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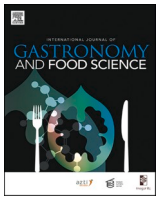

Changing crops, changing diets: Consumers' purchase intention of Sicilian tropical fruits

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ABSTRACT

The rising global consumption patterns and the impact of climate change have contributed to the growing production and consumption of tropical fruits. In response, agricultural practices in Mediterranean regions have adapted to cultivate tropical fruits locally, leading to a burgeoning culinary and gastronomic interest in these fruits. Based on a study of Sicilian consumers (N = 511), this paper aims to analyze the purchase intention and consumption frequencies and usage patterns of Sicilian tropical fruits in order to meet new consumers' needs in post-modern societies. This work contributes to the understanding of consumer demand as it is so important for local producers to develop more accurate strategies to support possible expansion of tropical fruits both in Sicilian gastronomy and for cultivation where agronomic conditions are favorable. Results reveal that consumers are willing to pay more for products which have a quality certification and a local origin. While tropical fruits production and consumption is increasing in Mediterranean regions, they also contribute to the identification of the territory.

1. Introduction

In recent decades, consumers in Europe have shown considerable interest in tropical fruits due to expanding globalization, and better information about them (Sabbe et al., 2009). In this sense, multiple factors, such as income growth, changing consumer preferences in both emerging and high-income markets, and improvements in transportation and supply chain management, have encouraged rapid growth in international trade in these products. Thanks to large retailers, there has been the increasing distribution and consumption of products guaranteed by Protected Designations of Origin (PDO) and Protected Geographical Indications (GPI) certifications that reassure consumers of the safety, quality and good ethics of production processes. For these reasons, for example, fruit consumption in Italy has increased from 96 kg per capita in 1961 to 123 kg in 2019 (University of Oxford, 2022a).

In post-modern societies, the consumer is seen as an evolving individual increasingly seeking rewarding experiences that privilege emotions and feelings (Fabris, 2003). The post-modern person is described by scholars as an individualistic and conscious consumer who aspires to occupy the central position in the market and to condition supply by reversing the distribution of traditional bargaining power between business and consumer (Brown, 1995) in a context where the experience economy plays a central role in the relationships between production and consumption (Pine and Gilmore, 1998).

In addition, changes in consumers' purchase intentions which look more and more towards tropical fruits are also a consequence of the climate change which has resulted in "shifting the seasons and the crops that farmers can grow" (Terazono, 2021). This is specially manifested in Italy, where avocado and mango crops along with many other exotic foods such as bananas are present in agricultural production since the last years (Coldiretti, 2018). Previous studies have analyzed the responses of fruit trees to climate change (Ramirez and Kallarackal, 2015) and showed that agriculture is facing adaptation challenges, specifically in the Mediterranean regions (Iglesias et al., 2011). This also results in a larger availability of the products and in consumers increasing awareness and preferences towards them (Cornara et al., 2020). Within this context, the objective of the present work is to analyze the degree of penetration of tropical fruits within the Sicilian consumer market with particular attention to the willingness to pay for quality products.

Harris (1993) recognises the relevance of tropical fruits in the history

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of cuisine, and also in relation to the development of modern gastronomy (see also Blancke, 2016). Previous research has acknowledged the nutritional values of tropical fruits (see, for example, Dos Santos et al., 2021), and also its use in the elaboration of jellies and marmalades (see also Ginés-Ariza et al., 2022). The use of tropical fruits is also wide in cocktails (Akonor, 2020). In this sense, while "fruit juices may be produced from a single fruit or a combination of two or more fruits (cocktail). A major advantage of fruit cocktails is the fact that it provides a wide range of pleasant aromas and flavors and a sum of nutritionally different components" (Akonor, 2020, p.2). According to the same author, "commonly available fruit juice cocktails are made from tropical fruits such as pineapple, orange and mango. These fruits are generally sweet and colorful with an intense pleasant flavor and are notably rich in vitamins. However, other unpopular fruits including soursop (Annona muricata), which is less acidic and has a pleasant aroma and juicy flesh may be used in mixed fruit juices" (*ibid*). The use of tropical fruits in the culinary narratives (Fusté-Forné, 2017) is an opportunity for agricultural production (see Gnoumou et al., 2022) and the regional development of territories.

In Sicilian gastronomy, the introduction of tropical fruits can offer a wide range of benefits, such as combining flavors, as they are known for their unique and intense taste; also, they are often colorful and eye-catching. Tropical friuts can be used to decorate and embellish dishes, cocktails, or desserts. They lend themselves well to mixing different cuisines. Experimenting with incorporating tropical ingredients into traditional dishes from other cultures can create unique combinations. The creative aspect of the work is to analyze the consumption of tropical fruits in such a way as to analyze the impact of the two major market forces; on the demand side there is a change in consumer preferences that pushes the production side to reshape the supply by offering tropical fruits which are also later used in gastronomy.

1.1. *The spread of tropical fruit production in Sicily*

In relation to the Italian market, bananas and some major tropical fresh fruits such as mango, avocado, papaya, cherimoya and lychee are among the food preferences of Italians both for their taste and, more importantly, for the extraordinary nutritional properties and benefits they possess. Banana (Musa spp.) is the most significant of all tropical fruits. All known banana cultivars are a rich and diverse source of many of the key health-promoting dietary phytochemicals such as carbohydrates, potassium, vitamin C, fiber, and provitamin A carotenoids (Elayabalan et al., 2017). Today it is cultivated in most tropical and subtropical areas of the planet. Major producers include China and India with 11.51 million and 31.5 tons produced, respectively (University of Oxford, 2022b).

Mango (Mangifera indica L.) is native to areas between India and Burma and probably from areas near Nepal and Bhutan, in the foothills of the Himalayas (Kostermans and Bompard, 1993). In the West, however, the most widespread cultivars exhibit red coloration, due to a greater attraction to European consumers (Zuazo et al., 2006). The fruit is considered a good source of dietary antioxidants, such as ascorbic acid, phenolic compounds and carotenoids (Schieber et al., 2000; González Aguilar et al., 2008), of which β-carotene is the most abundant (Kabir et al., 2017). The fruit itself is recognized as a source of vitamin E, calcium, phosphorus, magnesium and fiber; it has strong antioxidant activity and greatly boosts immune defenses, also possessing antibiotic, diuretic and laxative properties (Kim et al., 2007).

In Sicily, given the proximity to European markets, the fruits can be harvested at a more advanced stage of ripening, thus maintaining better quality and organoleptic characteristics, depending on the greater persistence in the plant (Farina et al., 2017a) going to have a better market placement. For the past few decades, a growing interest in mango cultivation has also developed in Sicily, ending up with excellent results, leading to the production of a fruit of excellent quality, in terms of flavor and organoleptic properties. Relatively high market prices are recorded, denoting a certain interest also from the commercial aspect. Today, on the other hand, there are fruit plantings which are widespread in some sublittoral tracts, where they denote a certain potential for expansion; in fact, there have been several plots under cultivation for some time now, although distributed in a fragmentary manner, affecting a large stretch of the coastal strips, both Tyrrhenian and Ionian (De Michele et al., 2005).

Avocado (Percea americana) belongs to the Lauraceae family of tropical and Mediterranean trees and shrubs. It is native to Mexico and Central and South America. It is a source of carbohydrates, protein, fiber, essential micronutrients for human consumption such as, polyphenols, fats, oils, vitamins (vit. C, E, K, B1, B2, B6, B9) and minerals (P, Na, Mg, K, Fe and Zn). (Orhevba et Jinadu, 2011). Several studies show that Sicily has a vocation for avocado production, together with good market trends, avocado cultivation could develop on a large scale, as is already the case in other Mediterranean countries such as Spain (Voth, 1999). In Sicily there are farms of very different sizes. Many farms have a few hectares, and their production is for the local market.

Papaya (Carica papaya L.) is a fruit tree belonging to the Caricaceae family, native to tropical America, particularly the area stretching from Mexico to Panama. In the last decade its cultivation has also spread in the Mediterranean basin and also in Sicily where it is grown mainly in coastal areas and could represent a possible alternative to some traditional crops such as many vegetables, now in crisis due to their low economic value. In Sicily, the target market for the product is only the local one, although it would seem that there are good investment prospects for the regional, national and European markets. Distribution takes place mainly at local district markets and at fruit and vegetable stores that sell tropical fruit, and often, these markets, in order to adapt the product to the needs of consumers, carry out first processing operations on the fruit. Papaya fruit has important nutritional values as it is low in calories and rich in vitamins and minerals. It ranks among the top fruits in terms of content of vitamins (mainly Vit. A, Vit. C and Vit. E), riboflavin (Vit. B2), thiamine (Vit. B1), fibre and mineral elements such as calcium, potassium and iron (Krishna et al., 2008).

The Annona is a plant belonging to the Annonaceae family native to the Andean highlands of Peru, Ecuador, Colombia and Bolivia, now also widespread in Chile, California, Florida, southern Africa and several Mediterranean countries. In Italy the availability of this fruit is scarce and there is marginal production mostly limited to large cities, with the exception of the few coastal areas in which the fruit can be grown.

Lychee or China cherry (Litchi chinensis Sonn.) is a plant in the family Sapindaceae, the only species in the genus Litchi is a tropical and subtropical plant native to southern China and Southeast Asia, now cultivated in many parts of the world. Interest in this crop is related to the goodness of its fruit and high nutritional value. Previous studies have shown a long list of beneficial health compounds including antioxidant, cancer-preventive, antimicrobial, anti-inflammatory activities and so on, so much so that in 2012 Litchi chinensis was included in the list of functional foods (Emanuele et al., 2017). In tropical countries the fruit reaches maturity in late autumn, while in Sicily it ripens in August. The lychee fruit is rich in carbohydrates and fiber while lipids and protein are scarce. It is also valued for its nutritional properties. In this sense, the fruit is very rich in nutraceuticals, key compounds with extra health benefits beyond the basic nutritional value found in food (Septembre-Malaterre et al., 2016). Beyond the differences between cultivars of various origins, the beneficial effects of the fruits have been related in part to their high content of micronutrients including vitamins (B1, B2, B3, B6, C, E, K), carotenoids, minerals (potassium, copper, iron, magnesium, phosphorus, calcium, sodium, zinc, manganese, and selenium), and polyphenols, which are highly represented compared to other tropical fruits (Arts and Hollman, 2005).

2. Materials and methods

To achieve the research objectives, a survey was conducted by

administering a questionnaire using the web interview technique. The questionnaire was disseminated through social networks and mailing lists. The use of social networks and mailing lists provided the opportunity to determine online sampling as a sampling strategy, as it exploits online resources and platforms to select participants to be involved in the research. Social network and mailing list sampling is a methodology used to collect data from a specific population through the use of social media platforms and email address records. This approach exploits the presence of users who are regularly registered on social platforms or subscribed to targeted mailing lists, thus facilitating access to a wide range of potential participants. The participants can be selected based on specific criteria encompassing demographics, geographic location, or particular areas of interest. Furthermore, directed advertising campaigns can be harnessed to effectively reach distinct user cohorts within the platform's domain. Concerning mailing lists, the approach entails the dissemination of surveys to a randomized or selectively chosen subset of individuals present within the aforementioned list. However, it is imperative to duly consider certain limitations associated with this sampling methodology. For instance, participants may not faithfully represent the entire target population, given that access to social networks and membership in mailing lists are frequently influenced by variables such as age, educational attainment, or specific spheres of interest. Additionally, not all members of social networks or mailing lists may actively respond to or participate in the given initiatives.

The survey was conducted from December 1, 2021 to January 1, 2022, by using Google Forms, an online questionnaire creation platform, employed to administer the survey to participants during the study. The user-friendly nature and efficient data collection capabilities of Google Forms led to its selection as the preferred tool. Utilizing the features of Google Forms allowed for customizable questions, organized response management, and real-time data collection, proving to be effective in gathering data from the participant sample accessible. This method of administration provides a greater quantity on the population data and it is effective in achieving the research objectives because it facilitates the dissemination of the questionnaire. The sample size was defined in relation to the research objectives, the time available and the availability of resources (Vianelli and Ingrassia, 2011). After careful analysis of the responses received by the researchers, the survey participants were 511 consumers who completed the questionnaire. The questionnaire was divided into two sections: the first dealing with socio-demographic aspects (gender, age, number of household members, educational qualification, city of residence and annual income) while the second focused on some qualitative variables such as knowledge of tropical fruits and quality certifications, consumption habits, willingness to pay, and purchase channel. The second section of the questionnaire focuses on the consumption of tropical fruits with specific questions such as: (1) Where do you purchase tropical fruits? (2) Do you consume tropical fruits? (3) Which do you know? (4) Do you know Quality Certification (PDO, PGI)? (5) Are you willing to pay a higher price for a certified product than for a non-certified one? (6) How much higher is the WTP for certified tropical fruit? (7) Do you buy Tropical Fruit based on geographic origin? (8) Would you be willing to buy Tropical Fruit from Sicily? (9) How much is your WTP for tropical fruit from Sicily?

With the aim of providing a general overview of the results obtained, the next section is dedicated to the results, which respectively deal with the socio-demographic variables that made it possible to determine the profile of the study participants (Table 1) and the objective variables that instead determined the consumers' behaviour of the participants (Table 2). In order to achieve the research aims, several we investigate also about of gender, age, income, level of education and number of family members on tropical fruit consumption.

3. Results

The first section of the results is entirely devoted to descriptive statistics. With regard to the socio-demographic profile of the participants, Table 1 provides a picture of this profile through the different answers given by the sample.

Table 1
Socio-demographic profile of the participants (own source).

	N	%
Gender		
Male	251	49
Female	260	51
Age		
15–20	38	7
21–30	177	35
31–40	46	9
41–51	76	15
51–60	99	19
61–70	57	11
Over 70	18	4
Family members		
1	46	9
2	89	17
3	111	22
4	187	37
5	67	13
More than 5	11	2
Educational Level		
Bachelor's Degree	104	20
Master's Degree	148	29
Master's or PhD degree	45	9
Upper Secondary School	207	41
Lower Secondary School	7	1
Residence city (inhabitants)		
Large size (>250,000)	224	44
Average size (between 5001 and 250,000)	221	43
Small size (up to 5000)	66	13
Annual Income €		
>50,001	86	17
From 25,001 to 50,000	191	37
From 10,001 to 25,000	167	33
Up to 10,000	67	13

Female respondents accounted for 51% of the participants and the remaining 49% men. The variability of the age sample shows multiple participation of all age groups, making it clear how many participants of each age contributed to the questionnaire. To better analyze the results, the sample of consumers surveyed was divided by age group according to another similar research (Sgroi and Salamone, 2022). Table 1 shows the age ranges, specifically, the 15–20 age group accounts for 7%. The 21–30 age group is represented by 35% of the participants, the 31–40 age group 9%, and the 41–50 age group 15%. The 51–60 age group is represented by 19%, the 61–70 age group by 11% and the over-70 age group about 4%. Another aspect analyzed was the number of family members. Regarding this aspect, households up to four members prevail, and represent 37% of the sample; households with three members are 22% while those with five members are 11% and over five are only 2%. While the remaining part i.e., households consisting of one or two family members are 9% and 17% respectively.

Regarding the level of education, it is noted that it is high as 20%, 29% and 9% hold a bachelor's, master's or doctoral degree while the remaining part i.e., 41% and 1% have upper and lower high school diploma. The largest part of the catchment area is in large cities (>250,000 inhabitants), around 44%, while 43% are in medium-sized cities (between 5000 and 250,000) while the least part, around 13%, are in small cities (up to 5000 inhabitants). As far as annual income is concerned, it is seen that 17% earn over 50,000 € per year, while 37% between 25,001 and 50,000, 33% are between 10,001 and 25,000, while the minority 13% earn up to 10,000 € per year.

The second part of the descriptive statistics section is devoted to the consumers' behaviour of the participants (Table 2).

Results show that most of the respondents (76%) buy from supermarkets or hypermarkets, and the preferences of Italian consumers fall

Table 2
Consumers' behaviours of the participants (own source).

	N°	%
Where do you purchase tropical fruits?		
Supermarkets or hypermarkets	389	76
Neighborhood markets	64	13
From farm to fork (km0)	40	8
Traditional fruit vendors	211	41
Do you consume tropical fruits?		
Every day	35	7
once a week	118	23
2 to 3 times a week	114	22
1-2 times a month	143	28
Almost never	82	16
Never	19	4
Which do you know?		
Banana	493	96
Avocado	476	93
Mango	470	92
Anona	68	13
Litchi	187	37
Papaya	395	77
Do you know Quality Certification? (GPI,PDO)		
Yes	434	85
No	77	15
WTP a premium price for a certified product respect to non-certified one		
Yes	422	83
No	89	17
How much higher is the WTP more for certified tropical fruit?		
0.50 euro per kg of fruit	260	51
0.75 euro per kg of fruit	103	20
1 euro per kg of fruit	104	20
More than 1 euro per kg of fruit	44	9
Do you buy Tropical Fruit based on geographic origin?		
Yes	272	53
No	239	47
Would you be willing to buy Tropical Fruit from Sicily?		
Yes	496	97
No	15	3
How much is your WTP for tropical fruit from Sicily?		
0.50 euro per kg of fruit	134	26
0.75 euro per kg of fruit	113	22
1 euro per kg of fruit	140	27
More than 1 euro per kg of fruit	124	24

on these two sales channels (Fig. 1).

As stated by Ismea (2022), these two segments maintain the predominant position in order of share with 42% of the total value of product demand in supermarkets while hypermarkets are the 25%. The choice can be traced back to some positive factors that large-scale retail offers i.e. greater assortment and choice at more competitive prices, passing through the possibility of taking advantage of special offers and promotions that represent precisely the specific value proposition of large-scale retail groups. In order to attract customers, tools such as private labels are used, i.e., the marketing of products under the supermarkets or the group's own brand, made available to the large-scale retail trade in order to build customer loyalty with a product that is in all respects comparable in quality to the products of widely known companies and brands, but decidedly cheaper in price. In terms of frequency of consumption, tropical fruits are consumed by 28% of respondents once or twice a month and 22% once a week (Fig. 2). It can be seen that there is marginal consumption as these products are still uncommon on the tables of Italian consumers. Results show respondents are not so much affected by price, and only a third of them (32%) acknowledged a high influence of price on the decision to buy tropical fruits. This is also important in relation to the potential consumption of tropical fruits with a quality label, as described in the following paragraph.

As for quality certifications such as the PDO and the PGI, respondents are adequately informed and, in fact, 85% are familiar with them (Fig. 3).

In addition, Italy is the European country with the highest number of agri-food products with PDO and PGI recognized by the European Union (European Commission, 2022) which is a demonstration of the excellent quality of the productions, but above all of the strong link there is with its territory of origin. There are 318 quality products in the country which favours the production system and the economy of the territory. Thanks to the European certification, consumers are guaranteed with a higher level of traceability and food safety than other products (MIPAAF, 2022).

Another key aspect of the consumers' behaviour is the willingness to pay (WTP). Results show that about 85 percent of respondents are in favor of paying a premium price for a certified product. In this sense, some studies show that consumers are willing to pay up to two euros per kilo to buy quality products (Tsakiridou et al., 2009). In this case, 51% are willing to pay 0.50 euro more per kg of product. In this context, another important factor we found is the origin of the products (Fig. 4).

In particular, about 53% of the consumers are interested in the origin of the fruits as can also be found from numerous agribusiness marketing studies, where the evaluations made by consumers are significantly influenced by the origin of the products. For consumers, information on geographical origin can serve to identify the product and evaluate its quality (Curtis et al., 2006). In our survey, 97% of the consumers are

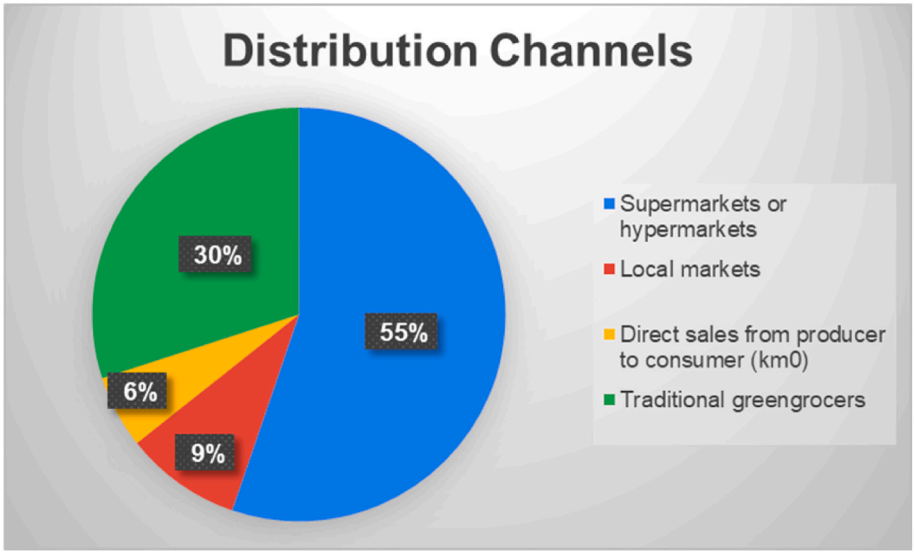

Fig. 1. Distribution channels (own source).

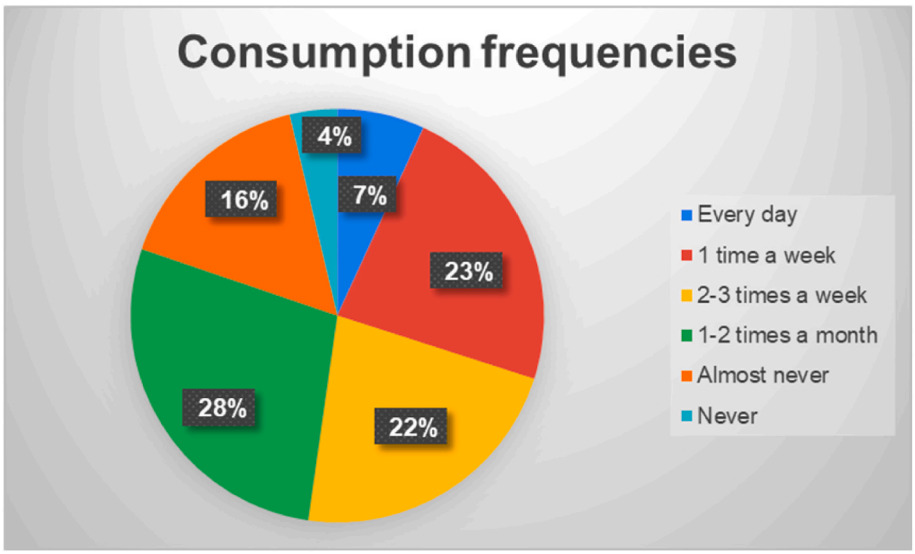

Fig. 2. Consumption frequencies (own source).

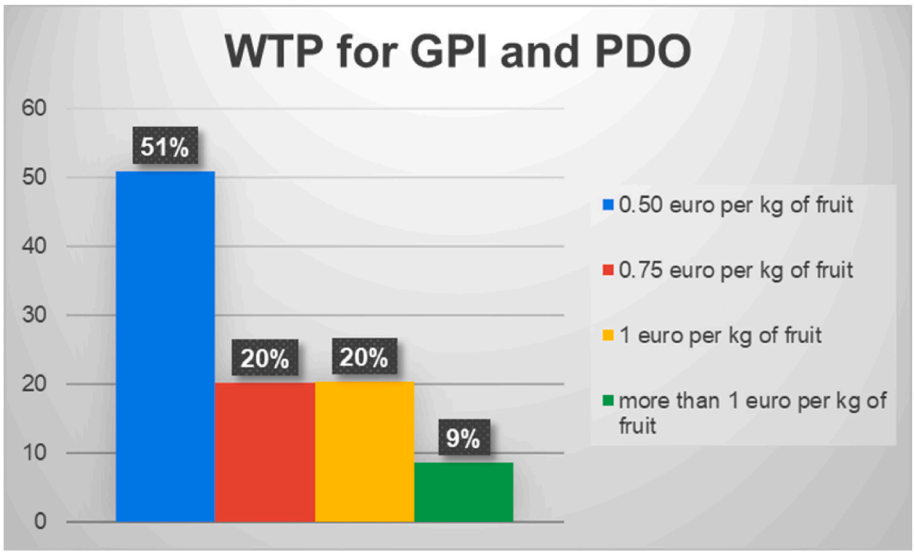

Fig. 3. Willingness to pay for GPI and PDO products (own source).

willing to pay a higher price for tropical fruits from Sicily because they are found to be fruits of excellent organoleptic and sensory quality, allowing for strong potential for fruits made in Sicily (Columba et al., 2012) which also protects and promotes the relation between food and the territory.

To test the effect of socio-demographic characteristics described in the previous section, ANOVA is used as a statistical technique. The analysis conducted should reveal that demographic variables such as age, gender, education level and annual income may influence tropical fruit consumption frequency. ANOVA technique was used to examine significant differences between groups according to these variables, providing an in-depth understanding of the socio-demographic factors influencing consumer choice (Table 3).

Based on the results in Table 3, we can observe that only the variable "Educational_Level Lower Secondary School Certificate" has a p-value at the limit of significance (0.0546), while all other independent variables are not statistically significant. The R-square multiple of the model is very low (0.02106), indicating that the independent variables explain only a small part of the variation in the dependent variable. The p-value of the F-statistic (0.09583) indicates that the model as a whole may not be statistically significant.

The two significant variables in the regression are "Educational_Level Lower Secondary School Certificate" and "Income> 50.001". We provide a more detailed explanation for each of them:

Educational_Level Lower Secondary School Certificate: This variable represents the educational level of the participants. The coefficient estimate for this variable is −0.43761, with a standard error of 0.22714. The associated p-value is 0.0546, indicating marginal significance. This means that the Soru estimated coefficient could be non-zero, but its statistical significance is borderline.

Income> 50,001: This variable indicates the participants' income, with a value above 50,001 euros. The estimated coefficient for this variable is −0.41376, with a standard error of 0.25830. The associated p-value is 0.1098, indicating marginal significance. Again, the estimated coefficient may differ from zero, but its statistical significance is borderline.

Both variables have p-values greater than 0.05, indicating that we cannot say with confidence that they have a significant effect on the dependent variable (Consumption_Frequencies).

From the results of the analysis of variance (ANOVA) for model

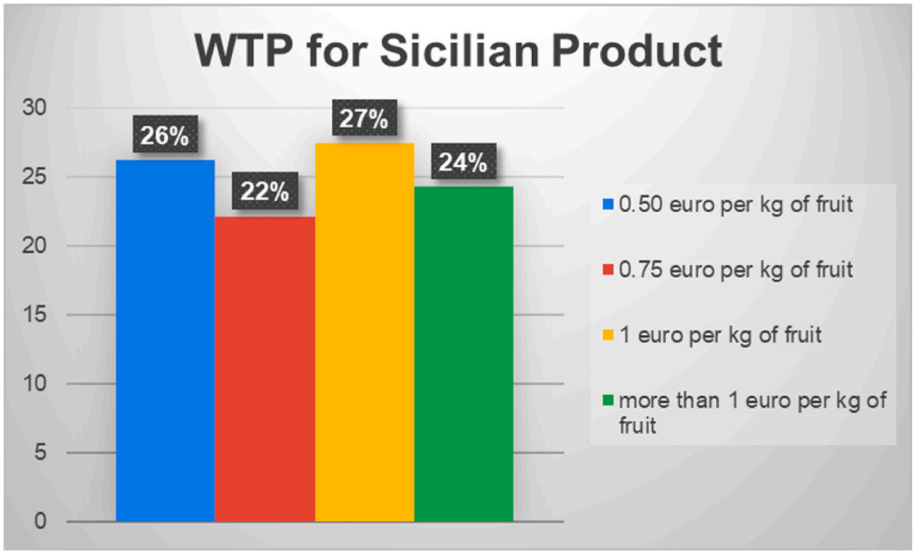

Fig. 4. Willingness to pay for Sicilian products (own source).

Table 3
Generalize Linear model (own source).

	Estimate	Std. Error	T value	Pr (>|t|)
(Intercept)	375.179	0.65870	5.696	2.11e-08 ***
GenderM	−0.08076	0.17433	−0.463	0.6434
Age21–30	−0.34026	0.36142	−0.941	0.3469
Age31–40	0.22643	0.44225	0.512	0.6089
Age41–51	−0.57097	0.40425	−1412	0.1585
Age51–60	0.04522	0.38198	0.118	0.9058
Age61–70	−0.21422	0.41894	−0.511	0.6093
AgeOver 70	−0.31298	0.56949	−0.550	0.5829
Educational_Level (LowerSecondary)	−0.51650	0.24143	−2.139	0.0329 *
Educational_LevelMaster's Degree	−0.05936	0.26364	−0.225	0.8220
Educational_LevelPh.D or Master	−0.49044	0.36047	−1.361	0.1743
Income €25.001-€50.000	−0.19133	0.20702	−0.924	0.3558
Income> 50.001	−0.43438	0.26143	−1.662	0.0972
Income Up to €10.000	0.10547	0.28280	0.373	0.7094
IGP_DOP_KNowledgeYes	−0.22126	0.24057	−0.920	0.3582
WTP_SicilyYes	0.35206	0.52081	0.676	0.4994
WTP_CertificationYes	−0.23862	0.22843	−1.045	0.2967

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1.

Table 4
ANOVA Test for LM (Linear Model) (own source).

	Df	Sum Sq	Mean Sq	F value	Pr (>F)
Gender	1	2.07	2.0708	0.5740	0.4490
Age	6	24.12	4.0201	1.1144	0.3526
Educational Level	3	27.77	9.2571	2.5662	0.0539
Income	3	13.82	4.6062	1.2769	0.2816
GPI_PDO Knowledge	1	2.88	2.8755	0.7971	0.3724
WTP_Sicily	1	0.93	0.9304	0.2579	0.6118
WTP_Certification	1	3.94	3.9363	1.0912	0.2967
Residuals	494	1782.05	3.6074		

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1.

(Table 4), we can draw the following interpretations.

- "Gender": There is no evidence of a significant effect of gender on the response variable "Consumption_Frequencies". The p-value associated with the gender factor is 0.4490, which exceeds the significance value of 0.05. This indicates that the observed differences in consumption frequencies between genders could be random or due to other factors not considered in the model.
- "Age": The age factor also does not show a significant effect on the response variable. The p-value associated with the age factor is 0.3526, which exceeds the significance value of 0.05. This suggests that the observed differences in consumption frequencies between the different age groups could be random or influenced by other variables not considered in the model.
- "Educational_Level": The educational level factor shows marginal significance on the response variable. The p-value associated with the factor is 0.0539, which is close to the significance value of 0.05. This suggests that there may be an association between level of education and consumption frequencies, but further analysis or a larger data sample is needed to confirm this association.
- "Income": There is no evidence of a significant effect of income on the response variable. The p-value associated with the income factor is 0.2816, exceeding the significance value of 0.05. This suggests that differences in consumption frequencies related to income could be random or influenced by other variables not considered in the model.
- "IGP_DOP_Knowledge", "WTP_Sicily" and "WTP_Certification": None of these factors show a significant effect on the response variable. Their p-values exceed the significance value of 0.05, indicating that the differences in consumption frequencies associated with these factors could be random or influenced by other variables not considered in the model.

In conclusion, the results of the ANOVA suggest that educational level may have some relationship with consumption frequencies, although the statistical significance is marginal. The other factors examined, such as gender, age, income, knowledge of PGI_DOP, interest in Sicily products and WTF certification, do not seem to have a significant impact on the consumption frequencies considered in the model.

4. Conclusions

The interest in tropical fruits has significantly increased in recent decades. While most of them are imported from South America, China and India or other parts of the world and the journey they make to reach Italy is always very long, the local production of tropical fruits in Mediterranean regions is also growing due to different factors, such as climate change. However, nowadays there is a marginal and fragmented production in the Italian territory especially in Sicily where fruit plants

are found mainly around the coastal strips. In this sense, domestic production provides fruits with more appreciable organoleptic and nutritional characteristics than imported ones determined by a greater persistence on the plants. Fruits produced in Sicily could potentially be conveyed to European markets. All these fruits are rich in carbohydrates, protein, fiber, micronutrients essential for human consumption such as, polyphenols, fats, oils, vitamins (C, E, K, B1, B2, B6, B9) and minerals (P, Na, Mg, K, Fe and Zn). In developed countries, due to high per-capita income, consumer preferences tend to change variably, and tropical fruits represent a great opportunity for Sicilian fruit farms as this study reveals, perhaps intercepting greater demand in the future, and a consumer preference for this product and the relevance of its origin. As underlined by the questionnaire responses, the younger generation has shown considerable knowledge of tropical fruits, as well as a willingness (93% of respondents) to pay a premium price for fruits of Sicilian origin.

With regard to the commercial aspect, the products could be publicized more with a more appropriate promotion of the same, with a view to attracting the same consumers to the introduction of these tropical fruits of particular value in different aspects namely organoleptic and sensory (see Matsuura et al., 2004). Tropical fruits could play a significant role in Sicilian gastronomy, helping to enrich the variety of flavors and aromas of the local cuisine. Sicily is a Mediterranean region, and its favorable geographic location allows the cultivation of various tropical fruits due to its mild climate and suitable growing conditions. Locally grown tropical fruits can be harvested at the right time of ripeness, ensuring maximum freshness and maintaining their nutritional and organoleptic properties. In addition, their inclusion in traditional recipes or pairing with local ingredients can lead to unique and surprising dishes. Culinary innovation using tropical fruits helps keep Sicilian culinary traditions alive and stimulate the interest of visitors and locals alike. The introduction of tropical fruits into Sicilian cuisine can affect tourism enhancement because tourists and visitors are interested in discovering and tasting new flavors with a local origin. The fusion of tropical elements with Sicilian culinary tradition creates a unique gastronomic experience that reflects the richness and diversity of the region. This would lead to a growing use of the product in gastronomic experiences.

The ANOVA analysis allowed us to understand how the socio-demographic profile of the sample influences the frequency of consumption of tropical fruits. Specifically, it has been shown that high consumption of tropical fruits is positively associated with higher levels of household income. Consequently, we expect that individuals with higher-than-average lifestyles and consumption patterns tend to purchase tropical fruits. Additionally, another relevant variable in the model is the level of education, particularly low levels of education, which are negatively associated with the frequency of consumption. There is a tendency to consume fewer tropical fruits when individuals have a maximum educational level of lower secondary school.

4.1. Theoretical and practical implications

This paper adds texture to the understanding of the familiarity and purchasing intention of consumers in relation to tropical fruits based on the case of Italy (see, for example, Sabbe et al., 2008 for the case of Belgium), and confirms the relevance of the quality certification and the local origin as crucial drivers of consumption and elements for the planning and development of marketing strategies. This is the main theoretical implication of the paper which also informs, from the perspective of practical implications, local stakeholders about the most important tropical fruits consumed in Sicily. Tropical fruits are recently adopted as examples of agri-food products that could protect and promote a Sicilian territorial identity. These are bananas, mango, avocado, papaya, annona and lychee, which are among the food preferences of Italians because their taste and nutritional values. This research is pertinent to better understand the opportunity relationships between gastronomy and production realities in the area starting with the enhancement of local products. The unique characteristics of tropical fruits of Sicilian origin favor their protection and promotion, as well as their gastronomic enhancement. Producers, restaurateurs, and government representatives could recognize the potential of Sicilian tropical fruit as an opportunity for collaboration and enhancement. as an opportunity for collaboration and enhancement of territorial authenticity.

4.2. Limitations and further research

This paper is limited to the analysis of the consumers' purchase intention of Sicilian tropical fruits, which means that future research could also develop the understanding of the market from the supply perspective, and also explore the role of tropical fruits in different distribution and sales channels. Obviously tropical fruits are more expensive than conventional fruits and it could make it difficult to include tropical fruits on restaurant menus or their availability to consumers. Lack of familiarity with tropical fruits on the part of cooks, restaurateurs, or consumers may limit their inclusion and creative use in recipes and culinary preparations. Future studies may also analyze the consumption of tropical fruits in different Mediterranean regions to identify similarities and differences. This research also offers a series of opportunities for the development of the relationships between the agriculture and the gastronomic sectors, where the use of tropical fruits (for example, in cocktails) is still underexplored and may represent another path to protect and promote the authenticity of a territory. Moreover, this is particularly interesting because it increases the richness of the area by promoting the food and wine of Sicily.

Implications

This research contributes to the understanding of the tropical fruits production and consumption which is increasing in Mediterranean regions because of climate change. Departing from the study of the demand, this research shows that consumers are willing to pay more for quality and local tropical fruits. Since tropical fruits contribute to the identification of the territory, this research analyses how the changes in the agricultural production result in changes in food consumption dynamics.

Author statement

The authors designed, implemented and wrote the research.

Declaration of competing interest

The authors declare that there is no conflict of interest.

Data availability

Data is contained within the article.

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