125 (2023) 713–730, <https://doi.org/10.1108/BFJ-09-2021-1010>.
- [70] G. Chrysoschoidis, Repercussions of consumer confusion for late introduced differentiated products, *Eur. J. Market.* 34 (2000) 705–722, <https://doi.org/10.1108/03090560010321992>.
- [71] L. House, J. Lusk, W. Bruce Traill, M. Moore, C. Calli, B. Morrow, W. Yee, Objective and subjective knowledge: impacts on consumer demand for genetically modified foods in the United States and the European Union, *AgBioforum* 7 (2004) 113–123, <https://doi.org/10.22004/ag.econ.20125>.
- [72] A. Gracia, T. De Magistris, Organic food product purchase behaviour: a pilot study for urban consumers in the south of Italy, *Spanish J. Agric. Res.* 5 (2007) 439–451, <https://doi.org/10.5424/sjar/2007054-5356>.
- [73] G. Di Vita, M. Borrello, R. Vecchio, G. Gulisano, M. D'Amico, Purchasing drivers of fresh citrus fruits in urban Italy: is it all about taste? *Nutrients* 12 (2020) 979, <https://doi.org/10.3390/nu12040979>.
- [74] S. Sabbe, W. Verbeke, P. Van Damme, Perceived motives, barriers and role of labeling information on tropical fruit consumption: exploratory findings, *J. Food Prod. Market.* 15 (2009) 119–138, <https://doi.org/10.1080/1045440802316750>.
- [75] M.A. Badri, M. Alkhaili, H. Aldhaheeri, H. Alnahyan, G. Yang, M. Albahar, A. Alrashdi, Understanding the interactions of happiness, self-rated health, mental feelings, habit of eating healthy and Sport/Activities: a path model for Abu Dhabi, *Nutrients* 14 (2022) 55, <https://doi.org/10.3390/nu14010055>.