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Article

Consumer evaluation and sensory analysis of *Queso Bola de Ocosingo* (Mexico)

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Abstract:

Information on consumer acceptance of and preference for a product are vital to developing marketing strategies. An analysis was done of consumer acceptance of and preference for *Queso Bola de Ocosingo*, an artisanal cheese, aged for one of three periods: fresh, 21 d and 45 d. Sensory testing panels were organized at three food-related scenarios: a gourmet foods event; a rural culture fair; and a culinary exhibition. A total of ninety (90) panelists participated. Parametric and non-parametric statistical tests were applied to the data. Comparisons of panelist responses considering the scenarios and panelist socioeconomic characteristics found that panelists reporting lower income and educational levels more highly valued visual characteristics and preferred fresher cheeses. Panelists reporting higher income and educational levels appreciated cheese aroma and taste attributes influenced by aging period. *Queso Bola de Ocosingo* has production and cultural characteristics in common with other artisanal cheeses produced in Mexico, and promoting its consumption can contribute to preserving the country's culinary heritage.

Key words: Acceptance, Differentiated foods, Gastronomic fairs, Untrained panelists, Preference.

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Introduction

Over the last few decades increasing emphasis has been placed on preservation and promotion of the production and consumption of local products. This partially responds to consumer fears of excessively industrialized food production and lack of knowledge on the origin of food; these have driven consumers to concentrate on external food product attributes such as price, physical appearance, labels and seals[1,2].

Several authors have mentioned the importance of restoring confidence in food through a return to local food sourcing and production, thus protecting cultural diversity[3,4]. A new segment of consumers has emerged that is concerned with the way food is produced and which has the ability to manage its own food resources. These consumers can potentially contribute to recovering the traditional meanings behind the producer-consumer relationship. For example, they have played a role in the reactivation of local markets, food fairs and other types of gastronomic events as scenarios for product evaluation[1,4-6].

Research on changes in consumer preferences has been done largely in Europe[7-10]. However, consumers are also changing in Latin America where their characteristics and the main reasons for their preferences remain unknown. This is mostly due to the fact that studies to date in developing countries have mainly considered the effects of the entrance of regional agriculture into the world market, and its implications in traditional forms of production and changes within local populations, especially in terms of diet[1]. A need exists to study consumer tastes and preferences for local products such as Mexican artisanal cheeses.

Forty different cheeses have been described in Mexico. Many of these are made in poorer regions following traditional artisanal techniques and are marketed mainly in local markets, thus fulfilling an important role in regional economic development[11].

Queso Bola (ball-shaped cheese; QBO) is a type made by ten artisanal producers in the city of Ocosingo, in the state of Chiapas, in southern Mexico. Its center is a ball of acid cheese made with double cream raw cow's milk, and this is wrapped with a double lining of cheese made from skim milk. The traditional process begins when the fresh raw milk is received. Cream is added to soften

the cheese's internal texture, and it is then curdled and the whey removed. It forms a paste which is placed in blanket and hung to age for at least 21 days before being wrapped with skim cheese. The blanket is changed periodically to prevent product contamination. Once aged, balls cheese are shaped and wrapped with two layers of a stringy skim cheese. This protects the internal aged cheese from contamination, allowing its marketing at room temperature[11,12].

Competition with different types of industrially-produced cheeses that cost less, as well as the reputation and high demand for QBO, have caused negative changes in the QBO production process. These include shortening of curd acidification time and increasing inventory rotation, both of which reduce expenses and increase profits. The local market has responded by offering three types of QBO, a fresh type, one aged the traditional 21 days and another aged 45 d. However no differentiation is made between these types in terms of labelling (especially between the fresh and 21-d aged cheeses) or price. This compromises the gastronomic heritage of this traditional product because the fresh type is essentially a different product in which the curd is not allowed to acidify for the time required in traditional processes. Properly aging QBO requires experience and knowledge, and is vital to ensuring cheese quality. Because this cheese is made with raw milk, aging is also important to lower risk to consumer health.

Studies have shown the QBO aged for 21 d to have an acceptable microbiological profile[12,13], but fresh QBO has not been studied. Evaluations are needed of consumer acceptance of fresh and aged QBO, followed by microbiological analyses to determine how safe they are for consumers. This could help to preserve this artisanal cheese and ensure consumers receive healthy food. The present study objective was to evaluate consumer acceptance of and preference for three types of QBO (fresh, aged 21 d and aged 45 d), and analyze the implications of these preferences.

Material and methods

Panelist selection and evaluation scenarios

Panelists were untrained consumers, who are suitable for spontaneous, fast responses unconditioned by previous training[14-16]. Tests were done in three scenarios, each an event which attracts different kinds of attendees. The Gourmet Show (GS) is held every year at the World Trade Center in Mexico City and is aimed at bringing together the suppliers of quality cooking products with potential consumers. The National Rural Culture Fair (FCR) is held annually at the Autonomous University Chapingo and brings together local producers from all over Mexico. Local handcraft and food products are on exhibit and for sale, and there is a food court for the sale of

prepared food from all the participating states. The annual Gastronomic Exhibition (MG) of the Institute of Agricultural and Rural Sciences (ICAR) of the Autonomous University of the State of Mexico commemorates The International Day of Food. Attendees are largely university students, teachers and administrative personnel. Scenario choice was done for convenience, given the ease of access to apply sensory tests.

Recommended panel size for this kind of sensory test is 50 to 500 panelists. These are usually recruited because they are product users or are familiar with the products to be evaluated[15,17]. A total of ninety (90) panelists were interviewed among the three scenarios: 34.4 % in the GS; 30 % in the FCR; and 35.6 % in the MG. Although most had no prior knowledge of QBO, they were chosen under the assumption that attendees at food events are more likely to be open to trying handmade local products. This was also an advantage because QBO is not widely known nationwide so the spontaneous responses of the untrained panelists were more probable to approximate those of the general population[15].

Cheese samples

In an effort to avoid process-related biases, the QBO samples used in the evaluations were taken from cheeses prepared in the same factory. Three QBO types were tested: 1) fresh cheese, curd acidified for three days before wrapping, 17- to 19-day total production time (hereinafter “fresh cheese”); 2) aged cheese, 21-d curd acidification prior to wrapping, 35- to 37-day total production time (hereinafter 21-d cheese); and 3) aged cheese, 45-d curd acidification before wrapping, 59- to 61-d total production time (hereinafter 45-d cheese).

Tests were done by placing randomly-coded QBO samples on a plate (to prevent any preconceptions based on ageing time), along with water, bread and fruit (green apples) to clean the panelists´ taste buds prior to evaluating the samples, and between samples.

Tests

Acceptance and preference tests were applied. The first measures perception of sensory characteristics using a scale while the second merely requires selection of the most pleasing sample[15]. After evaluating the samples panelists were asked for information on their place of origin, gender, age and income to facilitate statistical analyses.

Acceptance was evaluated considering ten attributes: external and internal appearance; external and internal color; texture in hand; smell; texture in mouth; taste; aftertaste; and price. Each attribute was graded on a five-point scale (1: Do not like; 2: Like somewhat; 3: Indifferent; 4: Like; and 5: Like very much); this was accompanied by a visual scale to expedite the evaluation process and avoid any discrimination against panelists lacking formal education[18].

Preference was determined by panelists indicating their order of preference of the evaluated samples. After both tests were done panelists were informed of the characteristics of each cheese type and how it is made and asked about their disposition to buy each type and to pay a different price for their preferred cheese (range was ± 60 % of base price per 300 g piece).

Statistical analysis

Validation of question reliability was done with the Cronbach alpha coefficient, considering the thirty attributes included in the three evaluations. The resulting value (0.935) indicated the questionnaire to be reliable for gathering data on cheese characteristics. This analysis was done with the SPSS ver. 16 statistical package.

Data were analyzed using various statistical techniques, all applied with the Infostat statistical package[19,20]. Comparison of attributes between cheeses was analyzed with the Friedman test since each panelist in all three scenarios tested three samples and evaluated each attribute, meaning they are related samples. Results presentation was facilitated by classifying attributes as visual (external and internal appearance, external and internal color) or other (texture in hand, smell, texture in the mouth, taste and aftertaste). Perception of price was presented separately because it is not a sensory attribute, but is still fundamental to generating a complete product evaluation[21,22]. A Kruskal-Wallis test was applied to compare differences between the three scenarios in terms of cheese attributes. Parametric and non-parametric statistical tests, based on variable measurement scale, were used to identify cheese preferences. Quantitative variables were compared using an analysis of variance (ANOVA), with a Tukey test to identify differences between means, and a chi-square test for differences between nominal values. Finally, a Kruskal-Wallis test was applied to identify any differences between scenarios in willingness to pay a price other than the base price.

Results and discussion

Panelist socioeconomic profile

Most attendees at the GS were from Mexico City and had the highest education and income levels of the three scenarios. Those at the FCR were from different parts of Mexico and had the lowest average education level. At the MG, almost all attendees were students from the State of Mexico, and this group had the lowest average age (Table 1).

Table 1: Consumer profile characteristics by evaluation scenario

Variable/ Scenario	GS	FCR	MG	Statistic	*P*
Place of origin (%):				X^2= 26.722	<.0001
Mexico City	48.4	26	3.1		
State of Mexico	38.7	33.3	81.3		
Other states	12.9	40.7	15.6		
Age, years	32.5±11.1 (ab)	34.4±17.2 (b)	26.6±6.3 (a)	F= 3.43	<.037
Gender (%):				X^2= 0.525	.776
Male	51.6	51.9	43.7		
Female	48.4	48.1	56.3		
Education level, years	17.3±3.4 (b)	12.4±2.8 (a)	16.2±2.5 (b)	F= 27.169	<.001
Occupation (%):				X^2= 36.865	<.001
Professional	30	7.4	9.4		
Independent Worker	20	25.9	0		
Employee	16.7	25.9	0		
Student	33.3	40.7	90.6		
Monthly income*	1,077±995 (b)	442±347 (a)	415±243 (a)	X^2= 8.98	<.001

GS = Gourmet Show; FCR = Rural Culture Fair; MG = Gastronomic Exhibition; a,b Different letters in the same row indicate significant difference (P<0.05); *US dollars at MXP 18.492/USD 1. Source: Banco de México (http://www.banxico.org.mx/dyn/portal-mercado-cambiario/index.html). Consulted 18 July 2016.

Attribute perception by cheese type and evaluation scenario

Overall consumer perception by cheese type did not differ between types (Table 2). Because QBO is a *sui generis* product among Mexican artisanal cheeses[11], it was attractive to the panelists, which influenced their positive evaluation of its attributes.

Table 2: Attribute perception by cheese type

Attributes	Average*			T^2	*P*
	Fresh cheese	21-d cheese	45-d cheese		
Visual	3.95	4.01	3.92	0.39	0.6789
Other	3.53	3.48	3.43	1.14	0.3208
Perception of price	3.29	3.41	3.44	1.35	0.2619

*Ordinal type measurement scale; average used to illustrate tendency of attribute measurement. T^2= Friedman test.

Visual attributes received better overall evaluations, probably reflecting the fact that the panelists placed more importance on the most easily perceived characteristics. This could be an effect of the global food supply model which is based on symbols and signals to more easily bridge the gap between producer and consumer[1,23]. Otherwise, this absence of differences between samples may also be attributed to QBO being an unconventional and striking cheese (only 15.6% of panelists had prior knowledge of it), which would coincide with the largely positive evaluation of all attributes. Since the participants had no previous experience as food evaluation panelists, they failed to detect sensory differences between samples. Similar results have been reported in a study in which goat cheeses aged for different periods were sensory evaluated, and in which consumers who were unfamiliar with cheeses of intense aroma and flavor could not easily recognize sensory differences between samples[24].

Comparison of evaluations by scenario and cheese type identified differences between the different cheese samples for visual attributes. However, for other attributes and perception of price only the 45-d cheese differed from the other types (Table 3).

Table 3: Comparison of sensory attributes by scenarios and cheese type

Attributes	Average*			H	*P*
	GS	FCR	MG		
		Fresh cheese			
Visual	3.86 (a)	3.68 (a)	4.27 (b)	8.98	0.0105
Other	3.48	3.56	3.55	0.09	0.9547
Perception of price	3.13	3.15	3.56	2.37	0.279
		21-d cheese			
Visual	3.99 (ab)	3.72 (a)	4.28 (b)	6.77	0.0315
Other	3.63	3.32	3.48	1.07	0.5824
Perception of price	3.58	2.96	3.63	5.03	0.0652
		45-d cheese			
Visual	4.04 (ab)	3.64 (a)	4.11 (b)	6.07	0.0457
Other	3.93 (b)	3.04 (a)	3.27 (a)	11.25	0.0035
Perception of price	3.97 (b)	2.93 (a)	3.38 (ab)	10.15	0.0046

*Ordinal type measurement scale; average used to illustrate tendency of attribute measurement. H= Kruskal Wallis test; ab Different letters indicate statistical difference ($P<0.05$).

Among the scenarios, FCR attendees gave the lowest evaluations to all three cheeses, much like MG attendees, who found visual attributes to be more important for all cheese types. At the GS, however, attendees gave better evaluations to the other attributes and perception of price for the 45-d cheese. The GS panelists also exhibited more consistent evaluations, with higher ratings as cheese age increased. Trends were not as clear in the MG and FCR scenarios because the most positive ratings were generally given the fresh cheese with ratings decreasing with cheese age. These differences in cheese attribute perception based on cheese age may be explained by variations in panelist characteristics and the possibility that some panelists may have had more regular access to this type of product.

Panelists in the FCR were the most diverse and had the lowest education level while the MG panelists were mostly students and the youngest group on average. Both these groups had lower income than the GS panelists (Table 1). That panelists from lower-income levels may place greater value on the characteristics of fresher cheeses is plausible since fresh cheeses are common in Mexico and are generally cheaper[25,26]. Even though the MG panelists were all studying degrees involving evaluation of local products (e.g. tourism, gastronomy), they still placed more importance on visual attributes. Perhaps this was because they were younger and may not have had the experience necessary to distinguish and evaluate products based on intrinsic properties. Panelists at the GS, in contrast, had higher education and income levels, better fitting the profile of consumers who search for and value unique, quality foods. Consumers of this type typically

appreciate “fine foods” and seek sensory experiences not offered by mass-produced foods (although these can be made with high quality raw materials). Often they purchase their food at markets selling only specialty or artisanal products. It is this greater contact with differentiated products that most probably allows these consumers to evaluate products based on attributes beyond the visual.

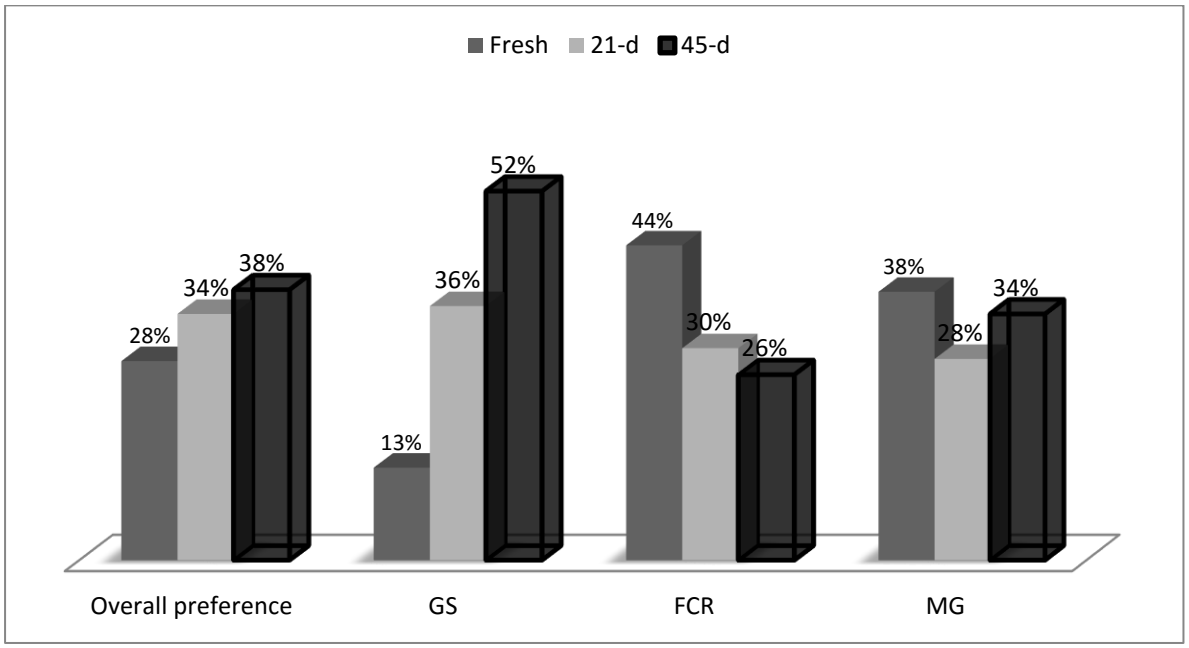
Two types of consumers can apparently be identified among the panelists. The first make choices based on intrinsic attributes associated with a certain degree of knowledge of and experience with a product or similar products; this type is best represented by the GS panelists. The second type largely consider visual aspects, including product appearance, as a kind of codification for making purchase decisions; the MG and FCR panelists best represent this type[6,22].

Perception of price differed notably for the 45-d cheese (Table 3). Taking into account that all three cheese types were assigned the same price, the GS panelists gave a lower valuation to the price of the fresh cheese and a higher one to the 45-d cheese. The latter provided them with a richer sensory experience and they therefore felt it had better value for price than the other types. Among the FCR and MG panelists, the opposite was true in that they gave better valuations to the price of the fresh and 21-d cheeses than to the 45-d cheese. They are presumably not accustomed to products with strong aromas and flavors, meaning the 45-day cheese seemed them expensive.

Comparison of preference results by scenario

An important component of the present study was to evaluate if the perception of attribute results support panelist preference. The preference results suggest the existence of specific consumers for each cheese type. Preferences differed between scenarios (χ^2=8.121; *P*=0.087), particularly between the GS and FCR panels (Figure 1). The former clearly preferred the 45-day cheese while the latter preferred the fresh cheese; the MG panel exhibited no clear preference.

Figure 1: Overall preference by scenario



GS= Gourmet Show; FCR= National Rural Culture Fair; MG= Gastronomic Exhibition.

Consumer preference can also be explained by considering demographic characteristics, consumer accessibility to and frequency of contact with differentiated products, and the influence of the evaluation scenarios on panelist's individual experiences[2]. The preference for a particular cheese was linked with education and income levels (Table 4).

Table 4: Consumer profile characteristics by preferred cheese type

Variable/Preferred cheese type	Fresh cheese	21-day cheese	45-day cheese	Statistic	*P*
Place of origin (%):				X^2=3.866	0.424
Mexico City	24	22.6	29.4		
State of Mexico	44	51.6	58.8		
Other states	32	25.8	11.8		
Age, years	31.12±10.9	27.97±12.3	33.62±13.1	F=1.723	0.185
Gender (%):				X^2=0.404	0.834
Male	48	45.2	52.9		
Female	52	54.8	47.1		
Education, years	14.67±3.7 (a)	14.71±3.2 (ab)	16.82±3.3 (b)	F=4.059	0.021

Occupation (%):				X^2=5.769	0.451
Professional	16	6.5	24.2		
Independent worker	16	16	12.1		
Employee	20	9.7	12.1		
Student	48	67.7	51.5		
Monthly income*	463±255 (a)	467±471 (a)	945±948 (b)	F=4.617	0.013

*US dollars at MXP 18.492/USD 1. Source: Banco de México (http://www.banxico.org.mx/dyn/portal-mercado-cambiario/index.html). Consulted 18 July 2016.

A preference for 45-d cheese clearly coincided with higher education and income levels. The preference per scenario results also support the acceptance tests results, suggesting the existence of two consumer types: one of lower education and income level which accepts and prefers the fresh cheese, these panelists were in a scenario in which gastronomy was presented as an aspect associated with general culture (i.e. FCR); and another of higher education and income levels which accepts and prefers more mature cheeses, these were panelists in a gourmet food event who likely had more specialized sensibilities (i.e. mainly GS panelists). In the MG scenario the preference results did not tend towards a particular type, suggesting that panelists were a mixture of consumer types.

Food choices are also influenced by consumer experience[22]. Considering this the panelists that preferred the fresh cheeses are probably consumers who prefer milder cheeses because they are commonly found in the markets were they shop[24]. Due to the nature of the FCR, the attendees were probably consumers who share characteristics similar to average Mexican consumers; that is, they are more inclined to consume fresh cheese due to its lower price and greater availability[26]. The preferences of the GS panelists highlight that consumption of aged cheeses is more likely limited to those regions of the country where they are produced, making them a traditional food stuff, and to gourmet markets in large urban areas where specialized fairs play a key role in product exposure.

The evaluation scenarios themselves, as an element in the social context that produces individual expectations and experiences, may have influenced the results. They can contribute previous codification that provides indirect information on the expected quality of the products on offer in a specific scenario[2,27]. This may explain why consumers at the GS placed more value on intrinsic attributes and preferred the most aged cheese; they are at an event centered on differentiated gastronomy and they hope to find products offering rich sensory experiences. The FCR, in contrast, is a more general and diverse event including cultural events such as a book fair, food exhibition and handcrafts, and attracted consumers that preferred fresh cheeses. Acceptance of the three cheese types at the MG did not differ, perhaps because the students at the event studied degrees such as tourism and gastronomy, and are thus sensitized to local products, but lacked the knowledge and experience needed to perceive the differences between the cheese samples.

The attribute perception and cheese preference results reflect important aspects of QBO and its potential consumers. These can be analyzed to identify areas of opportunity and improve QBO marketing strategies; for instance, considering cheese maturation days, regional origin and promoting local products at food-agriculture fairs and gastronomic events [28].

Panelists from an apparently higher socioeconomic class preferred the 45-day cheese, highlighting the potential for marketing to this consumer sector within the region where QBO is produced; for instance, the tourist destination of *San Cristóbal de las Casas* is relatively near *Ocosingo*[28]. The other two groups tended to appreciate QBO for its visual attributes and freshness, and were apparently from lower socioeconomic classes, much like the greater part of Mexico's population. This consumer sector can be offered a fresher cheese that also happens to be cheaper, an appealing quality according to the perception of price results.

Purchase intention and willingness to pay a different price for the preferred cheese type

Before information on QBO was provided the panelists they gave the lowest ranking to perception of price (Table 3). Providing product information can transform consumer perception, a tendency reflected in willingness to purchase the product and to pay a preferential value[21,29]. This was observed in all three scenarios; panelists were more willing to buy their preferred cheese type after they had received information on how it is produced (93.5 % in the GS; 87 % in the MG and 74 % in the FCR). Of note is that the GS panelists were willing to pay more than the market price of QBO, those at the MG were willing to pay near the market price and those at the FCR less than the market price. The differences between the willingness of the different groups to pay for their preferred cheese was significant for the fresh and 21-d cheeses and highly significant for the 45-d cheese (Table 5).

Table 5: Comparison between scenarios for willingness to pay for preferred cheese type

Willingness to pay	Average (proportion over base price)*			H	*P*
	GS	FCR	MG		
Fresh cheese	0.15	-0.05	-0.01	4.77	0.0840
21-d cheese	0.12	-0.08	0.00	4.76	0.0833
45-d cheese	0.18 [b]	-0.15 [a]	-0.04 [a]	11.91	0.0022

*Ordinal type measurement scale; average used to illustrate tendency of attribute measurement. GS = Gourmet Show, FCR = National Rural Culture Fair, MG = Culinary Exhibition; H = Kruskal-Wallis test; ab Different letters indicate difference ($P<0.05$).

Willingness to pay a higher price was at least partially associated with panelist purchasing power (Table 5), but could also be attributed to educational level and access to differentiated quality products. Only the GS panelists were willing to pay additional value for any of the three tested cheese types, particularly for the 45-d cheese (18 % additional, on average). In the other two scenarios, in which the lowest income levels were recorded (Table 1), panelists did express willingness to pay for this same cheese type, but at a price below the base price.

Although price and income level clearly influenced purchase decision in the present study, other factors intrinsic to the product may have a greater influence on purchase decision, but this implies that the consumer has the possibility of acquiring knowledge on the product. Flavor is reported to be the most important attribute when determining product quality and willingness to buy a local food as long as the consumer can live the sensory experience. However, when sensory information is not available on a product other factors such as price, brand, packaging and the property of being artisanal or local come into play[2,30,31]. Once panelists had chosen their preferred cheese and expressed their intent to purchase, they were asked about their principal reasons for buying it. Flavor was the main reason for 55.4 % of the panelists, the properties of its being unique and artisanal for 20.7 %, appearance, curiosity and its being a local product for 24 %, and price for just 6.5 %. Overall, for the panelists participating in the sensory evaluation, taste was more important than price, although the prospect of paying added value was conditioned by socioeconomic variables and individual experiences.

Conclusions and implications

Knowledge of consumer tastes and preferences provided by studies like the present allow traditional food producers to access more profitable specialty food markets, and contribute to maintaining traditions. In this case the QBO aged over 21-d was perceived to be richer than fresher types and was highly valued in a gourmet foods market sector. The fresher types also have a market since the largest proportion of panelists preferred them. This variety of artisanal cheese is made with raw milk, meaning that, even though there are consumers who prefer the different types, each type needs to be tested to ensure it meets microbiological quality standards and poses no consumer health risk. The QBO cheese aged 21 d requires longer curd acidification periods, therefore attains lower pH levels and poses a minimal threat to consumer health. The microbiological quality of the fresh cheese is yet unknown and may represent a risk to consumers. This is cause for concern since any pathology linked to consumption of fresh QBO of poor microbiological quality could negatively affect the reputation of the 21-d and 45-d cheeses, which are richer and most likely safe.

Currently a proportionally larger amount of fresh QBO is marketed highlighting the need to conduct research on the minimum curd acidification time required to guarantee the safety of this cheese type.

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