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HONEY CONSUMER'S PERCEPTION: ARE BRAZILIAN CONSUMERS FAMILIAR WITH STINGLESS BEE HONEY?

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Abstract

Stingless bees have a fundamental important role in the economies and traditions of South America indigenous cultures. Are mainly responsible for the pollination of several plant species. This way, the aim was to identify if Brazilian consumers know stingless bee honey and its sensorial characteristics, what is the consumption of this, as well as to generate information to assist in the development of the productive chain of the specie. A closed structured questionnaire with 20 questions was used and the participants were invited via social media. Data were collected in November 2020. The statistical analyses were performed related to the description, characterization of the participants and frequencies. In addition to these,, multivariate analyzes, for word association and questionnaire responses were performed. It is clear that most participants have some confusion between the sensory and physical characteristics of honey from native stingless bees and *Apis mellifera*. This lack of knowledge of the product can cause problems both in the handling of honey for sale and for consumption. Another interference would be linked to the taste, when we highlight the acidity and less sweetness of this pot-honey, and the consumer can often deduce that the product is damaged or not from a good origin. There is little consumer awareness of the benefits and qualities of stingless honey. Many consumers are still unaware of the differences between breeding sites and characteristics of native stingless bees. Still, a large part of these associates the quality of this honey with the honey of *Apis Mellifera*.

Keywords: Health assessment. Human nutrition. Perception profile. Wild bees. Wildlife conservation.

1. Introduction

Brazil has a wide variety of native stingless bees (*Meliponini*, *Apidae*, *Hymenoptera*), and these insects are mainly responsible for the pollination of several plant species (Garibaldi et al. 2013), directly impacting on food production. Stingless bees played a fundamental important role in the economies and traditions of American indigenous cultures (Quezada-Euán et al. 2018) and now its commercial activity is in full growth in Brazil, with the discovery of “new” species to produce honey.

Stingless bees are taxonomically grouped into 32 genera (Souza et al. 2006), being *Tetragonisca, Scaptotrigona, Meliponinae and Plebeia*. The biology of these bees varies between the aforementioned genera, with differences in body size, number of bees per hive, time between laying and the groups cited, among others, that make the management of these species more complex. The unique characteristics that each genus establishes for the construction of honey pots, with different amounts of waxes and resins, sizes, moisture, fermentation times, nectar and pollen gathering from preferred plant species, make this product unique and special. In addition, many bioactive substances have already been found in *Meliponinae* sp. honey (Alvarez-Suarez et al. 2012; Silva et al. 2013), which are associated with antiseptics, anti-inflammatories, antioxidants, promote cell functions in erythrocytes, among others.

This type of honey has its own strong characteristics, with peculiar aromas and flavors, associated with greater moisture and acidity, when compared to honey from Apis mellifera sp., arousing the interest of new consumers, whether for homeopathic preparation or even gourmet cooking. Furthermore, it has the potential to generate income for small producers who, through management techniques, increase the productivity of the hives. Furthermore, they also contribute to the pollination and quality of crops dependent on this pollen dispersal mechanism (Jacob et al. 2019) and, with interest in plants used in human food, such as coffee, tomatoes, eggplant, annatto, coconut, strawberries, guava, cupuaçu, açaí, camu-camu, among others (Abelha 2020).

These bees are more efficient pollinators because they are characterized by exploiting a single floral source for a certain period of time (Slaa et al. 2006), unlike bees of the Apis mellifera species, which pollinate a variety of plant species (Garibaldi et al. 2014), being less specific regarding the floral source. McWatters et al. (2006) cite that to produce or commercialize any product it is necessary to know the preferences of the target consumer in relation to this, testing, questioning, and re-testing to achieve the success of the product. Consumers' shopping perceptions are changing, they are considerably more critical and concerned with consuming healthy and/or functional foods (Kaur and Singh 2017) so, sensory science seeks to understand the behavior and motivations in relation to these products, mainly those that will be launched on the market (Rojas-Rivas et al. 2018), even so, stingless bees do not have a direct preference for any type of flowering plant to produce their honey.

Among the qualitative methods used, the word association technique has been shown to be quite useful for investigating consumers' perceptions. The technique of free word association has gained ground in the sensory and consumption research of a variety of food products in recent years (Pontual et al. 2017; Rosa et al. 2019; Ávila et al. 2020). The aim was was to identify if Brazilian consumers know stingless bee honey and its sensorial characteristics, what is the consumption of this, as well as to generate information to assist in the development of the productive chain of the specie.

2. Material and Methods

Free words association

The free word association technique was carried out through the Google® docs web interface. Participants were invited via social media, in order to reach all regions of the country. A total of 1021 Brazilian consumers participated (53% female and 76% aged between 16 and 45 years). Participants visualized an image related to the object of study and were invited to spontaneously write the first four words, phrases or terms that came to mind. In addition to the free word association, the participants were invited to answer a closed-question survey with questions related to the production, consumption and trade of honey produced by native stingless bees, as well as sociodemographic questions.

Attitudinal questionnaire

The choice and number of participants focused on the search for potential consumers and / or their perceptions of the honey produced by native stingless bees. As instruments for data collection, a closed structured questionnaire with 20 questions was used. Data were collected in November 2020. The survey

used was qualitative, seeking to approach a specific topic and characterized as convenience research (Table 1).

Table 1. Questionnaire on perception, knowledge and preferences about native stingless honey.

Questions	Options
1. What is the preference for consumption of products of animal origin?	( ) Meat ( ) Eggs ( ) Milk ( ) Honey ( ) I'm vegan ( ) Other
2. How often do you consume honey?	( )Daily ( ) Eventualy ( )Weekly ( ) Monthly ( ) Do not consume
3.What is the reason why you consume honey?	( ) It is part of my culture and my family ( ) It is necessary to consume honey, as it brings health benefits ( ) I consume for pleasure
4. Have you heard of stingless native bee honey?	( )Yes ( )No ( )I do not know
5. Have you ever consumed native bee honey without a stinger?	( )Yes ( )No ( )I do not know
6. If so, how was this honey obtained?	( ) Market ( ) Melipolinicultorer ( ) Fair of rural producers ( ) Other ( ) Not applicable
7. Do you know the health benefits of honey?	( )Yes ( )No
8.How do you know, or deduce, that native stingless honey can be consumed?	( ) In the same way as common honey ( ) With fruits ( ) *In natura* ( ) Cakes ( ) Homeopathy ( ) Dishes prepared by chefs ( ) Other
9. Do you think there is a difference between the quality and taste of the honey of the "common" bee (*Apis melifera*) and that of honey from native stingless bee?	( )Yes ( )No ( )I do not know
10. Do you consider animal welfare very important in the honey trade of native stingless bees?	( )Yes ( ) Perhaps ( ) No
11. Do you consider the packaging to be very important in the trade of native bee honey without sting?	( )Yes ( ) Perhaps ( ) No
12. Do you consider the price to be very important in the trade of native bee honey without sting?	( )Yes ( ) Perhaps ( ) No
13. Do you consider easy access to purchase very important in the honey trade with native stingless bees?	( )Yes ( ) Perhaps ( ) No
14. Do you consider the environmental impact to be very important in the honey trade of native bees without stingers?	( )Yes ( ) Perhaps ( ) No
15. Do you consider the quality of honey to be very important in the honey trade of native stingless bees?	( )Yes ( ) Perhaps ( ) No
16. Do you consider crystallization of honey to be very important in the honey trade of native stingless bees?	( )Yes ( ) Perhaps ( ) No

Free words association and attitudinal questionnaire

Only worthwhile words that made sense with the aim of study were considered for data analysis, with the calculation of the frequency of mention of each word. The words cited by at least 5% of consumers were grouped into categories according to the most relevant words associated with the product, or that were recurrent or similar. Words with similar meanings were grouped into different categories by means of inductive triangulation coding (Silva et al. 2014).

Data and words classification were performed by researchers with extensive experience in the word association method, as recommended by Guerrero et al. (2010). The Principal Component Analysis was performed on the covariance matrix of the dimensions evaluated, in order to obtain a sensory map of the consumers' perception regarding the consumption and trade of honey produced by native stingless bees.

The analyzes related to the description, characterization of the participants and frequencies (binomial test) were performed using Jasp® (2021) for Linux® program. Multivariate analyzes, for word association and questionnaire responses, were performed using the SAS® Factor procedure (SAS 2013),

with the choice of the type of analysis (main components or exploratory analysis) according to the data set. SAS OnDemand was used for statistical analysis.

3. Results

Free words associations

The 4999 words cited, whether isolated or in sentences, were 15 dimensions grouped (Table 2). The most related to honey from stingless bees were: health and "sweet" (158 mentions), flavor and honey (141 mentions) and quality (136 mentions). Of these 15 dimensions, for the principal components analysis, those that showed frequency of appearance greater than 15%, were selected. The two main components, obtained in the analysis of the dimensions, explained 100% of the variation (Figure 1). It is noted that, when asked, consumers cited words related to sensory characteristics and health / nutrition in similar opportunities.

Table 2. Frequency of mention of the dimensions, categories and examples of individual associations when participants thought of native stingless-bees honey.

Dimension*	Examples§	Citation frequency§
Sensorials characteristics	Flavor, texture; aroma; candy	43.36
Health/nutrition	Nutritive; healthy; health; life; remedy	38.54
Non sensorials characteristic	Quality; tasty; yummy; beautiful	31.27
Food	Honey; pure	22.81
Environment or ecosystems	Natural, sustainability; preservation	18.49
Value, purchase or consumer market	Expensive; added value; hard access	17.01
Animal references	Bee; species	12.49
Unknown or curiosity	I want to try it;	11.7
Feelings	Childhood; wonderful	11.31
Generalist / comparative	Better than; unusual	11.11
Production types or systems	Family production; low production	11.11
Cultural or regionalist	Exotic; brazilian;	5.01
Coocking	With bread; with fruits; breakfast	3.05
Negative statement	I do not like	1.83
Innovation/research	Genetical enhancement	1.7

§Frequency of dimension citation.

The environment / ecosystem was also mentioned together with the previous ones, but in less opportunities. On the other hand, the type of food (food) showed a negative correlation with the appearance of words related to the price or production of honey. The "Quality" dimension presented a low appearance ratio with the others previously mentioned, which shows that it is remembered, regardless of whether it is associated with other words or, in this case, with the dimensions evaluated.

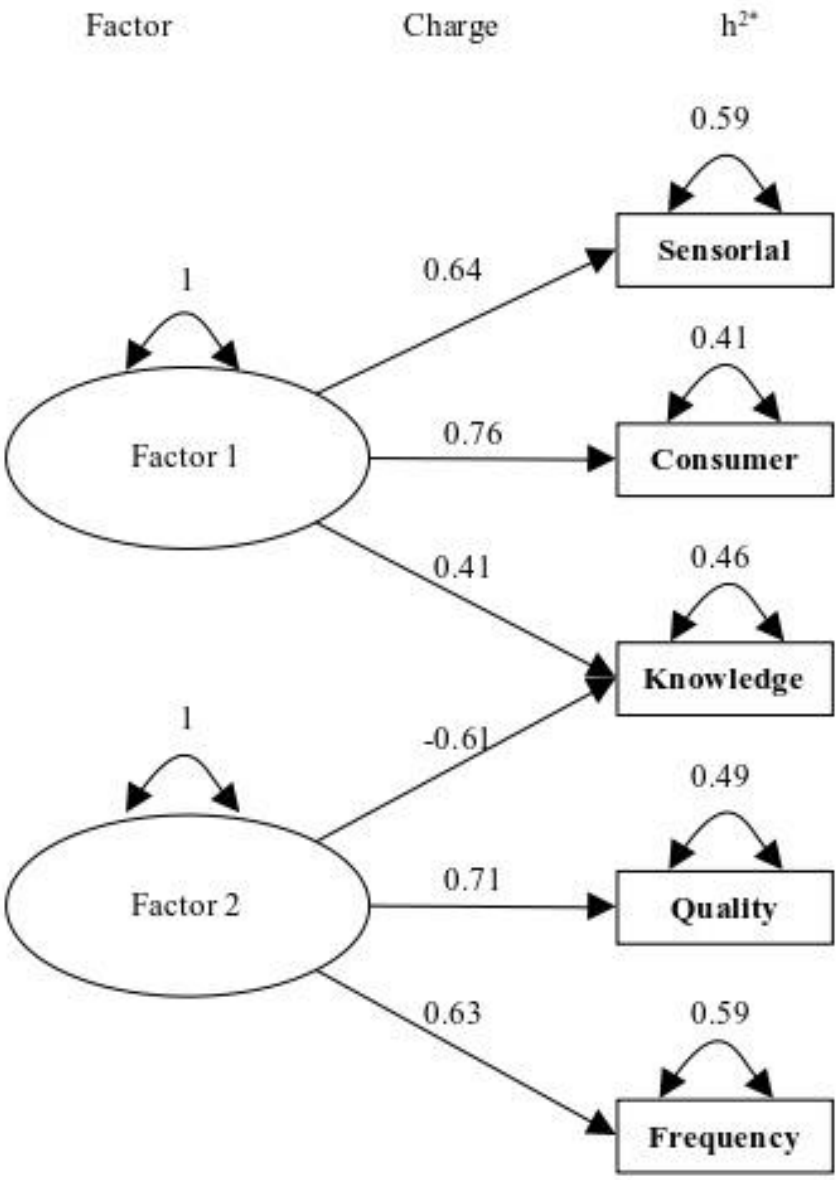

Figure 1. Diagram of paths, load of factors and commonality on knowledge, quality and preferences of stingless native bee honeys; *Communalities (h^2) of the questionnaire items following Varimax rotation.

Descriptive analysis of participants (questionnaire)

The profile of respondents was diverse. A total of 1021 completed questionnaires were obtained and, of these, 3 were discarded for not being answered by residents in Brazil and one for not having answered all the questions that referred to the characterization of the survey. Thus, 1017 people-answers were analyzed, with a greater participation of individuals aged between 16 and 45 years (76.91%; Table 3).

In addition, 80.3% are enrolled in or have higher education or graduate degrees. Regarding home purchases, 83.6% of the individuals evaluated report some participation in this activity. When asked about the preference of products of animal origin, honey was mentioned by more than half of the individuals (Table 4).

Table 3. Characterization of the interviewed volunteers about their perception, knowledge and individual preferences about native stingless honey.

Variable	Counts	Proportion	P-value[§]
Age group			
16-30	409	0.4022	<0.001
31-45	363	0.3569	<0.001
46-60	194	0.1908	<0.001
60+	51	0.0501	0.9427
Gender			
Female	540	0.5310	0.0518
Male	477	0.4690	0.0518
Education level			
Incomplete elementary school	9	0.0088	<0.001
Elementary school	9	0.0088	<0.001
Incomplete high school	19	0.0187	<0.001
Complete high school	163	0.1603	<0.001
University education	376	0.3697	<0.001
Postgraduate	441	0.4336	<0.001
Are you linked or have you ever been to rural areas?			
No	273	0.2684	<0.001
Yes	744	0.7316	<0.001
Household income			
< US$200	64	0.0629	0.0613
US$ 200 to US$ 400	140	0.1377	<0.001
US$ 400 to US$ 700	195	0.1917	<0.001
US$ 700 to US$ 1,000	156	0.1534	<0.001
US$ 1,000 to US$ 2,000	242	0.2380	<0.001
US$2,000 to US$ 4,000	177	0.1740	<0.001
>US$ 4,000	43	0.0423	0.2806
The description that best fits your profile when you shopping for foodstuffs			
“Me”	415	0.4081	<0.001
Somebody at same house	166	0.1632	<0.001
Everyone at same house	436	0.4287	<0.001

[§]Chi-square test.

Still, the interviewees declare, in relation to the honey trade in stingless bees, that the quality of the product and the environmental impact that may occur with the stimulation of honey production are of great importance (Table 4).

Analysis of knowledge and consumption preference (exploratory factor analysis)

Due to the data exploratory factor analysis, the increase in the frequency of consumption tends to have a positive correlation with the quality of stingless honey in relation to *Apis mellifera* sp. (Figure 2), making up the first factor.

Table 4. Frequencies of consumption of products of animal origin, shapes, reasons and difficulties related to the consumption of native bee honeys without sting.

Consumer responses	Frequency[§]	P value[§§]
Consume of animal products		
Meat	0.9233	<0.001
Eggs	0.8741	<0.001
Milk	0.7355	<0.001
Honey	0.5644	<0.001
Others	0.0413	<0.001
The ways to prepare and consume		
In natura	0.8987	<0.001
Fruits	0.7404	<0.001
Cake	0.5674	<0.001
Homeopathy	0.4494	0.0014
Chef's coocking	0.4484	0.0011
Reasons for the participants consume		
Health	0.5251	0.1169
Culture	0.2911	<0.001
Pleasure	0.471	0.0689
Not	0.0708	<0.001
Main access difficulties		
Accessibility at supermarket	0.706	<0.001
Price discount	0.4523	0.0026
Increase the amount of bees breeding habitat	0.528	0.079
Procedence information	0.589	<0.001
Compelling packaging	0.3058	<0.001
Advertising	0.5703	<0.001
Information on nutritional benefits and environmental importance	0.7611	<0.001
Information about breeding and differences between native stingless and "common" bees	0.6332	<0.001

[§]Frequency of citations; [§§]Chi-square test.

4. Discussion

Words association and consumers feelings

Words like taste, sweetness, texture and aroma were mentioned by about half of the participants, followed by words like health, nutritious and medicinal. In times when health has been prioritized, it is increasing the use of honey as a source of soluble carbohydrate to sweeten food and / or drinks, in search of a healthier alternative. However, both physical, chemical and sensory every-type honey characteristics are not constant (Karabagias et al. 2014; Tafere 2021) and are dependent on factors such as producer species, bee flora and all post-honey gathering procedures. As previously mentioned and important to highlight, stingless bees look for flowering and easily accessible species to produce their honey, however, there is no specific preference regarding flowering, in this way, with an infinite number of plant species explored, the honey from these bees does not have its own pattern;

Duried Alwazeer (2015) mentions that the honey is resulting from complex substances contained in honey, derived from the feeding sources of these bees. However, many consumers are unaware of the nutritional properties linked to honey from native stingless bees, or do not know if they have already consumed this product. According to Camargo et al. (2017), this is a unique product because it is more acid and has a higher moisture content, its flavor is peculiar, and its viscosity is lower when compared to *Apis mellifera* honey. Acidity, despite being one of the parameters prioritized by connoisseurs of this type of honey, is extremely variable, even within the same genus, as in the case of *Meliponinae*. This variability directly interferes with consumer acceptance and preference (Souza et al. 2013). When comparing honeys, the product from native stingless bees can have a sugar content up to 15% lower than honey from *Apis mellifera* sp. and has around 25 to 35% moisture content. This moisture content, when the product is not-

well stored, can cause a faster deterioration due to the high probability of fermentation processes (Escuredo et al. 2013).

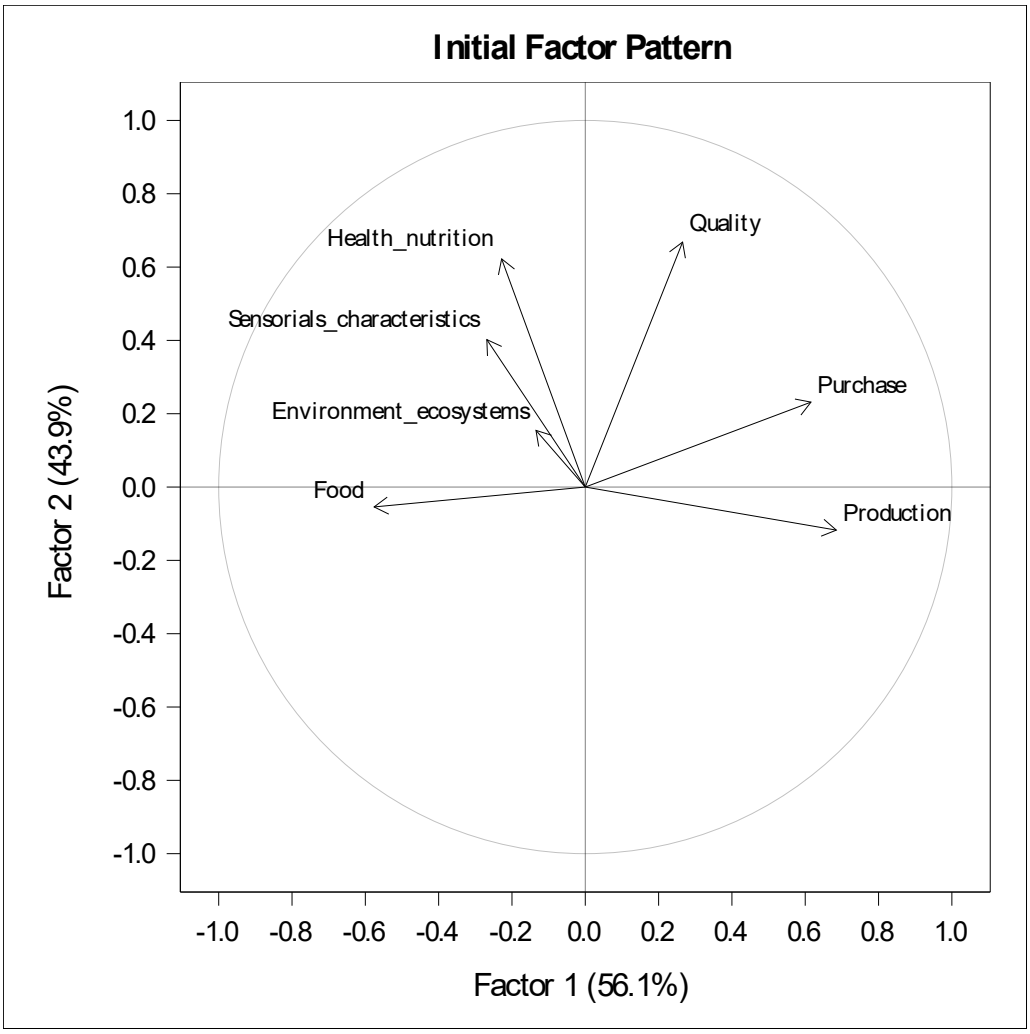

Figure 2. Linear combination of dimensions related to individual perception, knowledge and preferences about native stingless honey.

Although the characteristics cited to health are linked only to nutritional parameters, honey from native stingless bees also has peculiar therapeutic properties such as antimicrobial and anti-inflammatory properties (Bodganov et al. 2008). In addition, vitamins like B-complex are found, which regulate energy production and strengthen the immune system, but, especially, vitamin C is known for its antioxidant function. However, the high moisture content can lead to contamination such as molds, yeasts that, according to Fernandes et al. (2018), may be due to inadequate conditions during the handling and processing of honey or linked to microbiota present in pollen.

Because it is a product that is not widely marketed in Brazil, it often ends up being made available by the melipolin farmer himself, which makes it difficult for consumers to access and know about its characteristics, especially the sensory ones. When comparing apiculture (breeding bees of the genus *Apis mellifera* sp.) and melipoliniculture (breeding bees of subfamily *Meliponinae*), there is a lower productivity of the latter, in addition to melipoliniculture being performed at natural environments and, often, as a hobby of the producer or as a secondary activity of rural properties, mainly family farming. This factor also interferes with the amount of honey produced, which is significantly lower when compared to the production of *Apis mellifera* sp. Despite this, Holanda et al. (2012) cite that this product has high added value.

Due to the breeding in a wild environment, the population of native stingless bees is decreasing in their population, mainly due to the constant burning and wide use of pesticides, directly impacting the food resources of this species (Kerr et al. 2001; Rosa et al. 2015). However, Barbiéri and Francoy (2020)

state that meliponiculture, as a colony maintenance tool, helps to conserve native stingless bees, stimulating and multiplying nests and swarms.

Charactherization of consumer's

The characterization of the consumer's profile is mission-critical, especially in issues such as geographic location, lifestyles, and personality, as these parameters are associated with individual consumption and social status values (Bree et al. 2006; Ribeiro et al. 2009).

There is a great deal of diversification as to how to consume native stingless bees pot-honey, with a greater report for "*in natura*" consumption and with fruits. Among the issues that most hinder the consumption of honey, those evaluated suggest the difficulty in purchasing and publicizing the beneficial properties of the product as the main obstacles. Thus, the evaluated relate the consumption of honey from stingless bees mainly to the health and pleasure that the consumption of this product provides.

Still, the interviewees declare, in relation to the honey trade in stingless bees, that the quality of the product and the environmental impact that may occur with the stimulation of honey production are of great importance (Table 4). According to Villas-Bôas (2017), there is a growing demand for this type of honey by renowned "cuisine chefs", who have been spreading the knowledge about it. Currently, with the consumer's easier access to a differentiated cuisine due to the easy access to programs and social media, products like this, which were unknown before, start to have a spotlight. Saludin et al. (2019) describes that, as the stinglees bees pot-honey consumers can have a peculiar taste, is needed to update and understand the current preferences among them on this product, their expectations on honey quality and the sensory characteristics that influence them to buy stingless bee pot-honey. However, melipoliniculture has much more to offer than just sophistication to the taste. It has a wide participation in income generation for small producers, environmental impact through targeted pollination, which increases the productivity and quality of crops dependent on this pollen dispersion mechanism.

Also, the knowledge about stingless bees is correlated with the two factors obtained. Thus, the relationship between knowledge about these animals, the consumption of its honey and the knowledge of the benefits of consuming it can be observed. As previously mentioned, when relating the data in figure 2 to the association of words, most mistake themselves when the sensory and physical characteristics of pot-honey from native stingless bees and *Apis mellifera* sp. This lack of knowledge of the product can cause problems both in the handling of honey for sale and for consumption.

Due to the legislation in force in Brazil (Brazil, 2000) as the international (FAO, 2008), which does not contemplate the physical-chemical differences of this type of honey and products for qualitative and productive standards, the biggest problem presented in both cases is linked to the high moisture content, which, as explained by Alves et al. (2011), reduces shelf-life and makes it unsuitable for consumption.

Another interference would be linked to the taste, when we highlight the acidity and less sweetness of this pot-honey, and the consumer can often deduce that the product is damaged or not from a good origin. Despite it is ancient use in the Americas and some countries, native stingless bees pot-honey is still a product little known or appreciated by most of the population in Brazil. Barbiéri and Francoy (2020) point out that, even though melipoliniculture is an easily performed activity, it requires a high interaction with the environment from the producer and, coupled with lower production when compared to *Apis mellifera* sp., there is less availability to be offered to the consumer.

There is little consumer awareness of the benefits and qualities of native stingless bees honey. Many consumers are still unaware of the differences between breeding sites and characteristics of native stingless bees. Still, a large part of these associates the quality of this honey with the honey of *Apis mellifera* sp.

5. Conclusions

There is little consumer awareness of the benefits and qualities of native stingless bees honey.

Many consumers are still unaware of the differences between breeding sites and characteristics of native stingless bees. Still, a large part of these associates the quality of this honey with the honey of *Apis mellifera* sp.

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