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Factors Driving Consumption Preferences for Fresh Mango and Mango-Based Products in Italy and Brazil

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Abstract: In many European countries the consumption of tropical fruit is constantly growing, and people are increasingly turning to diets rich in fruit and vegetables. In this context, mango is considered a super-food for its nutritional medium-high energy value. Produced mainly in developing countries, tropical fruits animate an interesting international market. Production in Mediterranean countries is also growing and is increasingly requested in European markets. The aim of this work is to investigate the factors that drive the inclination to purchase fresh mango and mango food and drinks in Italy and Brazil in order to observe consumer preferences in the two countries. The personal experiences, motivations and choices of consumers regarding fresh mango and mango-based products were taken into consideration. Through an online survey, a semi-structured questionnaire was administered in Italy and Brazil which led to a total sample of 453 participants. The data were statistically analyzed, and a PLS-SEM model was used to empirically examine the factors influencing the consumption of fresh mango and mango food and drinks. The research hypotheses are all supported. For a comparison between the two countries, a multigroup analysis (PLS-MGA) was performed. In Italy, consumers are attentive to the quality and safety of the fruit; they choose the point of sale where they buy fresh mango or mango foods because they trust the seller to guarantee the fruit's origin and transformation. In Brazil, new consumer trends are emerging especially in gastronomy; since they are local foods, they are considered safe, sustainable and healthy by consumers. The study addresses a little-explored topic and aims to enrich the debate on consumer orientations, preferences and reasons for buying mango and mango products.

Keywords: mango; tropical fruit; consumers; PLS-SEM; PLS-MGA; semi-structured questionnaire; mango quality; mango post-harvest; Italy; Brazil



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1. Introduction

Mango is a tropical fruit prized for its fresh and sweet flavor [1] and is one of the most consumed fruits in the world. In many nations it is an integral part of culture and history. Mango was first cultivated in India more than 5000 years ago. It is a fruit that belongs to the Anacardiaceae family, scientific name *Mangifera indica*. Strictly speaking, tropical fruits are defined as fruits produced in warm and humid regions, situated between the Tropic of Cancer and the Tropic of Capricorn, with an average temperature of around 27 °C [2,3]. The utilization of exotic fruit is rapidly growing in many European countries. This growing demand can be explained by the attractiveness of exotic fruit, global communication, international travel experience, interest in fruit consumption in general and, consequently, increased health awareness among consumers, as well as by the demographic increase in ethnic minorities in Europe [4–6].

Some of these products have long been appreciated by consumers, such as banana, pineapple, mango and avocado. In addition, lesser-known exotic fruits such as tamarind,

feijoa, litchi, guava, rambutan and many others are developing a presence in European markets, where interest in new flavors and varieties is extending. Following this positive orientation, producers and retailers are spreading an increasing number of exotic fruits with high nutritional value, also known as “superfruits”, onto the market. This word is generally used to indicate the high health benefits of these fruits, being rich in fiber, vitamins, minerals and antioxidant elements, such as phenolic acids, flavonoids and anthocyanins.

As indicated by Euromonitor reports and Mintel’s Global Food and Drink Trends 2030, a growing number of consumers are becoming aware of functional foods with the aspiration of obtaining further benefits for their health. Furthermore, the actual demand for healthy and convenient foods has accentuated, and consumers are increasingly choosing processed fruit, such as dried fruit, jam and fruit snacks [7–9]. This growing desire for more nutritious foods is pushing the food industry to innovate and make greater use of tropical fruits as ingredients for a rich range of food products, both as a means of varying flavors and to meet consumer interest in new and innovative products [10].

Furthermore, the production of tropical fruits and their supply to the world market supports the employment of a significant part of the populations of developing countries, represents an opportunity for income for their families and equates to foreign exchange earnings for the countries concerned. At the same time, for the countries that import them, they currently represent a relevant element in satisfying the needs of their citizens for fruit and berry products in terms of volume, assortment and availability during the entire year. Considering that the Food and Agriculture Organization of the United Nations declared 2021 “International Year of Fruits and Vegetables” [11], the market for fruit juices and nectars is growing significantly and has attracted the interest of farmers, distributors and the juice and nectars industry to meet the demand [12].

Mango, thanks to its high nutritional and bioactive peculiarities, is considered the most commonly consumed fresh fruit in the world [13,14]. Mango is widely accepted by consumers for its sweet taste and exotic flavor and is an important tropical fruit for human nutrition in different parts of the world. Mango pulp and agro-industrial residues contain various bioactive compounds, including nutritive and non-nutritive substances with biological properties.

Even in Italy, interest in mangoes in the last five years has resulted in a constant increase in imports equal to +37%. This interest is fueled and encouraged by ever-increasing consumption recorded throughout Europe, particularly for mango and avocado. The products obtained in the Mediterranean areas where the cultivation of mango and other tropical fruits has been introduced are highly appreciated in Europe for their excellent production quality and record-high sales prices.

Given the importance of mango in many different markets, it is useful to understand consumers’ perception of quality and how this influences their purchase and consumption decision-making process. This information can enable industry players to improve their actions to meet consumer demand [15]. This also encourages opportunities for actors across the industry to work more efficiently and improve profitability [16].

Advances in transportation, trade agreements and shifting consumer preferences in favor of these fruits have led to growth in trade. However, tropical fruits are highly perishable during the different steps of production and distribution, and these aspects represent the main obstacles to the quality of the fruit and the guarantee of supply to international markets. In this context, few studies have investigated consumer preferences for tropical fruits.

The aim of our study is to determine the predominant aspects that influence the demand for mango and mango-based products to understand their role, purchasing propensity and preferences. To obtain this objective, different drivers and attributes were carefully studied to classify homogeneous market parts for tropical fruit, based on consumer attitudes and lifestyles. In particular, this work focuses on the consumption preferences regarding fresh and processed mango in the city of Bahia in Brazil and in some Italian cities with the aim of grasping the main product characteristics and to study the different

consumption habits and preferences in the two countries, one of ancient tradition and the other recently introduced.

2. Hypothesis Development

2.1. Theoretical Background

The “Theory of Planned Behavior” (TPB) aims to understand the processes that lead individuals to intentions in their consumer choices. This theory is one of the most widespread in behavioral data analysis and socio-psychological analysis as it allows us to study the interrelationships between variables that are not directly measurable (latent variables or factors), and it has been frequently applied to behavioral studies on food and beverage consumption [17–19]. In recent times, many scholars who deal with food and drink consumption have added other constructs to those indicated by Ajzen [20], for example, to delve deeper into aspects related to organic food [21], to sustainability [22], to food waste [23], to moral standards [24], to behavior in choosing local food [25], to the study of innovative products including functional food or even to healthy and dietetic nutrition [6].

In the academic field, other theories have joined the TPB by integrating and enriching the marketing approach. For example, Rituparna Basu and other authors (2023) [26], in their article, carry out an in-depth review of postmodern marketing practices and highlight a growing interest among researchers in consumer vulnerability, reiterating a concept examined by Hill & Sharma (2020) [27] and by Riedel et al. (2022) [28], highlighting many of the aspects that revolve around the effects that modern markets have on current culture and societies. In “postmodern” consumption, products are differentiated, demand is highly segmented, markets are unstable, and territory plays a decisive role. In this condition, individual freedom influences consumer choices just as the environment, the social and cultural context and health aspects do [29]. As early as the 1990s some authors identified the postmodern consumer [30,31] as someone who satisfies his own needs within a cultural model that is independent from the act of consumption, concepts reaffirmed in the 2000s [32,33].

Gilal et al. in 2019 [34] and Cassia and Magno in 2024 [23] address the role and value of self-determination theory (SDT) in marketing studies. They highlight, within the framework of the theory of human motivation (proposed by Deci and Ryan in 1985 [35] and taken up by the same authors in 2000 [36]), a person’s commitment to a specific behavior to distinguish, explain and predict intrinsic and extrinsic motivations for purchasing decisions.

Pang et al., 2021 [21] propose in their study Roger’s (1975) [37] Protection Motivation Theory (PMT), an extension of the Health Belief Model (HBM). The theory is usually used as a theoretical foundation for the study of protective behaviors in terms of attention to an individual’s health.

SDT and PMT represent a valid integration of the theory of planned behavior to empirically explore consumption behaviors. These different theories were a useful starting point for us to address and study the propensity to consume mango and mango-based foods and beverages. In fact, in this work, once the factors that influence the intention to consume fresh mango and mango-based foods and beverages were determined, a PLS-SEM model was developed.

According to Magno, Cassi and Ringle [38], partial least squares structural equation modeling [39,40] allows researchers to estimate models with constructs [39] where the application of advanced PLS-SEM methods can enrich both existing theories and business practices in marketing actions [40,41]. PLS-SEM offers researchers multiple advantages, such as handling small sample sizes, estimating complex models and balancing predictions and explanations [39,42]. In business research, the method is particularly suitable for research on success factors or for exploring the sources of competitive advantages [43]. Furthermore, in light of recent studies [38,44,45] that apply the PLS-SEM method to building research models, in a second phase we added the PLS-MGA multigroup approach with reference to the two countries, Italy and Brazil, in order to compare preferences, motiva-

tions, consumption habits and propensity to purchase. To achieve this goal, we asked the following research questions:

- Are the nutritional values of mango considered significant among consumers in the two countries?
- Do lifestyles and fruit consumption habits influence the intention to consume mango and mango-based foods?
- To what extent does an awareness of environmental and social sustainability influence mango consumption choices?
- How important are quality, safety and organoleptic characteristics in the intention to consume and purchase mangoes and mango-based products?
- Do mango-based products such as aperitifs, ice cream, desserts, jam, smoothies, etc. attract Italian and Brazilian consumers?
- In which stores do consumers prefer to buy fresh mango and mango-based products?
- Are curiosity and gastronomic culture for new uses and new dishes relevant factors in the consumption of mango and mango food in the two countries?

Our results will increase the understanding of consumer attitudes to these products: in Brazil they allow us to examine and strengthen the knowledge of consumer orientations and preferences, while in Italy, where fresh mango and mango foods and drinks are emerging products, analyses can offer valuable insights to supply chain figures with the aim of developing a tailored marketing plan to effectively meet consumer expectancy.

2.2. Research Hypothesis

The conceptual framework of this work is observable in Figure 1, which shows the potential motivations influencing the behavioral intention to purchase fresh mango and mango food and drinks. The interest of Italian and Brazilian consumers in mango is different: in Italy only in the last decade has there been an increase in consumption and a greater propensity to purchase (this above all in relation to the attraction for this exotic fruit and the wide range of mango-based products present in Italian stores), while in Brazil (the third-largest mango producing country in the world) the fruit, both fresh and processed, is widespread, well-known and highly appreciated.

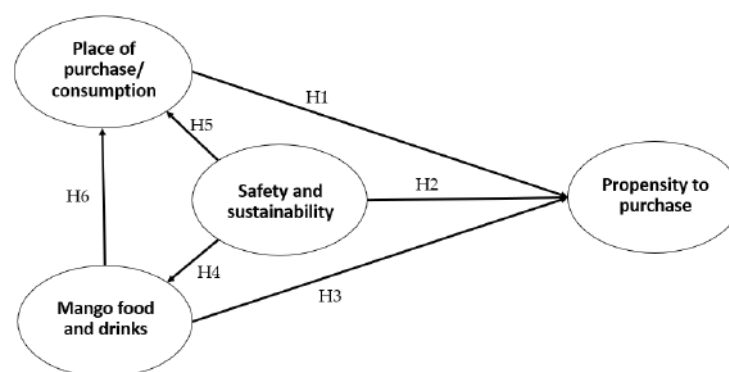


Figure 1. Conceptual model hypothesized in the analysis. Source: Authors' elaboration from data analysis in Smart-PLS4.

The model shows four main drivers that guide consumers' choices and their propensity to purchase: motivation; knowledge of and attraction to fresh mango and mango-infused foods and drinks; consumer expectations on food safety; and environmental sustainability. The points of sale preferred by consumers also come into play in these choices, including the availability and possibility of online purchasing.

2.2.1. Propensity to Purchase

The quality and organoleptic characteristics of a food reflect the qualities perceptible through one or more sense organs. Appearance, color, shape, aroma, flavor and consistency

and characteristics connected to it (fluidity, viscosity, friability) are just some of the most important and well-known organoleptic characteristics. Even at the beginning of the 1990s, Harris [46] recognized the importance of tropical fruits in the history of cuisine and in the development of modern gastronomy [47]. In Italian gastronomy, the introduction of tropical fruits offers a large range of benefits, such as the combination of flavors, use in decorating and embellishing dishes, cocktails or desserts, experimentation with traditional Italian dishes using ingredients and flavors of other cultures and the creation of new and unique dishes [48]. Mango, thanks to its singular flavor, has also conquered the taste of European and Italian consumers, and rather than naturally as a fruit, it is mostly consumed in the form of drinks and cocktails (along with other fruits such as pineapple, orange, etc.), ice creams, desserts and mango biscuits, all of which have recently been increasingly appreciated in gastronomy (poké, salads, sauces, fresh and tasty gourmet dishes, etc.), and is often used in the kitchen in recipes both in Italy and in Brazil. Sgroi et al. [48] state that mango currently attracts and intrigues young Italians looking for gastronomic experiments.

Another aspect that favors the propensity to purchase is the search for information on social media. Changes in consumer behavior have been studied due to the effect of social media and the Internet. Consumers are now immersed in a virtual space. The network has become a tool to activate connections and interactions. Often, when consumers purchase, they are unable to obtain sufficient and complete information [49]; for this reason, social media represent a support tool. This also happens with reference to mango and mango-based products to be purchased online and consumed at home and away from home both in Italy and in Brazil. The wide range of mango products and mango-based foods and drinks to purchase or prepare encourages consumers to take part in discussion groups to ask for advice, recipes, information and assistance in the decision-making process before purchasing [50,51].

The propensity to purchase is increasingly connected to practicality of use and to the expansion of the range of mango-based products, and it is encouraged by the food industry, which has increased the use of mango and tropical ingredients both in Brazil and in Italy. Furthermore, particularly in Europe and Italy, demographic diversification, the emergence of multi-ethnic and multicultural societies and the presence of different ethnic groups bearing different cultural and food heritages leads to a tendency and propensity towards new tastes and gastronomic curiosities. Even in Brazil, new and alternative methods of mango consumption are becoming more and more widespread due to the influence of other cultures and eating habits. This is the case, for example, with sushi prepared with mango and other tropical fruits, which is becoming very popular in Brazil.

2.2.2. Points of Sale

As regards the choice of sales points, i.e., where consumers buy mangoes and mango-based products, consumers have widely varying habits, and often they buy both in green-grocers and specialized shops and in supermarkets both fresh mango and artisanal mango-based products (such as ice cream and desserts, aperitifs, jam, etc.) and/or non-artisanal ones by purchasing packaged industrial products. The possibility of purchasing ready-to-use and practical products is very important [52]

Konuk [53] underlines that the role of the store image, in relation to perceived quality, trust in the store and the seller and perceived value, influences consumers' purchasing intentions. Indeed, trust is defined as "the consumer's expectation of the reliability of the services provided and the fulfillment of promises by the supplier" [54]. Manufacturing companies are trying to find market space and face strong competition. The store image is one of the most important distinctive aspects that provides a substantial advantage for retailers. It represents the set of a consumer's perceptions of a store with reference to different attributes. Thus, the point of sale (shop or open-air market) is viewed as a space for socializing and creating a climate of trust in the quality of the goods and the availability of the retailer. Loyalty is "the willingness to rely on a trusted business partner" [53,55]. The

theory of trust commitment gives particular importance to the concept of trust. This is even more relevant when considering online purchasing.

Considering that the choice of the point of sale has relevance to the propensity to purchase:

Hypothesis 1 (H1). *The identification of the point of sale has a positive and significant effect on the propensity to purchase.*

2.2.3. Safe and Sustainable: Health and Environmental Awareness

Fundamental elements in purchasing decisions are the aspects concerning food safety, the loss of biodiversity and health in general. Lately, to these traditional aspects have been added those that consider the risks linked to climate change and the sensitivity of respect for the environment.

Sustainable attitudes, identifiable in food choices that concern attention to products such as fruit and vegetables, involve an increasingly large part of consumers. This also involves production methods compatible with the environment and with the health of consumers, for a healthy diet and an adequate lifestyle [56–60].

Many elements determine consumer choices: raw materials used, nutritional aspects, production and marketing itself. Conscious purchasing is increasingly closely linked to food safety and the desire to purchase environmentally friendly food [61], even if all this is combined with the consumer's knowledge and experience.

These are consumption habits that are influenced by friends and family, which influence individual choices [61].

Safety and environmental sustainability attributed to food by the subjects interviewed are critical factors that influence value aspects, ethical and social orientations and behavioral intentions [62].

The values of consumers and their socio-economic environment shape and influence sustainable food attitudes and models. These consumers will be more likely to orient themselves towards consuming and purchasing food with sustainability requirements.

Consumer health and lifestyles have attracted much multidisciplinary research. The awareness of the significant implications of healthy eating for well-being and consumer interest in more nutritious foods, have gained momentum. Several studies [63] have demonstrated a direct link between lifestyle and life satisfaction or subjective well-being. The impact of healthy lifestyle behaviors on health is well-known, particularly the association between lifestyle behaviors and well-being.

The following hypotheses are formulated.

Hypothesis 2 (H2). *The aspects of safety and sustainability have a positive and significant impact on consumers' propensity towards purchasing mangoes and mango-based products.*

Hypothesis 4 (H4). *The safety and sustainability aspects have a positive and significant impact on the consumption of fresh mango and mango-based products.*

Hypothesis 5 (H5). *Safe, sustainable, ethical and responsible consumption has a positive and significant impact on the choice of sales outlets.*

2.2.4. Mango Based Products

Sulistyawati et al., 2020 [64], state that mango fruits are highly valued for their taste [65,66], for their exotic appearance and for the health advantages they provide. The transformation of fresh fruit into dried fruit, for example, is of interest to the global market since the dried product has a longer availability and high versatility in different food products, including breakfast cereals, fruit bars and mixtures with nuts [9,67]. Previous studies on consumer preferences on dried fruit have shown that health-related attributes, such as nutritional content, have a positive influence on health and that, among intrinsic

attributes, functional ingredients are considered important [8,68]. Information on consumer preferences for health and sensory properties is particularly useful for understanding which attributes could help increase the value of dried mango and other mango products for the relevant markets. Both types of information are essential for successful consumer-oriented product development.

Hypothesis 3 (H3). *The wide range of mango-based foods and products has a positive and significant impact on the propensity to purchase.*

Hypothesis 6 (H6). *Preferences for mango foods and drinks has a positive and significant impact on the choice of outlets from which to purchase them.*

3. Mango and Tropical Fruits: International Trade and Market Strategies in Italy

3.1. World Export-Import

World mango production grew from 25 million tons in 2000 to over 57 million in 2021. The volume of mango exports from 2000 to 2021 grew from 0.62 to 2.3 million tons, with an average annual growth of 26% [69]. Although tropical fruits play a limited part in global agricultural trade in terms of overall volume, accounting for only 3% of global agricultural food exports, their high average unit export value, well above \$1000 per ton, places them third in value behind bananas and apples. Trade in tropical fruits generates notable revenues for small-scale producers, as well as significant export earnings for many producing countries, thus contributing to their food security. It is estimated that approximately 99% of tropical fruit production occurs in developing countries, mainly in Asia and Latin America and a smaller share in Africa (Table 1). In most production areas, tropical fruits continue to be grown at a subsistence level rather than commercially. Combined exports of the four big tropical fruits represent only 5% of the total production volume, with the remainder consumed or otherwise used domestically. India is by far the biggest producer of mangoes globally, with a production quantity of around 25 million tons in 2022; however, due to the strong domestic demand for mangoes in the country, production is aimed almost exclusively at the internal market.

Table 1. Mango import and export by continent in 2023.

Continents	Mango Exports		Mango Imports	
	(Tons)	%	(Tons)	%
Asia	866,138	39.0	813,535	35.8
Africa	222,233	10.0	130,597	5.8
Central America and the Caribbean	520,994	23.4	11,123	0.5
South America	611,726	27.5	43,650	1.9
Northern America	-	-	697,077	30.8
Europa	-	-	567,906	25.0
Oceania	1902	0.1	6133	0.3
World	2,292,721	100.0	2,270,021	100.0

Authors elaboration from FAOSTAT 2023.

World exports in 2023 amount to 2,292,721 tons. The main world mango exporting countries are: Mexico (Central America and the Caribbean), which in 2023 exported 482,640 tons (equal to 21.1%); Thailand, India and Pakistan (Asia), which exported, respectively, 341,418 tons (14.9%), 145,499 tons (6.3%) and 123,617 tons (5.4%). In South America the main exporting countries are Brazil and Peru, which respectively export 275,818 tons (12.0%) and 266,045 tons (11.6%).

North America and the European Union are among the main world importers, with import shares of 30.8% and 25%, respectively. In particular in North America, the United States imports 19.0%, and Canada 11.7%. In these markets, consumer demand for mangoes has increased, driven by an increasing awareness of the nutritional and health values

attributed to these fruits. The growth of imports in these markets was further supported by strong production supply in Mexico, Peru and Brazil, which are the three main mango exporting countries to the United States and the European Union. In Asia, the main importers of mangoes and mangosteens are China (which imports mainly from Thailand), Saudi Arabia and the United Arab Emirates.

Even in Italy, avocado and mango are increasingly at the center of consumer preferences. Mango imports by Italy highlight the growing interest in this product; in fact, they went from 13.5 million kg imported in 2018 to 18.5 million kg in 2022 (+37%).

3.2. *Made in Italy Tropical Fruits*

Mediterranean countries such as Israel, Palestine occupied, Egypt, Spain and southern Italy are taking on an increasingly interesting role in the production of tropical fruits.

In southern Italy, the increasing interest among producers in mango cultivation is demonstrated by the high organoleptic quality of the product obtained and the economic interest fueled by the increases in consumption recorded throughout Europe. The cultivations of exotic fruit created in Italy have multiplied in recent years and are present in Sicily, Puglia and Calabria, where, more and more often, real tropical fruit plantations are first experimented with and then started, growing bananas, mango, avocado, lime, passion fruit, sour apple, feijoa and other minor ones [70,71]. The surfaces affected by mango cultivation are mainly found in coastal areas. In Sicily, the northern coastal area of the island is particularly suitable. In general, in Mediterranean-sub-tropical climate conditions, plants maintain a smaller size.

Southern Italy grows exotic fruit against the effects of climate tropicalization, a challenge of resistance and adaptation which in recent years has translated into concrete income opportunities for farmers.

A national survey shows that tropical fruit cultivation in Italy has tripled in five years, going from 500 hectares to the approximately 1200 currently cultivated in Puglia, Sicily and Calabria. This phenomenon is driven by the effect of climate change, which is radically modifying the map of agricultural production in these regions. More and more often, therefore, in the southern regions, real plantations of tropical and sub-tropical fruit never seen in the past in Italy are being experimented with and started, from the best-known—mango, avocado, lime and passion fruit—up to annona, feijoa, casimiroa, black zapote and litchi. More and more often, young farmers are choosing to bet on these new crops, sometimes recovering abandoned land due to the climate crisis. The increasingly long and scorching summers have pushed us to invest more and more in the cultivation of tropical fruit, which finds an optimal habitat in southern Italy. The challenge of adapting to the new climate pushes farmers to be resilient and innovative. Suffice it to consider that the production of tropical fruit in Italy, from a simple initial curiosity grown in a few hectares, is currently a real market phenomenon, recording, in the 2023–24 vintage, a strong demand for “made in Italy” mangoes both from the Italian markets as well as from the European ones. Compared to fruits coming from tropical countries, which have to face a long journey by ship or plane and for this reason are harvested at the first stages of maturation with significant repercussions on the quality of the product, mangoes of Italian origin are highly appreciated, even if they possess smaller dimensions than those from the areas of origin. The trend is motivated by the greater degree of freshness but also by concerns about guarantees of product traceability and safety and by concerns for the environment [72]. In Italy, the fruit entered the Istat basket in 2018, and, increasingly, large-scale retail consumers are looking for mangoes and other local tropical fruits on the shelves.

3.3. *Quality, Food Safety and Pre- and Post-Harvest Problems*

Mango is widely cultivated in tropical and subtropical regions. It is an economically very notable agricultural product for the production countries; therefore, an accurate

evaluation of the ripening phase is fundamental for the harvest and, above all, for the post-harvest management of mango.

Among the most important aspects that aid the acceptance of high-quality fresh mango by consumers are organoleptic aspects and chemical components, which mainly depend on the level of ripeness. These aspects are particularly important throughout the supply chain, particularly for export markets [73].

The quality of fruits can be evaluated thanks to a large range of indicators, such as physical aspects (e.g., size, shape, color) and chemical aspects (e.g., sugars, acids, polyphenols). The gustatory quality of a fresh fruit is heavily linked to the sweetness of the fruit, which reflects the recognized sweet taste of the sugars contained in the fruit. However, the recognized sweetness does not depend only on the total sugar content but, above all, on the internal balance of the various soluble sugars [74,75]. Another factor involved in the quality of fruit flavor is the acidity of the fruit [76,77]. Fruit acidity can be evaluated via different approaches and indicators, from simple pH measurements to measurements of individual acidity levels. Titratable total acidity (TTA) is a typically used indicator of fruit acidity that provides wider information than pH without requiring the measurement of all acids [78]. The balance between acidity and soluble sugars is surely one of the most important aspects of fruit flavor quality.

Many authors report that, in most of the main production areas of the world, mango fruits are susceptible to various defects and physiological problems (spongy tissue, tip pulp, jelly seeds, soft nose, seed rot, fruit diose, tapered tip) [79,80].

Kiran et al. [81] detect pre-harvest and post-harvest losses in India, mainly caused by environmental variables including climate change, global warming and numerous diseases and pests (spongy tissue and fruit fly). Furthermore, mechanical damage, storage conditions and the transportation and handling of mango have a major impact on post-harvest losses.

During the transportation and marketing period, mango fruit may suffer from severe losses caused by Mango anthracnose disease (MAD). MAD is the most common disease in post-harvest mango and the most serious damage factor for mango cultivation worldwide [82,83]. Recent taxonomic revisions have led to the identification of several *Colletotrichum* species involved in the disease, initially referred to as the *C. gloeosporioides* and *C. acutatum* species complex, including *C. aeshynomenes*, *C. alienum*, *C. asianum*, *C. dianesei*, *C. fruticola*, *C. musae*, *C. nupharicola*, *C. siamense*, *C. tropicale* and *C. karstii* [84]. In Italy, associated to MAD, were recovered *C. gloeosporioides*, *C. kahawae* subsp. *ciggaro* and *C. karstii* [85].

Infections can affect many plant organs, but major losses occur on fruits, where infections remain dormant until the fruits begin to ripen, causing brown or black sunken necrotic lesions on the peel, enlarging during postharvest and reaching the pulp [31]. On the other hand, fruit and vegetables are highly perishable, and, principally due to fungal pathogens, high losses of harvested production can be found in both industrialized and developing countries. Fungicides are used to control these microorganisms in pre- and post-harvest application. To reduce and eradicate its use, several post-harvest methods that are not harmful to the consumer have been applied to the mango fruits, including cold storage, hydrothermal treatment, UV, edible coatings and 1-MCP. Improved efficacy in post-harvest control can be achieved with the synergistic application of these different methods [86]. However, to pursue the best fungal disease control on fruits, an integrated approach among chemical, physical and biological methods is often necessary both pre- and post-harvest, starting from the planting of resistant, or less susceptible, cultivars to anthracnose. This approach reduces the need for fungicide application in the field, making it more cost-effective and sustainable.

Many scholars report new alternative and sustainable methods to replace synthetic fungicides, and non-synthetic materials using essential oils extracted from natural sources are increasingly being used to control anthracnose [83,87,88]. For this purpose, waste and processing residues of other agricultural products are used, turning them from waste into

resources. These new trends bring together environmental perspectives and food safety. On the other hand, consumers are increasingly aware of the importance of a lifestyle rich in fruit and vegetables, and the demand for high-quality, safe products free from pesticide residues, toxins and harmful microorganisms is increasing.

In Italy, despite their great economic impact on the European market, very few studies on mangoes have been conducted so far. Investigations conducted since 2014 by Leonardi et al. [89] have led to the detection of serious symptoms of woody canker, downy mildew and decay on mango plants in the major cultivation area of north-eastern Sicily. In this species, the onset of fungal and bacterial infections before and after harvesting can compromise plant growth and fruit quality. Luckily, to date only a few diseases affecting mangoes have been reported in Italy. Some pathogens (wood cankers and rots, necrosis, etc.) can limit mango production and lead to substantial crop losses, changes in quality, decrease in market value and, sometimes, post-harvest losses, in particular during maturation and storage. For this reason, with the aim of developing effective management strategies in mango orchards, it is needful to investigate the diseases that affect these crops in the cultivation areas of southern Italy because they could represent a limiting factor for production.

In the European market, the demand for tree-ripened fruit has recently grown. However, the qualitative response and marketability aspects of mango fruits ripened in trees grown in the Mediterranean area are still little evaluated, as for example in the case of nectarines and consumer preferences indicated by Christofides et al., 2022 [90].

Furthermore, the possibility of the sustainable use of mango waste, which falls within the scope of the circular economy, is underlined, such as the use of textile fibers derived from fruit with the aim of reducing the impact on the consumption of natural resources and on pollution. In the constant effort to reduce the environmental impact of the fashion industry, an innovative vegetable fabric similar to leather made from mango waste is produced in the Netherlands. This initiative not only reduces food waste but also offers a promising sustainable option in the world of fashion.

Finally, it is necessary to underline the aspects connected to the problems regarding the environmental sustainability of air and maritime transport. If, from a productive and economic point of view, the increase in global demand for mango makes the product extremely interesting, from an environmental point of view, the production from tropical countries arriving in Europe after long journeys by ship or plane causes a significant carbon footprint [91]. In the air transport and maritime transport sectors, we recall the proposal for a European regulation on guaranteeing equal conditions for sustainable air transport and Regulation (EU) 2023/1805 [92] on the use of renewable and low carbon emission fuels in maritime transport, which aim to promote the production and diffusion of sustainable alternative fuels in transport aviation and maritime as the entry into the market of low-emission and zero-emission powertrain solutions is indicatively expected by 2030 or even later.

4. Materials and Methods

Workplan and Data Collection

The paper examines the consumption of fresh mango and mango products in the city of Bahia in Brazil and in Italy, in the following cities: Milan and Turin (Northern Italy); Rome and Pesaro (Central Italy), Reggio Calabria and Catania (Southern Italy). The objective is to consider how well this fruit and its processed products are known, consumed and appreciated. We also look at consumption habits and the factors that determine preferences and propensity to purchase.

The collection of data useful for the investigation was achieved thanks to the use of specific questionnaire forms administered online in the respective languages from 17 July 2021 to 3 September 2021 in a post-covid period. The current trend seems to confirm the attitudes, habits and preferences of mango and mango food consumers. The questionnaire was shared via email, WhatsApp, Instagram and the Facebook portal. In the period indicated, 453 consumers responded to the questionnaire (163 Italians and 285 consumers

intercepted in Brazil). A questionnaire was used to collect information from the sample on the following: habits, frequency, prices, aroma, taste, seller trust and recommendation, attention to food safety, curiosity and aptitudes, opinion.

The questions collected predict binary, multiple-choice answers, while others use a five-point Likert scale.

The participants declared themselves available for the interview and were informed of the guarantee of anonymity and of the use of the data collected for research purposes only and in an aggregate manner. A snowball sampling method was used. The choice of this method of sampling is linked to motivations related to the duration and cost of the investigation. The questionnaire was pre-tested to ensure clarity and consistency in the wording of the questions [93,94].

The collected data were analyzed using multivariate analysis techniques. Databases were created thanks the use of the SPSS.26 and SmartPLS4 ver. 4.1.0.3 software [95]. For a first identification of latent factors that influence consumers in the process of choosing mango and mango-based products, an exploratory factor analysis (EFA) based on principal component analysis (PCA) was carried out. Reliability was evaluated with the use of the Kaiser–Meyer–Olkin (KMO) test and Bartlett’s spherical test [96,97]. Subsequently, the model PLS-SEM was used to test the research hypotheses and the relationship between the determining factors and consumer attitudes [22,98,99].

In this work, PLS-SEM was used as the data analysis method for the research model based on both the “measurement model” and the “structural model” of the research components [39,100,101]. “Model reliability”, “convergent validity” and “discriminant validity”, the bootstrap procedure, have been considered.

Finally, multi-group analysis (PLS-MGA) was applied, in order to better interpret the motivations that influence the behavioral intentions regarding purchasing mango and mango-based products of consumers in the two segments “Italian consumers” and “Brazilian consumers”. The analyses were applied to identify and analyze the specific path coefficients for each segment. The multi-group analysis allows us to verify whether the differences between the specific path coefficients of the groups are statistically significant. For this purpose, the parametric approach most frequently used by researchers, based on “t” tests, was applied. It allows us to highlight the paths, research hypotheses and distinctive factors that most influence the decision-making processes of consumers for the purchase of mango and mango-based foods.

5. Results

5.1. Sample Characteristics

Table 2 gives the socio-demographic characteristics of the sample. Those interviewed were aged between 18 and 75, with an average age of 37.7 years. Males represent 41.1% of respondents, and females 58.9%. Furthermore, 34.7% of interviewees belong to generation Y, called Millennials (between 29 and 43 years old), followed by generation Z (18–28 years old); the majority of those interviewed have a high school diploma (45.7%) or a degree (26.9%), are employed (37.1%) and have a medium-high annual income (58.5%).

As visible from Table 3 below, Italians have a greater preference for sweets/ice creams, habitually consuming mainly drinks, cocktails, ice creams, desserts and mango delicacies in approximately 39–45% of cases and consuming them often and very often in approximately 12% of cases. Mango juice is also highly appreciated by Italian consumers (34% of habitual consumption and in 20% of cases often or very often). As for Brazilians, they generally have higher consumption frequencies than Italians with respect to products whose habitual consumption frequency is 53–59% (jam, drink-cocktails and mango delicatessen), while, in the majority of cases, sweets (63.1%) and juice (59.6%) are consumed often and very often, respectively having a habitual consumption by 31.9% and 36.8%.

Table 2. Socio-demographic characteristics of the sample.

Indication		% Total	% Italy	% Brasil
Gender	Male	41.1	42.3	40.4
	Female	58.9	57.7	59.6
Age generation (years)	Gen Z 18–28	31.8	35.7	29.5
	Gen Y 29–43	34.7	25.6	40.0
	Gen X 44–59	24.3	26.8	22.8
	Baby boomer	9.3	11.9	7.7
	Not answer	0.0	0.0	0.0
	Low	2.4	0.4	2.0
Annual income	Medium-low	19.2	19.3	19.3
	Medium-high	58.5	65.5	54.4
	High	19.9	14.3	23.2
Food purchasing responsible	Interviewed	92.9	81.0	88.1
	Other	7.1	19.0	11.9
Components of the family	1–2 components	19.4	24.4	16.5
	3–4 components	62.9	63.1	62.8
	>4 components	17.7	12.5	20.7
Educational level	Middle school	17.4	3.6	25.6
	High school	45.7	40.5	48.8
	Degree	26.9	47.0	15.1
	Post-degree	9.9	8.9	10.5
Occupation	Employed	37.1	41.1	34.7
	Self-employed	22.1	16.7	25.3
	Retired	3.3	3.0	3.5
	Students	22.7	26.8	20.4
	Other occupation	14.8	12.4	16.1

Source: the authors.

Table 3. Frequency of consumption of fresh mango and mango foods in Italy and Brazil.

	Italy %							Brazil %						
	Fresh	Dried	Juice	Jam	Sweets and Ice Cream	Drink	Gastronomy	Fresh	Dried	Juice	Jam	Sweets and Ice Cream	Drink	Gastronomy
Never	22.6	58.3	25.6	63.1	24.4	25.0	41.0	0.4	7.7	0.7	6.7	0.7	3.2	2.0
1–2 times/year	15.5	26.2	16.7	14.3	15.5	17.0	12.5	2.1	13.0	2.8	9.5	1.4	6.7	2.8
1–2 times/month	33.9	11.3	33.9	17.3	44.6	45.3	39.3	24.0	46.0	36.8	54.0	31.9	53.0	59.0
1–2 times/week	13.7	1.8	16.7	2.4	8.9	8.3	4.2	26.0	13.0	33.3	14.7	36.6	19.6	19.6
More than 2 times a week	14.3	2.4	2.9	3.0	2.4	3.6	3.0	47.4	20.0	26.3	15.1	26.5	17.5	16.1

5.2. PLS-SEM Model

In detail, factor analysis was applied to 18 variables. The KMO (Kaiser–Meyer–Olkin) test value is 0.937. This index can take values between 0 and 1, and the closer the value is to 1, the more the adequacy of the sample improves.

Bartlett’s test of sphericity is a test that provides the p -value must be less than 0.05 to consider the model valid. In the study, the p value was found to be 0.000. Four components were extracted which identify four groups of latent factors, explaining 71.891% of the total variance. Thanks to this, it was possible to associate the main drivers of the choice of preferences with each component. Moving on to the application of the PLS-SEM model, “the internal consistency” and “convergent validity” have been evaluated. To verify the reliability and validity of the construct, the following criteria are examined: the factor loadings are all greater than 0.7, the composite reliability (CR), the average variance extracted (AVE) and Cronbach’s Alpha are valid, and the values are found based on the literature following the indices of model adaptations as indicated by many authors [39,44].

The PLS-SEM model results in Figure 2 and Table 4 show that the standardized loadings of all measurement items are above the acceptable cut-off level.

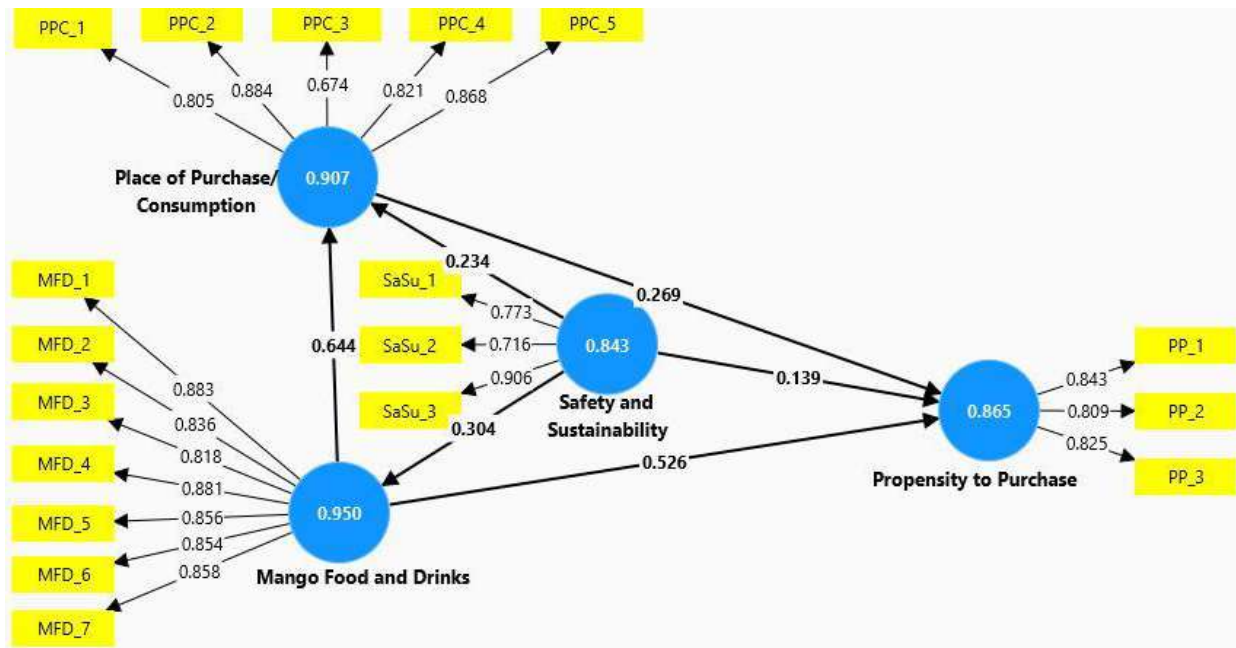


Figure 2. PLS-SEM model results. Source: Authors’ elaboration from data analysis in Smart-PLS4.

Table 4. Standardized factor loading.

	External Saturations	Cronbach’s Alpha	Composite Reliability (CR)	Average Variance Extracted (AVE)
Propensity to Purchase		0.768	0.865	0.682
PP_1 when I buy mango and mango food, taste and organoleptic qualities are important	0.843			
PP_2 when I buy mangoes and mango food I use the information acquired through social media	0.809			
PP_3 when I buy mango and mango food, curiosity about new foods and gastronomic multiculturalism count	0.825			
Mango Food and Drinks		0.939	0.950	0.732
MFD_1 consumption of ice cream and sweets at home and/or away from home	0.883			
MFD_2 consumption at home and/or away from home fresh natural mango	0.836			
MFD_3 consumption of mango juice at home and/or away from home	0.818			
MFD_4 consumption of mango jam at home and/or away from home	0.881			
MFD_5 consumption at home and/or away from home dried mango	0.856			
MFD_6 consumption at home and/or away from home mango drink-aperitifs	0.854			
MFD_7 consumption at home and/or away from home mango gastronomy	0.858			
Place of Purchase/Consumption		0.870	0.907	0.662
PPC_1 city markets	0.805			
PPC_2 Away From Home	0.884			
PPC_3 organic market	0.674			
PPC_4 online	0.821			
PPC_5 retail stores (GDO, retail, etc.)	0.868			

Table 4. Cont.

	External Saturations	Cronbach's Alpha	Composite Reliability (CR)	Average Variance Extracted (AVE)
Safety and Sustainability		0.736	0.843	0.644
SaSu_1 importance of place of origin	0.773			
SaSu_2 importance of nutritional values	0.716			
SaSu_3 importance of environmental and social sustainability	0.906			

Note: GFI fit statistics = 0.947; AGFI = 0.388; SRMR = 0.074. Source: the authors.

Reliability was assessed by exploring the “standardized loadings of the items” that make up the measurement model. As recommended by Chin [102], the model is valid when the standardized charges of the elements that compose it all have a value greater than 0.6. In our case study they are between 0.674 (consumption of mango juice) and 0.906 (health-conscious and sustainable consumer). In particular, items with a loading value equal to or greater than 0.7 were found to be valid.

Moreover, according to the indications of Dash and Paul [45], the items should be kept in the measurement model only if their standardized loadings are equal to or greater than 0.6. Since in the model the loadings of the variables are all higher than 0.7, except one which is in any case higher than 0.6 (PPC3), the values fall within the acceptable range.

As for composite reliability (CR) values, all factors exceeded the recommended value of 0.7 [100,103,104]. This also applies to the AVE value, which is considered acceptable when it is equal to or greater than 0.50. As you can see, the variance shared between a construct and its items exceeds the variance of measurement error [39].

Among the goodness-of-fit indices, the Goodness-of-fit statistic (GFI) was evaluated, which estimates the proportion of variance provided by the expected covariance of the population. This index ranges from 0 to 1, and, usually, the widely recommended threshold is 0.90. However, for small samples and lower factor loadings, it should be higher than 0.95 [105]. In our example, GFI = 0.947 is within the valid value. Furthermore, regarding the “Adjusted goodness-of-fit statistic” index (AGFI), the value is well within the valid range (AGFI = 0.388). PLS-SEM is a random predictive method; Schuberth et al. (2023) [106] argued that among the goodness-of-fit indices, the standardized root mean square residual (SRMR) should also be included to examine the method. SRMR values should not be higher than 0.08 [45] In our processing, the SRMR index (equal to 0.074) was also valid [106]. AVE values have a score greater than 0.6, which confirms the validity of the applied model, as well as Cronbach’s Alpha.

The discriminant validity of the model is examined with the Fornell–Larcker criterion and the Heterotrait–Monotrait (HTMT) correlation ratio.

The results illustrated in Table 5 show that each construct shares more variance with the items assigned to it (bold values on the diagonal of the table) than with the remaining constructs in the model, thus confirming the requirements of the Fornell–Larcker criterion who are satisfied [98].

Table 5. Discriminant validity: Fornell–Larcker criterion results.

Fornell–Larcker	Mango Foods and Drinks	Propensity to Purchase	Point of Sale	Safety and Sustainability
Mango foods and drinks	0.855			
Propensity to purchase	0.761	0.826		
Point of sale	0.715	0.705	0.814	
Safety and sustainability	0.304	0.414	0.429	0.803

Source: the authors.

Many authors suggest using the HTMT correlation ratio because it has higher performance than the Fornell–Larcker criterion. The Heterotrait–Monotrait Matrix (HTMT) is useful for assessing discriminant validity in PLS-SEM. It should be less than 0.85 or equal to 0.90, according to a more lenient threshold, or significantly less than 1 [107,108]. As shown in Table 6, all HTMT values are less than 0.85/0.90, thus indicating good discriminant validity.

Table 6. Discriminant validity: Results of Heterotrait–Monotrait matrix (HTMT).

Heterotrait-Monotrait Matrix (HTMT)	Mango Foods and Drinks	Propensity to Purchase	Point of Sale	Safety and Sustainability
Mango foods and drinks				
Propensity to purchase	0.884			
Point of sale	0.784	0.844		
Safety and sustainability	0.324	0.506	0.513	

Source: the authors.

Table 7 highlights the results of the PLSpredict CVPAT procedure. As indicated by benchmarks [100,107], Q2 predict values are valid when they are greater than zero (0.000). Also valid are the evaluation metrics related to the “coefficient of determination R²”, which indicates the percentage of variance of the dependent variable explained by the independent variables of the model, Hair et al. (2017) [105] recommend R² values equal to 0.75, 0.50, 0.25 (substantial, moderate and weak).

Table 7. R² e Q² predict.

	R ²	R ² Correct	Q ² Predict
Mango foods and drinks	0.092	0.090	0.085
Propensity to purchase	0.648	0.645	0.162
Point of sale	0.560	0.558	0.177

Source: the authors.

Table 8 highlights the results of the bootstrap procedure. To examine the formative measurement model, the indicators to be validated are also in this case the convergent validity (construct reliability and validity) and the statistics relating to collinearity (VIF indicators). Hair et al. (2017) [105] consider multicollinearity valid when the value is below the threshold value five and the minimum tolerance level of 0.20. Additionally, in this case, the statistics found with reference to collinearity are valid (Table 8).

Table 8. Results of the PLS-SEM process.

Hypothesis	Paths	Path Coefficients	Confidence Intervals		t-Value	p-Value	VIF	F ²
			2.5%	97.5%				
H3	Mango foods and drinks → Propensity to purchase	0.526	0.437	0.614	11.799	0.000	2.043	0.385
H6	Mango food and drinks → Point of sale	0.644	0.581	0.701	20.931	0.000	1.102	0.854
H1	Point of sale → Propensity to purchase	0.269	0.176	0.356	5.943	0.000	2.274	0.091
H4	Safety and sustainability → Mango foods and drinks	0.304	0.206	0.404	5.985	0.000	1.000	0.102
H2	Safety and sustainability → Propensity to purchase	0.139	0.062	0.222	3.354	0.001	1.226	0.045
H5	Safety and sustainability → Point of sale	0.234	0.160	0.306	6.297	0.000	1.102	0.113

Source: the authors.

According to Cohen (1998) [109], to evaluate F² specifies the following values apply: 0.02 is a small effect, 0.15 is a medium effect, and 0.35 is a large effect.

As can always be seen from Table 8, all the hypothesized paths are valid. In particular, paths H6 and H3 are those with a greater effect and greater t-value, followed by H5 and the others. They are the PLS-SEM paths with the t-values and p-values of the different hypothesized paths.

In detail, “Mango drinks → Point of sale” (respectively t-value = 20.931 and p-value = 0.000), followed by H3 “Mango foods and drinks → Propensity to purchase” (11.799 and 0.000), and by H5 “Safety and sustainability → Point of sale” (6.297 and 0.000).

Also valid are paths H4 “Safety and sustainability → Mango foods and drinks” (t-value 5.985 and 0.000 significance), H1 “Point of sale → Propensity to purchase” (t-value 5.943 and 0.000) and finally H2 “Safety and sustainability → Propensity to purchase”, with the lowest value of t-value 3.354 and a p-value equal to 0.001.

5.3. Multi-Group Analysis (MGA)

Multi-group partial least squares analysis (PLS-MGA) was also applied in this work to help analyze the influences of differences in factors within groups

The recommended approach in the PLS-SEM multi-group analysis which considers two groups—in our case, Italy and Brazil—is non-parametric

Multigroup analysis (MGA) gives us the opportunity to test differences in group-specific parameters (external weights, external loads and path coefficients). The results are based on the bootstrap of each group: in detail, the two groups, from Italy and Brazil, were selected, and all the procedures were performed to evaluate any significant differences in the parameter estimates (external weights, loadings external and path coefficients). All data sets selected in the Italy Group were compared with all data sets and research hypotheses selected in the Brazil Group.

The data are verified with the FIMIX segmentation procedure, which is an approach based on latent classes that allows for the identification and treatment of heterogeneity not observed in PLS-SEM. The permutation procedure checks whether the predefined data groups have statistically significant differences in the estimates of the group-specific parameters and also supports the MICOM (Measurement Invariance Assessment) procedure.

The MGA was conducted with reference to the two countries under investigation, Italy and Brazil, to examine and compare the path coefficients, ensuring that all the constructs in the two groups are reliable and valid. The results of bootstrapping the models are shown in Table 9.

Table 9. Multi-group analysis: Bootstrap results—Path coefficients.

	Hypothesis	Path Coefficients		Average		DEVST		t-Value		p-Value	
		Brazil	Italy	Brazil	Italy	Brazil	Italy	Brazil	Italy	Brazil	Italy
Mango foods and drinks → Propensity to purchase	H3	0.361	0.544	0.361	0.544	0.055	0.059	6.591	9.262	0.000	0.000
Mango food and drinks → Point of sale	H6	0.493	0.479	0.493	0.482	0.057	0.058	8.643	8.279	0.000	0.000
Point of sale → Propensity to purchase	H1	0.274	0.310	0.273	0.310	0.058	0.071	4.744	4.380	0.000	0.000
Safety_and sustainability → Mango foods and drinks	H4	0.443	0.392	0.446	0.396	0.052	0.073	8.494	5.365	0.000	0.000
Safety_and sustainability → Propensity to purchase	H2	0.350	0.006	0.352	0.008	0.055	0.060	6.401	0.097	0.000	0.923
Safety_and sustainability → Point of sale	H5	0.339	0.281	0.340	0.284	0.060	0.065	5.683	4.338	0.000	0.000

Source: the authors.

As can be seen, all paths except one are valid and significant with reference to individual countries. The research hypothesis H2 “Safety and sustainability towards purchasing propensity” is not supported for Italian consumers (p-value = 0.923). A greater difficulty

therefore emerges for Italy when making purchase decisions. However, it does not manifest itself when choosing the product (H4) and/or the point of sale (H5) in detail due, most likely, to the trust placed in the seller and/or in the labeling to guarantee the origin and processing of the product. The difference between the two countries is also highlighted with reference to the t-value (Brazil = 6.401 and Italy = 0.097).

In Italy there is a greater propensity to purchase mango foods and drinks (H3), thanks to the wide range of products available on the market; in fact, in Italy a t-value = 9.262 was recorded compared to the Brazilian value equal to t-value = 6.591. On the contrary, in Brazil mango foods and drinks are local products and considered safer, healthier and more sustainable than in Italy (H4). The t-values in Brazil are a little higher than in Italy (8.494 and 5.365 respectively). In the other hypotheses the paths are very similar and differ slightly.

6. Discussion

In our study, we highlight how consumption preferences influence the acceptance and subsequent propensity to purchase fresh mango and mango-based products. In particular, hedonic variables and sensory feelings, such as organoleptic characteristics, are important predictors of consumption and purchase intentions regarding fresh mango and mango-based products; nevertheless, we highlight an increasing interest in sustainable nutrition and lifestyles oriented towards health and food safety [110].

These results are in line with the work of Kiloes et al. (2021) [73], which illustrates the importance of general consumer expectations for fresh and processed tropical fruit. The authors present a systematic review of the literature on consumers' perception of mango quality, summarize the intrinsic and extrinsic quality aspects (identified in the various scientific articles consulted) and report that taste and sensory experiences in particular play a predominant role in shaping consumer satisfaction and therefore in the acceptance of mango and tropical fruits in general.

Our study also highlights a preference for mango-flavored food and drinks purchased and consumed primarily because they are liked (in fact, taste and organoleptic qualities are considered important) and secondarily for the trust given to the place of purchase and sellers. The PLS-SEM analysis approach that we applied in the study shows, in fact, a particular attention to the choice of the point of sale (Hypothesis H6, "mango food and drinks → Point of sale") expressed by the consumers interviewed, which records a t-value equal to 20.931 and F^2 0.854; this preference is followed by the research hypothesis H3 on the propensity to purchase "Mango food and drinks → Propensity to purchase" (t-value = 11.799 and F^2 = 0.385).

As for the hypotheses H4 "Security and sustainability → Mango Food and Drinks" and H1 "Point of Sale → Propensity to Purchase", consumers manifest a very similar interest even if less strong (respectively, for the H4 T hypothesis-Value = 5.985 F^2 = 0.102, and H1 T-Value = 5.943 F^2 = 0.091). Finally, with reference to the H2 research hypothesis "Safety and sustainability → Propensity to Purchase" (T-Value = 3.354 and F^2 = 0.45), it is evident that the insecurities have also emerged from the PLS-MGA analysis manifested by especially Italian consumers. In less recent years, some authors also reported that consumers are not willing to compromise on taste for a promise of better nutritional and health value [111,112].

In this framework, the propensity to consume novel foods and the tendency towards gastronomic multiculturalism, together with the influence of nutritional information on mango, tropical fruits and their processed products, have been the object of further attention in this study as suggested by Sabbe et al. (2009) [111] "Other issues to be explored in future studies are the effect of other extrinsic characteristics, like origin (e.g., country and production system) and neophobia on the acceptance of novel fresh and processed tropical fruit products. Additionally, further investigation is recommended on nutrient composition and dietary contribution of tropical fruits to human nutrition to find more objective reasons to promote tropical fruit consumption".

Food safety and environmental and social sustainability influence the propensity to consume and purchase fresh mango and mango-based products both directly (H2) and indirectly, through the mediation connected to the point of sale (H5) and the mediation determined by the wide range of mango foods and the different varieties of mango products available on the market (H4), both in Italy and in Brazil. Among these, in the third position we find the hypothesis H5 relating to the path “safety and sustainability → Point of sale” (t-value = 6.297 and $F^2 = 0.113$) which confirms the importance for the consumer to purchase or consume fresh mango and mango-based products in the “right place” either for the type of product purchased (greengrocer, retail, large-scale distribution or consumed outside the home in bars, restaurants, etc.), or for the relationship of trust with the shop or the place of consumption. As for the hypothesis H2, the path “safety and sustainability → Propensity to purchase” highlights, both overall and in the comparison between the two countries, major discrepancies, confirming how in Italy there is a greater need for consumers on the importance of food safety and environmental and social sustainability.

In detail, the variables that characterize the latent factor relating to safety and sustainability are the importance for consumers of nutritional values, place of origin and environmental and social sustainability. Therefore, food and nutrition and ethical and social values are important predictors and guide the choice of products to purchase. They represent relevant aspects for an overall vision of market dynamics, further accentuated by the current surge in consumer demand for mango and fresh and processed tropical fruit.

In particular, the relationship between taste and nutritional aspects highlights how perceptions related to health and nutritional aspects can influence a person’s taste experience [113] and supports the findings of the literature according to which consumers are inclined to purchase mangoes for their peculiarities such as taste and nutritional content, usually associated with health and well-being and an awareness of the importance of a diet rich in fruit and vegetables.

As for sustainable content, it is met with consumer approval in both countries and is characterized by interest in quality and the origin of the products purchased/consumed and concern for the environmental impact of the production, transportation and processing of mangoes. The results that emerged highlight the importance of the origin of the product (by variety and place of cultivation), the preference in both Brazil and Italy for local production and the increasing demand for high-quality and environmentally friendly food products, safe and free of pesticide residues, toxins and harmful microorganisms. These are ethical values that encourage sustainable practices among contemporary consumers, preserve the environment and promote long-term common well-being. Responding to these needs is important to support the mango supply chain in formulating appropriate strategies to improve the quality, traceability and tracking of products, labeling, sustainable packaging and green certifications [111,114].

The work provides useful information in both the theoretical and marketing fields. From a theoretical perspective, the study enhances the growing body of empirical evidence in the field of consumer preferences, paving the way for an exploration of the impact of food values on the purchasing behavior of tropical fruits, especially mango. Furthermore, the findings have actionable implications for marketing strategies. For example, the study suggests that product knowledge can be improved through information campaigns that describe in detail the characteristics and provenance of mangoes. Furthermore, consumer interest in nutritional aspects and product origin should push for better and more effective product labeling to provide more information and stimulate mango consumption.

7. Limitations and Implications for Future Studies

This study presents some limitations, relating to the research method used and the nature of the data analyzed. A first limitation arises from the choice of the interviewees through online sampling. Due to this recruitment plan, the results cannot be generalized beyond the characteristics of the sample. Another limitation is that analyses and clusters were not applied for socio-demographic characteristics and their relationship with the

expectations and acceptability of tropical fruits and derived products. Consequently, important characteristics that determine consumers' expectations of fresh and processed tropical fruit products may have been overlooked in this work. Therefore, the results achieved from this study should be considered mainly exploratory and would therefore benefit from further testing based on the use of larger and more representative consumer samples.

In this work, a relationship between taste and health and nutritional benefits of tropical fruits was studied. Since some tropical fruits have nutritional and health values, more research needs to be conducted to gain a better understanding of taste, i.e., hedonic benefits, and other benefits such as health advantages. In this framework, the influence of nutritional information on the acceptance of tropical fruits and their products deserves further attention, for example, in relation to sports activities, well-being and healthy, safe and quality dietary patterns. Other issues to be addressed in future studies are the effect of other characteristics such as origin (country or place of provenance and production system) and neophobia on the acceptance of new fresh and processed tropical fruit products. Furthermore, further investigations are recommended on the nutrient composition and dietary contribution of tropical fruits to human nutrition to find more objective motivations to promote tropical fruit consumption [22,56,111,113].

8. Concluding Remarks

The PLS-SEM methodology applied in the study examines the variables that influence the propensity to purchase of Italian and Brazilian consumers and provides food for thought for companies that want to approach the production of mango and mango-based products, indicating which levers to act on. In fact, consumers say they like the taste, the aroma and all the organoleptic characteristics of mango, both fresh and processed, and that they orient themselves towards the point of sale based on the type of product they intend to purchase. The aspect relating to safety and sustainability is also confirmed as consumers say they can consider local productions as green products both in Brazil and, subject to availability, in Italy. These results are in line with the studies by Parashar et al. (2023) [56], who highlighted how much interest in sustainable foods and healthy lifestyles has increased. Furthermore, aspects related to multiculturalism, openness and curiosity towards new and exotic products and foods are also appreciated factors in both countries, as well as the recent trend of relying on social media for knowledge and purchases. The consumption of fresh fruit is subject to transformations; in particular, young people are attracted by new products. Mango, like other fruits, is often consumed ready to use and/or accompanied by salads and first courses, both in Italy and in Brazil.

For some years in southern Italy, tropical fruits have contributed to enriching the local cultural heritage thanks to its favorable geographical position, mild climate and suitable growing conditions. Tropical fruits grown in Southern Italy can be harvested at the right time of ripeness, ensuring maximum freshness and maintaining their nutritional and organoleptic characteristics unaltered. The consumption of tropical fruit and in particular mango has also had an interesting expansion in Italy and a strong boost that has contributed to broadening and enriching the Italian gastronomic panorama.

From these considerations it emerges that the issues that revolve around early harvesting, especially for export markets, have become very important in assessing the quality of fruit along the entire supply chain up to the consumer [79]. Accurately detecting the correct maturity of the mango crop is essential to ensure a product with optimal qualities since the quality of the crop is very often linked to its level of maturity; in fact, the ability to accurately determine the optimal time for harvest is essential to maintain fruit quality, ensure high market value and minimize post-harvest losses that may arise during the transportation and marketing period. In post-harvest handling, mango fruits can be affected by pathogens; the presence of these pathogens can generate post-harvest losses of between 5 and 30% of mango production.

These aspects, while confirming the high potential of southern Italy for mango production [115], are very important in developing countries producing tropical fruits, which

represent not only a fount of nutrition but also a source of income generation for farmers who produce them for export. However, if Western consumers appreciate the fruit in its varied and composite declinations, from guacamole to poké up to oil for cosmetic and food uses, this development would not occur without consequences in the places of production, and it is necessary to distinguish an ethical and sustainable diet from a trendy diet. Furthermore, climate change and irregular weather events increasingly represent a particularly serious challenge for the cultivation of tropical fruit because the vast majority of production is obtained in small farms of less than 5 hectares where cultivation depends heavily on rainfall.

On the other hand, tropical fruits are a relatively new group in global commodity trade and have only emerged as important in the international market since 1970. Export volumes of fresh tropical fruits from emerging or developing countries show the fastest average annual growth rates among internationally traded food commodities. These countries have become global agricultural suppliers. In this regard, the international community must manage and combine environmental protection and the growth of an export-based economy, so that cultivation does not expand at the expense of forests and human rights, aiming for more sustainable alternatives in terms of CO₂ emissions, the preservation of ecosystems and safeguarding the dignity of the most disadvantaged populations [116]. Value chains are vulnerable to risks and shocks that are beyond the control of any single actor. Therefore, concerted actions can benefit all stakeholders in the sector. FAO is leading the project “Building responsible global value chains for sustainable tropical fruit production and trade”, also known as the “Responsible Fruits Project”. The aim is to connect production systems with consumers and ensure their continuity of operation is essential for local and global food security, in the awareness that agricultural markets, supply chains and sustainable development are at the heart of the development process.

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