SAÚDE E AMBIENTE
V.10 • N.1 • 2025 - Fluxo Contínuo

ISSN Digital: **2316-3798**
ISSN Impresso: **2316-3313**
DOI: **10.17564/2316-3798.2025v10n1p596-614**

INTERFACES CIENTÍFICAS

ASSESSMENT OF THE PROFILE OF CONSUMERS OF STINGLESS-BEE PRODUCTS IN COARI, AMAZONAS, BRAZIL

AVALIAÇÃO DO PERFIL DOS CONSUMIDORES DE PRODUTOS DE ABELHAS SEM FERRÃO EM COARI, AMAZONAS, BRASIL

EVALUACIÓN DEL PERFIL DE LOS CONSUMIDORES DE PRODUCTOS DE ABEJAS SIN AGUIJÓN EN COARI, AMAZONAS, BRASIL

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ABSTRACT

This study aimed to outline the profile of consumers of stingless bee products in the municipality of Coari, Amazonas, Brazil. An exploratory cross-sectional study with a quantitative-descriptive approach was conducted. A semi-structured online questionnaire was applied and disseminated through social media. In total, 113 individuals participated in the study, most of whom were female (54.0%), with a mean age of 30.4 ± 8.8 years. Among participants, 98.9% reported purchasing honey, 83.1% stated a preference for stingless bee honey, and 40.4% preferred to purchase it at fairs or markets. However, although this preference exists, only 60.7% of respondents reported being able to distinguish stingless bee honey from that produced by honey bees (*Apis* spp.). Regarding honey consumption, 5.6% of the respondents reported daily consumption, with the main reason for purchase being medicinal use (64.2%). Honey quality (85.4%) was identified as the predominant factor influencing the choice of stingless bee products. This study provides novel and relevant information on the profile and expectations of stingless bee product consumers in Coari, Amazonas, Brazil. It serves as an important database for establishing marketing strategies that may contribute to the growth and development of meliponiculture, the protection of stingless bees, and the strengthening of the local economy.

KEYWORDS

Native bees; Meliponiculture; honey; pollen; Amazonia.

RESUMO

Este estudo teve como objetivo traçar o perfil dos consumidores de produtos de abelhas sem ferrão no município de Coari, Amazonas. Foi realizado um estudo exploratório, de corte transversal, com abordagem quantitativo-descritiva. Aplicou-se um questionário virtual semiestruturado, divulgado por meio de redes sociais. Ao todo, 113 indivíduos participaram do estudo, sendo a maioria (54,0%) do sexo feminino, com idade média de 30,4 ± 8,8 anos. Entre os participantes, 98,9% relataram comprar mel, 83,1% afirmaram preferir o mel de abelhas sem ferrão e 40,4% declararam comprá-lo em feiras ou mercados. No entanto, embora essa preferência exista, apenas 60,7% dos indivíduos informaram conseguir diferenciar o mel de abelhas sem ferrão daquele produzido por abelhas com ferrão (*Apis* spp.). Quanto ao consumo de mel, 5,6% dos entrevistados relataram consumi-lo diariamente, sendo o principal motivo da compra o uso medicinal (64,2%). A qualidade do mel (85,4%) foi apontada como o fator predominante que influencia a escolha dos produtos de abelhas sem ferrão. Este estudo fornece informações inéditas e relevantes sobre o perfil e as expectativas dos compradores e consumidores de produtos de abelhas sem ferrão em Coari, Amazonas, Brasil. Além disso, serve como um banco de dados importante para o estabelecimento de estratégias de marketing que possam contribuir para o crescimento e o desenvolvimento da meliponicultura, a proteção das abelhas sem ferrão e o fortalecimento da economia local.

PALAVRAS-CHAVE

Abelhas nativas; meliponicultura; mel; pólen; Amazônia.

RESUMEN

Este estudio tuvo como objetivo delinear el perfil de los consumidores de productos de abejas sin aguijón en el municipio de Coari, Amazonas, Brasil. Se realizó un estudio exploratorio transversal con un enfoque cuantitativo-descriptivo. Se aplicó un cuestionario virtual semiestructurado, difundido a través de redes sociales. En total, participaron 113 individuos, la mayoría de los cuales eran mujeres (54,0%), con una edad promedio de 30,4 ± 8,8 años. Entre los participantes, el 98,9% informó comprar miel, el 83,1% manifestó preferir la miel de abejas sin aguijón y el 40,4% indicó que prefiere adquirirla en ferias o mercados. No obstante, aunque esta preferencia existe, solo el 60,7% de los individuos declaró poder diferenciar la miel de abejas sin aguijón de la producida por abejas con aguijón (*Apis* spp.). En cuanto al consumo de miel, el 5,6% de los encuestados reportó consumirla diariamente, siendo el principal motivo de compra el uso medicinal (64,2%). La calidad de la miel (85,4%) fue identificada como el factor predominante que influye en la elección de los productos de abejas

sin aguijón. Este estudio proporciona información inédita y relevante sobre el perfil y las expectativas de los consumidores de productos de abejas sin aguijón en Coari, Amazonas, Brasil. Además, sirve como una base de datos importante para el establecimiento de estrategias de marketing que puedan contribuir al crecimiento y desarrollo de la meliponicultura, la protección de las abejas sin aguijón y el fortalecimiento de la economía local.

PALABRAS CLAVE

Abejas nativas; meliponicultura; miel; polen; Amazonia.

1 INTRODUCTION

Honey is a food that humans have consumed for thousands of years. The first records of its use are from more than six thousand years ago, and they appear in cave paintings found at the archaeological site of Cuevas de Las Arañas in Spain (WILSON, 2007). Naturally, it is produced and stored in large quantities by eusocial bees, the honey bees (tribe Apini), and the stingless bees (tribe Meliponini) of the family Apidae. There are at least 538 species of native stingless bees (NSBs) distributed throughout the planet (ASCHER; PICKERING, 2020), of which 246 species are present in Brazil, and approximately half (48.8%, 120 species) of them occur in the state of Amazonas (OLIVEIRA; NOGUEIRA, 2023).

Among the most populous municipalities in the state of Amazonas is Coari, which, according to the latest demographic census (IBGE, 2023), has about 86.713 inhabitants. Because it is located in the middle of the Amazon biome, it has enormous biodiversity and great potential for farming native bees.

The farming of the NSBs is known as meliponiculture (NOGUEIRA-NETO, 1953), an activity that is becoming more popular and which has been gaining great prominence on the world stage due to the easy management of bees, low operating cost, and the possibility of financial returns from the sale of the resulting products (CORREIA-OLIVEIRA *et al.*, 2010). Another important aspect of this activity is its low environmental impact, which contributes to the preservation of biomes in addition to generating employment and income (BARROS *et al.*, 2020; SANTOS *et al.*, 2020c).

According to the Brazilian industrial and sanitary inspection regulations of animal-origin products the NSB produces pot-pollen, and honey. NSB pollen results from the agglutination of floral pollen with nectar and salivary substances from NSBs, which are collected from cerumen pots. NSB propolis is derived from resinous, gummy, and balsamic substances that NSBs harvested and to which bees add salivary secretions, wax, and pollen. NSB honey, on the other hand, can be produced from nectar, plant secretions, or insect excretions, which are processed and stored by NSBs in wax pots (BRASIL, 2017).

The main product of meliponiculture is honey since it is highly appreciated by the consumer market and is widely marketed (ELIAS-SANTOS *et al.*, 2013; CHUTTONG *et al.*, 2016). NSB honey generally has sensory and physicochemical characteristics that are different from *Apis mellifera*

honey, such as a more acidic taste, which is related to the natural fermentation process; greater fluidity due to its high moisture content; in addition to less sweetness, which makes it less cloying (NORDIN *et al.*, 2018). There is great potential for the use of honey by the food, cosmetic, and pharmaceutical industries since it has antioxidant, expectorant, anti-inflammatory, antibacterial, and healing properties (ÁVILA *et al.*, 2018).

The marketing of honey depends on the consumer's assessment of the quality, safety, and purity of the product (PASIN *et al.*, 2012; CAMARGO *et al.*, 2017), and dietary behavior goes beyond the evaluated criteria (quality, safety, and purity) and also involves the selection, acquisition, conservation, preparation, beliefs, taboos and knowledge about the nutritional aspects of the product (SONATI *et al.*, 2007).

In this sense, analyzing the profile of consumers of a product is a very effective marketing strategy, as it can enable the understanding of consumer desires and needs, thus increasing the chances of success for both the product and the producer (MCWATTERS *et al.*, 2006). In addition, we did not find official information on the production and marketing of NSB honey in the Brazilian states and at the national level, which reinforces the need for studies such as this one. In this context, knowledge of the consumer market for NSB honey in the municipality of Coari, Amazonas, habits regarding its purchase and consumption, preferences and requirements, as well as knowledge about NSBs and their products, becomes important to understand the market requirements. Also, this information can be used to improve the meliponiculture production chain and to establish efficient marketing strategies. Here, we aim to analyze the preferences and expectations of buyers/consumers of honey from stingless bees in Coari, Amazonas, Brazil.

2 MATERIALS AND METHODS

This study employed an exploratory cross-sectional quantitative-descriptive approach that aimed to evaluate the profile of consumers of NSB honey in the municipality of Coari, Amazonas. Data was collected in the second half of 2021 via a semi-structured questionnaire (available on the virtual platform Google Forms) created using questions applied in previous research on the study topic (LIMA *et al.*, 2019). The questionnaire was available for four months, and through social media, the target audience was invited to participate in the survey.

The questionnaire included closed questions, encompassing the following information: a) socio-economic data like age, sex, race/color/ethnicity, civil status, location and zone of residency in the municipality of Coari, number of people living in the same house, monthly family income, occupation, and level of education; b) it evaluated the level of knowledge about NSBs and their products; c) it measured the purchasing habits regarding NSB products and consumption habits regarding NSB products.

The target population of the research was composed of individuals living in the municipality of Coari, of either sex, aged between 20 and 64 years, and who agreed to participate in the study voluntarily after signing the free and informed consent form. Participants who left any question unanswered were excluded from the study.

To calculate the sample, we adopted the confidence level of 95%, margin of error of 9%, proportion of the population equal to 50% adapted from Ribeiro Júnior *et al.* (2020) and population size estimated at 35.803 individuals in the last census, considering the age range of the target audience (IBGE, 2023). The sample size was calculated using the following formula:

$$n = \frac{Z^2.\ p\ .(1-p)}{e^2} \cdot \frac{N}{N + \frac{z^2.p\ .(1-p)}{e^2} - 1}$$

Where:
n = Sample size
N = Population size
Z = Value of the standard normal distribution for the desired confidence level
p = Estimated population proportion
e = Desired margin of error

It was defined that the sample number (n) was equal to 119 individuals. For the results of purchase and consumption of NSB products, an "n" equal to 89 individuals was used, disregarding interviewees who stated that they did not buy or consume NSB products.

The data obtained in the study were tabulated in an electronic spreadsheet using the Microsoft Office Excel® software (version 2016) and organized in graphs built on the GraphPad Prism® software (version 8.0.2). Data was analyzed using descriptive statistics, and the results were presented as absolute and relative frequency.

This research was approved by the Research Ethics Committee (REC) of the Federal University of Amazonas (UFAM), under approval n° CAAE 46370121.4.0000.5020.

3 RESULTS AND DISCUSSION

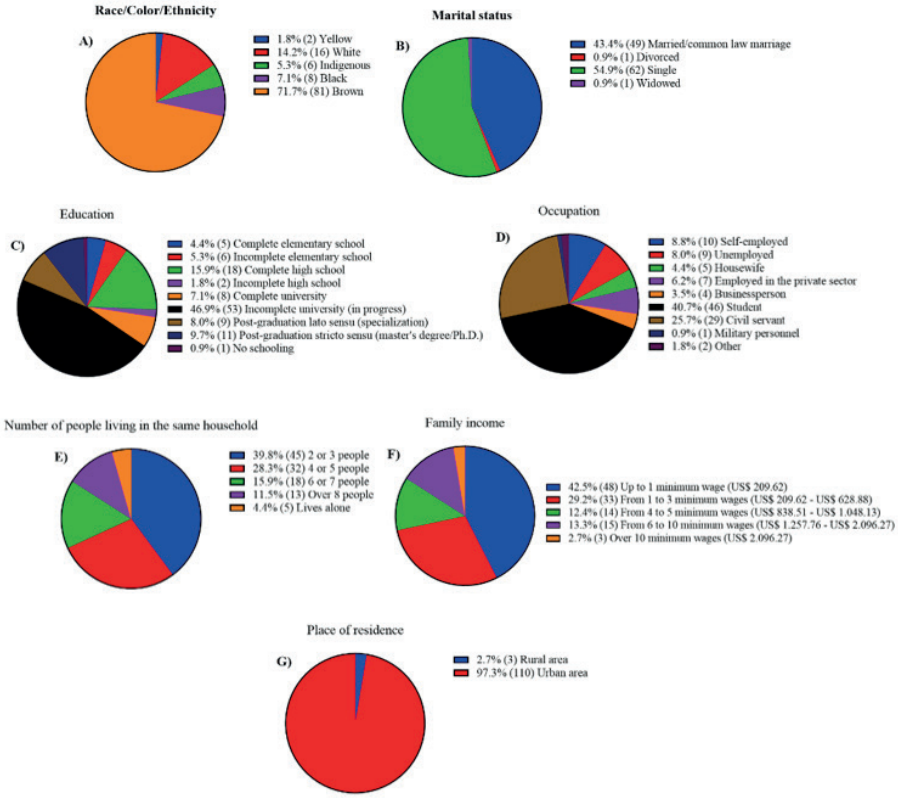
3.1 Socio-economic characterization of the research participants

One hundred and thirteen (113) individuals participated in the research, which equates to 95.0% of the calculated sample. The female sex was more predominant (54.0%) and had a mean age of 31.7±9.9 years (minimum 21 and maximum 64 years); males were 46.0% of the participants and had a mean age of 29.0±7.0 years (minimum 20 and maximum 50 years). The general mean age of the participants, of both sexes, was 30.4±8.8 years (minimum 20 and maximum 64 years).

Most participants declared to be brown-skinned (71.7%) (Figure 1A). Additionally, most participants declared themselves to be single (54.9%) (Figure 1B); in contrast, in the municipality of Terra Alta, in the state of Pará, Lima *et al.* (2019) reported that honey consumption is higher among married people. Most survey participants declared that they were a student (40.7%). Regarding the educational level of the participants, most were in higher education (46.9%) (Figure 1C and 1D). Cavalcante *et al.* (2019) analyzed the consumer market for meliponiculture products in the municipality of Tefé

in Amazonas State, and it was reported that 67.0% of respondents had a level of education up to complete high school. Santos *et al.* (2020a) reported that low education is related to the increase in honey consumption when associated with diseases. This relationship can be explained by the limited knowledge about the benefits of honey as a food, especially regarding its nutritional properties, which leads individuals with lower educational levels to use it mainly for its medicinal and therapeutic effects. Furthermore, knowledge derived from traditional or empirical practices further contributes to honey consumption and does not require a high level of formal education, reinforcing the strong influence of cultural and experiential factors in shaping consumption habits.

Figure 1 - Socioeconomic profile of research participants, comprising consumers of stingless bee products in Coari, Amazonas, Brazil, in 2021.



Source: Research data

We found that 97.3% of the participants were residents of the urban area of Coari (Figure 1G), which was also observed in other studies in other cities in Brazil, in which consumers were more engaged

in the urban area (CAVALCANTE *et al*., 2019), probably because of the access of internet and social media. It is worth mentioning that, in the rural area of Amazonas state, internet access is extremely limited or practically non-existent, which makes it impossible for greater participation of the population in surveys using electronic questionnaires.

Among the participants, 39.8% share a household with two or three people and have a monthly family income of up to one minimum Brazilian wage (42.5%) (Figures 1E and 1F). In Ubaíra city in Bahia State, individuals with a monthly family income of up to four minimum Brazilian wages have the highest consumption of *Apis mellifera* honey compared to individuals with an income greater than four minimum wages (SANTOS *et al*., 2020b).

3.2 KNOWLEDGE REGARDING NSBS AND THEIR PRODUCTS

Regarding the term "meliponiculture", 65.5% of the interviewees reported having never heard of it (Table 1). Most people who reported knowing the concept of meliponiculture obtained this knowledge through the media (Table 1).

The majority of participants (68.1%) stated that they had already heard about NSBs (Table 1), with honey being the most cited product as known (63.4%), followed by pollen (12.4%) and propolis extract (12.4%) (Table 1). Such findings are supported by those found in the study by Cavalcante *et al*. (2019), in which 100% of respondents said they had already heard of NSBs.

Although most participants know NSB products, this knowledge is little related to meliponiculture. It should also be noted that a considerable percentage of participants live in urban areas, and this lack of knowledge regarding the term meliponiculture, rather than about nature itself, may have a greater incidence in more distant places, such as rural areas (SANTOS *et al*., 2020a).

Table 1 - Data on interviewees' knowledge of meliponiculture and its products in the municipality of Coari, Amazonas, Brazil, in 2021. *Multiple responses were accepted.

Variable	Absolute Frequency (n)	Relative Frequency (%)
Do you know what meliponiculture is?		
No, I have never heard of it	74	65.5
Yes, Meliponiculture is the keeping of stingless bees	39	34.5
Means of communication*		
Reports	31	23.0
Courses	7	5.2
Lectures	12	8.9
Videos	11	8.1
I do not know what meliponiculture is	74	54.8

Variable	Absolute Frequency (n)	Relative Frequency (%)
Have you ever heard of stingless bees?		
No	36	31.9
Yes	77	68.1
What products from stingless bees do you know of?*		
Honey	102	63.4
Pollen	20	12.4
Propolis extract	20	12.4
Geopropolis	1	0.6
Wax	8	5.0
None	10	6.2

Source: Research data

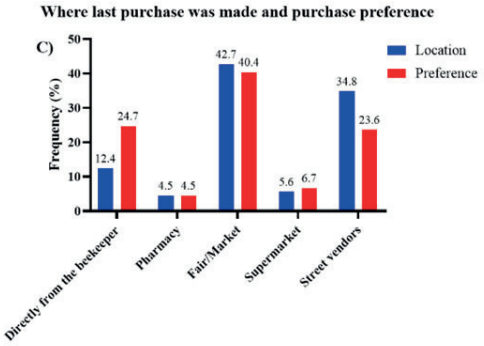
3.3 PURCHASING HABITS REGARDING NSB PRODUCTS

Of the total participants, 89 (78.8%) of the interviewees cited the habit of buying and consuming NSB products. The other 24 (21.2%) did not have such habits. This finding indicates that stingless bee honey is a prominent product in the local market of Coari, which may be explained by cultural knowledge and the value attributed to the product. Similar results were reported by Lima *et al*. (2019), who pointed out that most respondents (85%) in the municipality of Terra Alta in Pará State in Brazil had the habit of buying and consuming honey; however, 65% bought it infrequently. These results suggest that, despite local differences among municipalities, the consumption of meliponiculture products in the Amazon region is primarily positively influenced by traditional knowledge and local product availability, rather than by purchasing habits.

Honey was the most easily found (100.0%) and most often purchased (98.9%) product compared to the other NSB products. In the municipality of Tefé in Amazonas State, the products that were best known to consumers, in descending order, are honey, pollen, geopropolis, and wax, with honey from *Melipona subnitida* being the product that people would like to find more easily (CAVALCANTE *et al*., 2019).

Concerning the place of their last purchase, an expressive proportion of consumers (42.7%) acquired the products in fairs/markets, and these same places are preferred by a large number of consumers (40.4%) for the acquisition of products (Figure 2). In the municipality of Barreiras in Bahia State, Brazil, Alves *et al*. (2021) reported that 43.6% of people acquire honey directly from the producer. In the municipality of Coari, there are few stingless beekeepers; in addition, market traders buy honey from stingless beekeepers to resell at fairs and markets. Costa Junior *et al*. (2006) found that consumers in the cities of Crato and Juazeiro do Norte, Ceará State, have a preference for buying from producers, as they believe that honey purchased directly from them reduces the chances of adulteration of the product.

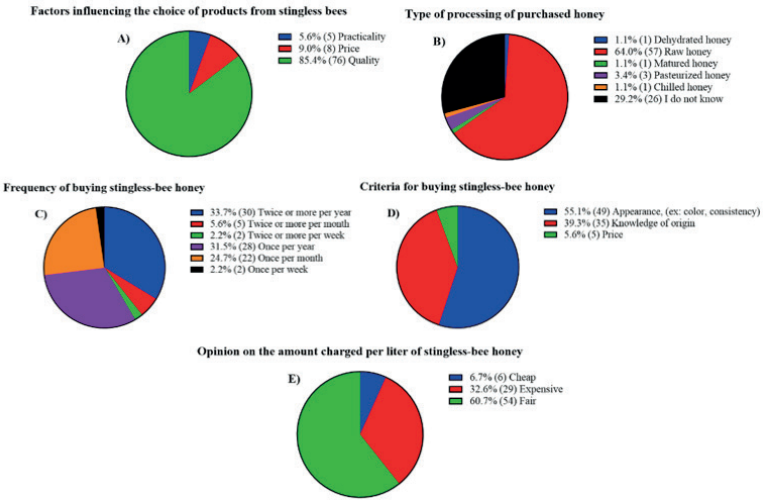
Figure 2 - Data on interviewees' purchasing habits in relation to stingless-bee products in Coari, Amazonas, Brazil, in 2021.



Source: Research data

Of the factors influencing the choice of NSB products, quality stands out (85.4%) (Figure 3A). Hygienic-sanitary quality throughout the meliponiculture chain is another important aspect regarding the stingless beekeepers when purchasing the product. According to Villas-Bôas (2012) and Pereira *et al*. (2017), an innocuous product for consumers' health is a good management practice throughout the production chain. Such care guarantees the supply of a quality product to the consumer. Venturieri (2008) also observed that the better the quality of honey and the absence of adulterations and contamination, the greater the demand for the product.

Figure 3 - Information on the purchase of stingless-bee products in Coari, Amazonas, Brazil, in 2021.



Source: Research data

Some people choose to buy directly from the producer due to environmental and social issues and the hard work of beekeepers. Furthermore, by purchasing directly from the producer, it is possible to find a more affordable product than, for example, in pharmacies or other establishments, where additional costs are added for profit. Meliponiculture is paramount for preservating native flora since bees are crucial in pollinating the forest and essential crops for human consumption, such as cashews, tomatoes, and coffee. In addition to their influence on the forest, bees also significantly impact various other ecosystems and natural spaces, promoting pollination, maintaining biodiversity, and supporting ecological balance, as well as contributing to the local bioeconomy (CORREIA-OLIVEIRA *et al.*, 2010; OLIVEIRA *et al.*, 2017; SANTOS *et al.*, 2020c). As such, we can highlight the importance of a bond of trust between consumers and producers and emphasize the importance of propagating correct information about bee products.

Regarding purchasing preferences, most participants (64.0%) usually buy raw honey (Figure 3B). Silva *et al.* (2009) reported that the most sought-after and purchased honey are those of organic origin, especially those with the seal attesting that the product is organic. However, this is separate from the reality of the municipality of Coari, where most of the honey marketed does not usually have labels. According to the Agricultural and Forestry Defense Agency of the State of Amazonas (ADAF - Agência de Defesa Agropecuária e Florestal do Estado do Amazonas), only three producers had a seal of inspection issued by the agency for stingless bee honeys in the state of Amazonas (ADAF, 2021). The labels contain important information about the product, such as the list of ingredients, origin, shelf life, net content, batch, and nutritional table, which helped the consumer at the time of purchase (SANTOS *et al.*, 2020a; LIMA *et al.*, 2021). Therefore, the labels aim to provide more information and safety to the consumer.

The frequency of purchase of NSB honey for 33.7% of consumers in Coari was two or more times per year (Figure 3C). On the other hand, the average purchase of consumers in the municipality of Tefé in Amazonas State was twice a year (CAVALCANTE *et al.*, 2019). The main criterion used to purchase NSB honey was appearance (color and consistency) (55.1%) (Figure 3D). The result differs from the study by Alves *et al.* (2021), who reported that the product's origin was the most adopted criterion when buying honey. However, the interviewees did not mention any labeling that attested to the product's provenance. As in our study, Costa Junior *et al.* (2006) also reported that appearance, color, and density are the criteria that stand out at the time of purchase.

In Coari, the average price paid for a liter of honey in the last purchase was US$ 8.15±US$ 4.03 (minimum US$ 1.90 and maximum US$ 22.86 reais); however, people would like to pay on average US$ 6.80±US$ 4.20 (minimum US$ 1.90 and maximum US$ 22.86 reais). Most respondents (60.7%) said the price charged per liter of honey is fair (Figure 3E). These data corroborate the data obtained in the study by Cavalcante *et al.* (2019), in which the average price per liter of honey in the municipality of Tefé in 2016 was US$ 10.25, and most of the respondents thought it was a fair price.

With the coronavirus pandemic (SARS-CoV-2), several changes occurred in the social and economic sphere, negatively impacting food production, distribution and supply. Such problems imply inflation in food prices, as demand and production costs increased, which also occurred with the

honey of NSBs (SCHNEIDER *et al.*, 2020; BACCARIN; OLIVEIRA, 2021). From 2022 onwards, a liter of honey in Coari began to be sold for US$ 19.05 and reached US$ 38.11 in Manaus in Amazonas State.

3.4 NSB HONEY CONSUMPTION HABITS

Regarding the reason for buying NSB honey, the results of the present study indicated that, in Coari, honey is mainly used as a medicine (64.2%), with consumption on its own being prioritized (48.3%) (Table 2). This information is corroborated by the studies of Silva, J.R. *et al.* (2018) and Cavalcante *et al.* (2019), who also reported the primary use of honey as a remedy. Other studies also report that the main purpose of honey is as a medicine, whether on its own or mixed with medicinal herbs, mainly due to pharmaceutical properties such as healing, expectorant, antioxidant, antibacterial, and anti-inflammatory properties (ÁVILA *et al.*, 2018; SILVA, M.G.C. *et al.*, 2018; CAVALCANTE *et al.*, 2019).

Table 2 - Information on the consumption of stingless-bee products in Coari, Amazonas, Brazil, in 2021. *Multiple responses were accepted.

Variable	Absolute Frequency (n)	Relative Frequency (%)
Purpose of use of honey from stingless bees*		
Nutritional	28	23.3
Cosmetic	9	7.5
Religious	1	0.8
Medicinal	77	64.2
Other	5	4.2
Formo f consumption of honey from stingless bees		
Added to Other foods	9	10.1
Sweetener in drinks	2	2.2
Mixed with medicinal herbs	35	39.3
On its own	43	48.3
Frequency of consumption of honey from stingless bees		
Daily	5	5.6
Twice or more per year	18	20.2
Twice or more per month	20	22.5
Twice or more per week	17	19.1
Once per year	6	6.7

Variable	Absolute Frequency (n)	Relative Frequency (%)
Once per month	13	14.6
Once per week	10	11.2
Estimated annual honey consumption of stingless bees		
100 mL to 500 mL	32	36.0
600 mL to 1L	41	46.1
2 L to 4 L	13	14.6
5 L to 7L	2	2.2
8 or more liters	1	1.1

Source: Research data

Regarding the frequency of consumption, 22.5% of the participants reported consuming NSB honey two or more times a month (Table 2). Santos *et al*. (2020a) reported that the frequency of consumption varies according to family income. Individuals with incomes of greater than four minimum wages have low honey consumption when treating illnesses.

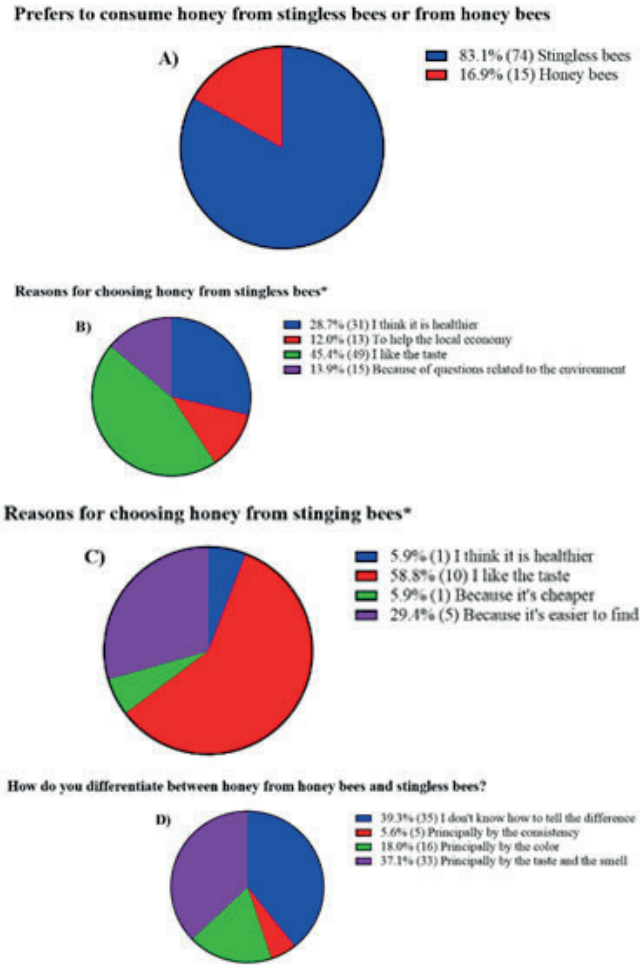
Regarding the annual estimate of NSB honey consumption (Table 2), 46.1% of consumers reported consuming 600 mL to 1 L of honey annually. Data on NSB honey consumption in Brazilian states remains to be limited. The consumption of honey from honey bees is better known. In 2020, world consumption was estimated at 1,904,131 tons, about 0.245 kg/per capita per year (FAOSTAT, 2020). Queiroga *et al*. (2015) highlight that the per capita consumption of honey in Brazil is much lower than in European countries, such as Switzerland and Germany, whose consumption is 2.4 kg/per capita per year.

When asked about the preference between NSB honey (e.g., *Melipona seminigra* – Uruçu and *Melipona interrupta* – Jupará) and honey from honey bees (e.g., *Apis mellifera* - African, Italian, European), 83.1% of participants said they preferred NSB honey, with 45.4% of people justifying their response by liking the taste and 28.7% by finding it healthier (Figure 4A, 4B and 4C).

Studies on the composition and health effects of NSB honey have become more frequent in recent yearsv (MARIUTTI *et al*., 2021). Fletcher *et al*. (2020) analyzed five samples of NSB honey from five different species and three continents (Australia, Malaysia, and Brazil). The authors identified the presence of the disaccharide trehalulose, an isomer of sucrose, the main component of honey, representing between 13 and 44 g per 100 g of each honey analyzed. Trehalulose has a sweetness power 70% higher than sucrose; however, its absorption is much slower. Trehalulose is attributed to beneficial properties for health, such as antidiabetic, anticariogenic, and antioxidant activity.

Regarding differences perceived by consumers between NSB honey and honey from honey bees (Figure 4D), 39.3% do not know how to differentiate the honey, followed by those who differentiate them mainly by flavor and aroma, color, and consistency.

Figure 4 - Perception and preferences of consumers in relation to honeys from stingless bees and honey bees in Coari, Amazonas, Brazil, in 2021. *Multiple responses were accepted.



Source: Research data

These results demonstrate a great potential to be explored, especially by stingless beekeepers, who can increase the sale of NSB products through knowledge of the market, its trends, and product characteristics to understand better and increase the value of the meliponiculture production chain. Formulating strategies such as meetings of stingless beekeepers, training events, and interactive lectures on NSB products with the community in general, etc., can be efficient strategies to reach new consumers.

Another key point to leverage meliponiculture is the incentive and directing of public and private resources in favor of the qualification of the production chain. According to Santos *et al.* (2021), the

Brazilian government can use the identification of areas of systematic conservation planning (PSC) as a strategy to encourage new meliponiculture projects, create support centers, and provide technical training, which would enable beekeepers to sell products nationally and internationally, thus ensuring the quality and purity of the product, as well as the sustainable management of NSB.

The Socio-Environmental Institute located in the Xingu indigenous reserve and the Brazilian Agricultural Research Company (EMBRAPA) are some of the non-governmental and governmental agencies, respectively, that have proposals that cover meliponiculture and its technical assistance, with emphasis on EMBRAPA (BARBIÉRI; FRANCOY, 2020; SANTOS *et al.*, 2021). At a global level, we can also observe the payment program for ecosystem services (PPES) and conservation of genetic resources as a possibility of encouraging meliponiculture, which consists of rewarding stingless beekeepers who use appropriate practices in the production chain or who have shown innovation about regional management in regards to the preservation of threatened bee species (KRISHNA *et al*. 2013; SANTOS *et al.*, 2021).

Such incentives increase the potential and meet the needs of the production chain and generate a positive impact for the qualification and rise of meliponiculture, with a positive reflection on generating employment, income for families, supply, and preservation of the environment, in addition to providing consumers with a certified product.

5 CONCLUSION

Stingless bee honey is the most easily found and sold NSB product in Coari city in Amazonas State in Brazil. Stingless bee honey is not only readily sought after by consumers for its taste but also valued for its quality. Furthermore, consumers demonstrate significant awareness and support for environmental conservation initiatives. In this context, meliponiculture emerges as a promising activity for the municipality of Coari, Amazonas, driving sustainable development and ensuring financial returns.

ACKNOWLEDGMENTS

The authors would like to thank the Fundação de Amparo à Pesquisa do Estado do Amazonas (FAPEAM) for the financial support granted through the Programa de Apoio à Interiorização em Pesquisa e Inovação Tecnológica no Amazonas (PAINTER) and for the scientific initiation scholarship granted to the first author of the article (PIB-MULT/0011/2021- PIBIC/UFAM - PAIC/FAPEAM).

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Recebido em: 11 de Março de 2025
Avaliado em: 7 de Outubro de 2025
Aceito em: 17 de Dezembro de 2025

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