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Cultural perception as a primary factor in the market for Red Sour Pitaya (*Stenocereus gummosus*) in the region of La Paz, Baja California Sur, Mexico

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Abstract. The study includes the analysis of cultural, commercial, and safety factors that affect the potential of the trade of the red sour pitaya (*Stenocereus gummosus*), as well as its characterization, consumer patterns, consumption channels, and the relevance, identity, and cultural value of the fruit in the Municipality of La Paz, Baja California Sur, Mexico. The investigation has the objective of understanding the perception of the product in local knowledge, which is identified in the study area, where the wild fruit takes an added value in informal commercialization and is amalgamated with the local culture. For the analysis and data collection, a simple random sampling was conducted, on 227 economically active people with purchasing power. The method of applying the instrument was digital, limiting face-to-face contact with people due to the current Covid 19 pandemic. The exercise characterizes a population with mostly university studies, which consumes the product in a traditional way, which reflected a greater appreciation of the pitaya fruit, by older people.

Keywords: *Added value; Business; Forest product; Segmentation.*

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Introduction

Currently, forest species, both timber, and non-timber represent a heritage for communities, especially those that lack important natural resources such as water, fertile land and that also do not have microclimates that favor the development of these species. The pitaya from the natural environment, that is to say wild or not induced, is a fruit that represents a relevant part in the culture of Baja California Sur, found even in historical accounts and ethnobotanical studies, which present it as an important food resource (Feiger and Moser, 1985; Turner *et al*., 1995; González-Abraham *et al*., 2010; Lozano, 2013) and in turn, its care is necessary to safeguard the biodiversity of species in ecosystems (Orozco-Ávila, 2017). According to Saucedo (2018), part of the most threatened flora in Mexico is cacti. This work describes part of the importance of the red sour pitaya, (*Stenocereus gummosus*), as a traditional fruit in the state of Baja California Sur, which is appreciated in national and international markets by consumers who value endemic products, where it reaches attractive prices. Therefore, this activity represents an alternative source of income and job creation that constitutes an apparently viable productive alter

However, this activity requires support to develop the national market and further encourage the habit of consumption, since its trade is practiced informally and with low added value. The pitaya marketing system is based on the collection of the fruit, which is carried out mainly by collecting settlers, not producers, who do it by tradition in the season, which is also appreciated as a symbol of the scarce rains in the area, which are expected as a gift provided by nature, adding a cultural value that strengthens the collective memory (Halbwachs, 2004).

The value of pitaya as a regional product

In the case of red sour pitaya, social and cultural factors are influenced by the seasonality of the rainy season and its marketing, elements that have been characterized by the generational change in the way of conceiving the hygiene of the goods and ways of acquiring them.

The value that people place on food can be seen from multiple points of view. According to Strang (2020), people value the planet by perceiving fewer and fewer species of living beings, including those that nature provides to humans for their livelihood or for their ecosystem service (López, 2019). Thus, this value may not be expressed by numerous factors such as the barriers that prevent them from enjoying them, essentially food (Sharareh *et al.,* 2021). Similarly, these foods can be valued according to the impact they produce on people when consuming them, especially at certain ages (Troncoso *et al.,* 2018). For their part, for Castellón and Fontecha (2018), the value of products, such as food in a region, is constructed according to the description of the territory itself, since the values of belonging to a culture and tradition are derived from it.

Regarding wild or forest fruits, classified as associated resources in the General Law of Sustainable Forest Development incorporated by SEMARNAT (2018), people usually have an interest in them to complement their diets or food sustenance (Ortiz *et al.,* 2021). However, it is important to consider that, these fruits do not emanate from cyclical or perennial crops (SAGARPA, 2016), they are seasonal and communities harvest them directly from their ecosystems (López, 2019), so they represent a nutritional and cultural value for their families. To analyze the consumption systems of edible wild fruits, it is necessary to do it within a comprehensive framework (Martínez *et al.,* 2021) that allows establishing the value of the product in the community and its environment.

As well as consider, the strengthening of the value chain in products of natural origin is important from an economic point of view, but also for its social impact. The red sour pitaya is increasingly valued for its benefits for the health of people and, the economy for those who harvest it (Tenore *et al.,* 2012). According to Mosquera *et al*. (2011), there is a growing trend in fresh pitaya consumption, as a result of the knowledge of the fruit and its nutritional benefits and other benefits by the end consumer, who is interested in each more and more in aspects such as health care and the consumption of healthy and natural products.

Behavior of the pitaya in the market

It is important to highlight that the growth of fresh consumption of pitaya fruit has occurred in Latin America, mainly in some regions of Mexico like Sonora desert and the south-central part of the country and the Yucatan peninsula (Ramírez, 2011) and in Colombia up to 95% of the total harvested (Alvarado *et al.,* 2015). Most of the pitaya is sold as fruit in public places and the collectors sell to intermediaries and these to the final consumer. Therefore, the value chain of pitaya fruit can generate various products; however, it is sought in its natural state, that is, freshly harvested.

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In Mexico country, the main producing regions are located in Michoacán, the Mixteca Baja Oaxaqueña, Jalisco, Zacatecas, Sinaloa, Sonora and Baja California Sur, consisting of family gardens and wild harvesting. Its uses include fresh or processed fruits, either in the production of freshwaters, juices, ice creams, atole, yogurt, ate, cakes, jellies, liqueurs, sparkling wines, syrup, jams, and "pitayate" which is the name given to the sweet prepared from crushed pulp sweetened with sugar (Hunt, 1992; Luna-Morales, 2004; Bravo-Avilez *et al.,* 2014).

Various species of pitaya (*Stenocereus* spp.) are collected for self-consumption and for marketing in arid and semi-arid areas, such is the case of the *Stenocereus gummosus* species (Engelm.) Gilbs. (Pitaya agria) (Mizrahi and Nerd, 1996). In turn, in Zacatecas where it is collected for commercialization in the study carried out by Campos-Rojas *et al.* (2011) where four pitaya phenotypes were discovered with production potential for commercialization. This fruit has been consumed as food since ancient times, however, today in various regions of the country it is used as an alternative means of obtaining income (Esquivel, 2004; Pliego-Ortiz, 2009).

The commercialization of the pitaya is carried out preferably within 24 hours of being cut, in the streets of the towns and cities, the transport of this fruit is done in wicker baskets or plastic or metal buckets and they are sold in plastic bags, with approximately 0.5 kg of pitayas.

The handling of the pitaya in the central supply markets, the volumes are low or it is limited by being the perishable fruit, reporting durability of the same from two to three months; Pitaya fruits that tend to burst are highly perishable with a shelf life of three to five days or less; the limited or no organization of producers per region to commercialize or industrialize pitaya; scarce products made from pitaya and the lack of publicity and promotion to increase the demand for pitaya worldwide (Flores, 2002).

According to the National Information and Market Integration System (SNIIM, 2021) in Mexico, we can find the main markets demanding pitaya such as: "Pedro Sáinz de Baranda" Market in Campeche, Oaxaca Supply Module, Chetumal Market in Quintana Roo, Central de Abasto de Mérida, Oxkutzcab Wholesale Center and the "Casa del Pueblo" market in Yucatán. Being the Chetumal market in Quintana Roo the one that most demands pitaya in 2021. The market in question demands the first pitaya in 18 kg boxes with a frequent price of $390 pesos per box. Likewise, the 20 kg box with a frequent price of $800 pesos. It also buys pitaya per kilogram with a frequent price of $25, 30, and 60 pesos. Prices may vary depending on the season and quality of the fruit. In La Paz Baja California Sur, the sale of pitaya in street stalls is advertised on social networks, at a price of $30, $40 pesos for six pieces.

According to Martínez-De La Cruz *et al.* (2015), most wild fruits tend to reactivate or energize rural economies, through commercialization in municipal markets that expose the resource to tourists, locals, and sale through cambaceo (door-to-door sale) being important the use of local wild fruits and contributing with a nutritional content and culture of society, a factor that raises the value of the product.

It is important to emphasize the growth of the older adult population in Mexico and in the world. This market sector is still important but forgotten (Cabrales, 2013). However, in Mexico, there are several regions, where the elderly represent an important market niche, which demands various products for their food, such as the sour pitaya. In addition, it represents a memory, an experience of childhood or youth, just eating this fruit; It is worth mentioning the existence of other fruits or processed foods that

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displace the food of fruits, however, there are still food customs that resist changes because the population has managed to transmit their practices; despite the changes, influences, and accessibility to all types of food (Gómez-Delgado and Velázquez-Rodríguez, 2019).

Given the context of the market for this fruit, it is necessary to know the characteristics, level, quality and lifestyle of consumers, in order to be able to propose a future panorama of diversification of traditional activity locally and thus scale to new market niches such nostalgia, nutraceutical, organic, fair or alternative (Amador-Betancourt, 2015; Amador, 2016; Quiroz-Gonzalez *et al*., 2018).

The regional value of the pitaya is driven mainly by its cultural appreciation and not so much by market factors; which is perceived to a greater degree by adults.

It is based on the assumption that pitaya can be valued according to the impact on people when consuming them, especially at certain ages (Troncoso *et al.,* 2018); and this value is built according to the description of the territory itself, since the values of belonging to a culture and a tradition emerge from it (Castellón and Fontecha, 2018).

Material and Methods

For the analysis and data collection, a survey was applied using a statistical formula for social studies (Galindo, 1998), applied to the economically active population of the city of La Paz, obtaining a sample size of 227 people. Subsequently, a simple random sampling was carried out, for the application of the instrument, which was carried out in digital mode, given the conditions derived from the health contingency caused by the current Covid 19 pandemic. The questionnaire instrument designed to know the perception of the factors Market and cultural value of the red sour Pitaya was made up of 15 items, of which 10 were multiple choice and 5 were dichotomous. The categories of analysis are demographic (age, sex, and study) and consumer habits (purchase frequency, place, hygiene, price, packaging, and cultural appreciation).

This research uses Pearson's chi-square test for cross-tabulation to determine the association between two variables (age - consumption, Age - Value) using a hypothetical situation and simulated data in order to see the relationship of the variables with the surveyed data. Then its use is described to evaluate how good a theoretical distribution can be, when it pretends to represent the real distribution of the data of a given sample. The SPSS package, version 24, was used for the processing, calculation, and statistical analysis of the data.

Results and Discussion

The research assumption is verified by identifying that the market segment of the adult population of the research area in La Paz, Baja California Sur, has an impact on maintaining a market of low organization of the regional product that does not integrate into a production chain, therefore, the local collector or merchant maintains the construction of a local identity, based on culture and longing for traditional collection techniques, as well as what is times related to the season of the year when the pitaya matures. In the analysis of the data, it is identified that the life experience of the adult in the region becomes relevant in determining the consumption habits of the pitaya.

The chi-square test has been used to study the association between the crossover of categorical variables through contingency tables. The chi-square test measures the difference between the value

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that should result if the two variables were independent and the one that has been observed in reality. The greater this difference, the greater the association between both variables.

Table 1 shows the table of contingency of age and consumption of Pitaya. As can be seen, in general terms the people surveyed considered that "because of its flavor" is the main reason for the consumption of Pitaya, with percentages ranging from 54.5% to 65% of preference. However, it can be observed that, at an older age, people value consumption "by tradition" to a greater extent, as it is the second response with the highest percentage of choice and passes from 22.2%, 22.5% and 24.1% in the ranges of age 21-30, 15-20 and 31-40 respectively, to 38.2% and 36.4% in the age ranges of 41-50 and 51-60 respectively.

Table 1. Contingency tabulation What age range are you in? And why do you think pitaya is consumed?

		By tradition	For nutritional qualities	By its flavor	For necessity	Other	Total
Age groups	15-20	22.5%	2.5%	65.0%	0.0%	10.0%	100.0%
	21-30	22.2%	4.9%	72.8%	0.0%	0.0%	100.0%
	31-40	24.1%	3.4%	62.1%	0.0%	10.3%	100.0%
	41-50	38.2%	1.8%	60.0%	0.0%	0.0%	100.0%
	51-60	36.4%	0.0%	54.5%	4.5%	4.5%	100.0%
	Total	27.8%	3.1%	65.2%	0.4%	3.5%	100.0%

Next, in Table 2, the result of the chi-square test between the variables age and Pitaya consumption is presented. As can be seen, there is a statistically significant association between age and why Pitaya is consumed. $\chi 2$ (16) = 30.238, $p < 0.05$.

Table 2. Chi-square tests.

	Value	df	Asymptotic significance (bilateral)
Pearson's Chi-square	30,238a	16	.017
N of valid cases	227		

In table 3, the result is now presented between the crossing of variables age and place where the Pitaya is bought. In the table it is observed that in all age groups "on the roadside" is the most frequent response with 35.0%, 45.7%, 55.2%, 78.2% and 77.3% in the age ranges 15-20, 21-30, 31-40, 41-50 and 51-60 respectively. With this, a marked tendency is observed in abandoning other purchasing methods at an older age, for example, the collection from the 41-50 and 51-60 age groups drops to 9.1% and 4.5% respectively.

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Table 3. Crossing of variables in what age range are you? and Where do you buy the pitaya?

		Where do you buy pitaya?					Total
		I do not buy, I collect	On the side of the road	In stores or establishments	Supermarkets	Other	
Age groups	15-20	20.0%	35.0%	15.0%	10.0%	20.0%	100.0%
	21-30	29.6%	45.7%	14.8%	4.9%	4.9%	100.0%
	31-40	27.6%	55.2%	3.4%	0.0%	13.8%	100.0%
	41-50	9.1%	78.2%	9.1%	3.6%	0.0%	100.0%
	51-60	4.5%	77.3%	0.0%	9.1%	9.1%	100.0%
Total		20.3%	55.9%	10.6%	5.3%	7.9%	100.0%

Next, in Table 4, the result of the chi-square test between the variables age and Pitaya consumption is presented. As can be seen, there is a statistically significant association between age and the place where the Pitaya is bought. $\chi 2$ (16) = 45.651, $p < 0.05$.

Table 4. Chi-square tests.

	Value	df	Asymptotic significance (bilateral)
Pearson's Chi-square	45,651a	16	.000
N of valid cases	227		

On the other hand, Table 5 shows the result between the crossing of variables age and frequent consumption of Pitaya. In this table, a marked trend towards frequent consumption of Pitaya is observed as age increases. For example, the youngest age group corresponding to the 15-20 range, 45.0% reported Yes to consume frequently, while 55.0% reported No. However, when comparing with the oldest age group, the percentage of Answer Yes, it goes to 77.3% and No, it decreases to 22.7%.

Table 5. Crossing of variables What age range are you in? * Consume Very frequently.

		Consume Very frequently		
		Yes	No	Total
Age groups	15-20	45.0%	55.0%	100.0%
	21-30	65.4%	34.6%	100.0%
	31-40	75.9%	24.1%	100.0%
	41-50	87.3%	12.7%	100.0%
	51-60	77.3%	22.7%	100.0%
	Total	69.6%	30.4%	100.0%

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Next, in table 6, the result of the chi-square test between the variables age and Pitaya consumption is presented. As can be seen, there is a statistically significant association between age and frequent consumption of Pitaya. $\chi 2$ (4) = 21.375, $p < 0.05$.

Table 6. Chi-square tests.

	Value	df	Asymptotic significance (bilateral)
Pearson's Chi-square	21,375a	4	.000
N of valid cases	227		

Conclusions

The investigation confirms the assumption raised, the pitaya has a value chain and is part of the local markets, although in an incipient way, but in the end, its elements such as price, quality and above all tradition and regional value, are perceived mainly by older people, in contrast to young people, who only manifest their consumption simply by taste and flavor.

The analysis carried out made it possible to measure and contrast some concepts and variables of the market and value of pitaya as a regional product. According to the information generated, these markets acquire this fruit for the taste and delight of the consumer, through the image, the history, the flavors, the smells, among others. These other values being added to the fruit.
Additionally, it could be extremely important to implement an adequate value chain and commercialization, since the pitaya is a valued and demanded fruit, in market terms, so it is necessary to implement strategies for the good use of the fruit.

Finally, it is important to promote the pitaya as part of the cultural food heritage of the region so that it is more highly valued and, therefore, can be preserved, so that it can exist in a sustainable way as part of the available food for consumers both in Mexico and in the world.

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Statement of ethics

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Consent to publication

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Data availability

Not applicable

Conflict of interests

The authors declare that they have no competing interests in this section.

Author contributions

Research, project management: **MACG** Writing, conceptualization, Research: **JAVE** Preparation of the original draft, conceptualization, Research: **LCAB** Methodology, data curation, **SRRL** Methodology, data analysis: **ISR**

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