

## Article

Received 27 Dec 2010  
Accepted 8 Mar 2011  
Available online 24 Jun 2011

### Keywords:

*Apis*  
free-choice profile  
honey  
Huottuja  
Meliponini  
sensory analysis

ISSN 0102-695X  
<http://dx.doi.org/10.1590/S0102-695X2011005000115>

# How a Huottuja (Piaroa) community perceives genuine and false honey from the Venezuelan Amazon, by free-choice profile sensory method

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**Abstract:** Pot honey is the most abundant honey in the forest, produced by many species of stingless bees (Meliponini) of the Huottuja (Piaroa) community in Paria Grande, Venezuela. However, the commercialization of this honey is low, and false honeys, which are sold in labelled bottles, are easily found in the market. This study has investigated the ability of an untrained panel of Piaroa assessors to differentiate the genuine from the false pot honey using the Free-choice profile. This sensory method allows consumers to use their own words to describe and to quantify sensory attributes of a product. The genuine honeys, light amber *Melipona fuscopilosa* "isabitto" and dark amber *Tetragona clavipes* "ajavitte", the false light and dark "angelita" honeys, and the amber *Apis mellifera* honey, were evaluated. Sensory attributes related to the appearance, color, odor, flavor and mouthfeel were elicited in a qualitative session and were quantified in 10-cm unstructured line scales using individual score sheets. The data were analyzed by Generalized Procrustes Analysis (GPA). The bidimensional plot successfully separated genuine from false pot honeys. The first dimension (39.50%) was represented by the low viscosity, fermented odor and sour taste, whereas the second dimension (24.69%) was related to fruity and honey odor and flavor. Huottuja assessors differentiated the five honey types in terms of the perceived sensory characteristics.

## Introduction

Honey standards from Brazil (Ministério da Agricultura, 2000) and Venezuela (Covenin, 1984) were produced only for *Apis mellifera*, following the guidelines of international standards of the *Codex Alimentarius* Commission (1969, 1987, 2001). However, stingless bees also produce honey. They differ from *A. mellifera* at the subfamily level known as Meliponini (Michener, 2000). A proposal for quality standards for meliponine honey was presented few years ago (Vit et al., 2004; Souza et al., 2006) and was inserted for the first time in a honey standard by the Colombian regulations (Norma Técnica Colombiana, 2007). This honey is produced primarily by *Melipona*, *Scaptotrigona* and *Tetragonisca* (in America), *Meliponula* (in Africa), and *Tetragonula* (in Asia and Australia). There are around sixty genera of stingless bees (Rasmussen & Cameron, 2010), with 391 Neotropical species groups (Camargo & Pedro, 2007), and more than 500 are estimated worldwide.

Huottujas are an ethnic group of Amerindians in Venezuela (Melnik & Bell, 1996) known as piaroas by the public. The Huottuja community in Paria Grande, located about 30 km to the South of the city Puerto Ayacucho, capital of the Amazonas State, has organized a cooperative of meliponiculture since 2005, and call its honey as "mayá". Instead of honey hunting, they keep and multiply feral colonies in rational hives. Both local horizontal layout, and vertical hives that facilitate colony division, after the Brazilian experience (Villas Bôas, 2008) are used (Figure 1). Different stingless bee species exploit resources according to their honey, pollen or propolis yields (Kerr, 1987). Native people know that and use stingless bee products accordingly. After harvesting the honey, the cerumen pots are used to handcraft ceremonial Huottuja masks, and souvenirs. Honey was previously pressed but now is extracted with a syringe.

Sensory attributes of honey stored in pots by Meliponini have been investigated by several authors in the past (Schwarz 1948; Gonnet et al., 1964). Kidder



Figure 1. A meliponary from the Paria Grande, Amazonas State, Venezuela.

& Fletcher (1857) suggested that the sour honey of Brazilian stingless bees “will compensate for sweet lemons”. However, no study was carried out using any population from the Venezuelan Amazon to describe pot honey sensory attributes. This work aimed at investigating the genuine and false pot honeys from the Venezuelan Amazon as well as the comb honey by using the sensory Free-choice profiling (FCP) method by local people named Huottuja.

## Materials and Methods

### Honey

Two artificial honey samples (light and dark) were purchased at the local market in Puerto Ayacucho, Venezuela, named as “angelita”, which is the common name given to *Tetragonisca angustula* honey. Salesmen informed that the light honey came from yellow flowers and the dark honey from purple flowers. Both honeys were bottled in a recycled glass container from a Colombian aguardiente distilled drink, and had a label. These honeys had the thick syrup visual appearance of artificial honeys. One of them had an ant inside, pretending to be a stingless bee. The insect inside the bottle is a local practice in false honey, also seen in the Venezuelan Andes. Two genuine meliponine honeys were provided by a local stingless beekeeper. These samples were already harvested and kept refrigerated. Entomological samples of these bees were kindly identified in the past at Universidade de São Paulo in Ribeirão Preto, Brazil. The five honey samples are described in Table 1.

The light amber honey was produced by “isabitto” *Melipona fuscopilosa* and the dark amber was produced by “ajavitte” *Tetragona clavipes*. The genuine and the false honeys are shown in Figure 2. Additionally, we used a reference honey of *Apis*

*mellifera*. The two bottles on the right are genuine *M. fuscopilosa* (isabitto) and *T. clavipes* (ajavitte) honeys. On the left side the two labeled angelita (name given to *Tetragonisca angustula*) false honeys, putatively originated from purple and yellow blooming. In the middle is the *A. mellifera* honey extracted from combs.

Table 1. Description of honey samples.

| No. | 3-digit | Local name             | Entomological identification | Origin                      |
|-----|---------|------------------------|------------------------------|-----------------------------|
| 1   | 408     | Angelita (dark honey)  | False honey (not bee made)   | Town market Puerto Ayacucho |
| 2   | 335     | Angelita (light honey) | False honey (not bee made)   | Town market Puerto Ayacucho |
| 3   | 120     | Abeja                  | <i>Apis mellifera</i>        | Nature shop                 |
| 4   | 510     | Isabitto (light honey) | <i>Melipona fuscopilosa</i>  | Paria Grande forest         |
| 5   | 252     | Ajavitte (dark honey)  | <i>Tetragona clavipes</i>    | Paria Grande forest         |



Figure 2. Stingless bee honeys from the Venezuelan Amazon, in Paria Grande.

### Assessors

A group of eight honey consumers, three females and five males, aged between 15 and 45 years old, from Paria Grande, a native Amerindian community took part in this study. They were selected based on their nutritional interest on honey, curiosity, commitment, availability and motivation. None of them had previous experience with sensory analysis, but all were familiar with forest pot honey. Their sense of smell was not altered by smoking, allergies, flues, or insomnia. The sessions took place in the morning, 2-3 h after breakfast. Their participation was voluntary and only rewarded with the pen they used to fill the forms. An informed consent form was filled prior to the sensory sessions.

### Sensory evaluation

In the first session, assessors received a briefing of the FCP procedure and were instructed to provide a list of attributes to depict the honeys using their words to describe the appearance (color and visual consistency), odor, flavor (aroma and taste) and other sensations in their mouth and throat. Comparative and hedonic terms were avoided. About 5 g of each one of the five honeys showed in Table 1 were presented following a balanced presentation order, and participants were asked to list the sensory characteristics they perceived after tasting each honey. Honey samples were presented in capped plastic cups coded with three-digit numbers, in a daylight illuminated room. Appearance was evaluated first, then the odor, and finally half spoon of honey was tasted and any other sensation was also recorded. Mineral water was served to rinse the mouth between samples, as well as a piece of the local cassava cracker known as *casabe*, to reset the palate (Figure 3). For the second session, individual score cards were prepared to measure the intensities of each sensory attribute generated during the first session. The samples were evaluated monadically by using unstructured 10 cm line scales anchored with the words “weak” or “absent” at the left end, and “strong” at the right end. Each assessor crossed the intensity on the line scale in the position that best described his/her perception. Help was provided individually to facilitate the evaluation process without any induction.

### Statistical analysis

The data acquired by FCP were analyzed by generalized Procrustes analysis, to generate an optimized consensus matrix by mathematical transformations, to reach a minimal overall deviation which was able to summarize the information about the samples, and replace

the panel mean (Williams & Langron, 1984). Correlations between the sample score of each sensory attribute and the corresponding sample score principal component, allowed the selection of the important attributes.



Figure 3. Presentation of honeys for sensory sessions.

## Results

### Elicited sensory attributes

The list of preliminary vocabulary elicited in the qualitative session was reduced to the 25 terms presented in Table 2, by the reduction of redundant and/or vague words. The eight assessors elicited on average thirteen sensory attributes (ranging from 10 to 16) for the five honey types produced by different species of Meliponini in different countries. For example fluid, thin, watery, viscous, thick etc. refer to low to high viscosity. The descriptor fermented was used to group alcohol, fermented and fermented pollen. Negative and positive correlations ( $<-0.7$  and  $>0.7$ ) between each attribute and the first two dimensions are given for each one of the eight assessors. As suggested by Guàrdia et al (2010) only agreed descriptors with correlation coefficients higher than 0.6 in at least one of the first two dimensions were used to visualize the relationships between samples and attributes. The first dimension was better explained by low viscosity (-0.8 to -1.0), fermented odor (0.9 to 1.0) and sour taste (0.8 to 1.0). However, brown color and the resin flavor also contributed to it. The second dimension coefficient's was more related to the fruity and honey odor, sweet, fresh fruit, fruity sweet and honey flavor. The sensation of biting nose was in the first dimension but burns the throat in the second. The assessors used many common words to describe the five honeys, but some sensory descriptors were unique and very specific, related to local resins named artocha, and fruits which are known as manteco.

As previously observed by Ferreira et al. (2009), the vocabulary developed to describe stingless bee honey by FCP, was similar to descriptors of appearance, odor, flavor, and trigeminal sensations used to describe *A. mellifera* honey by QDA (Vit 1993; Anupama et al. 2003; Persano Oddo & Piro 2004; Galán-Soldevilla et al., 2005).



This is a good evidence for the Codex Alimentarius Commission, to show that stingless bees also produce honey, as recognized by untrained panels using simple words to describe pot honey. However, besides the similarities, differences between honeys of each stingless bee species may be somehow comparable to the diversity attributed to botanical origins of the honey produced by only one bee species, the *A. mellifera*. *Melipona* species produce light amber honeys, while *Trigona* tends to produce dark amber honeys, similarly to the characteristic light amber acacia honey and dark amber chestnut honey, widely documented and familiar to beekeepers and consumers from locations where these honeys are produced. Besides that, the fermented descriptors are somehow distinctive in pot honey.

#### Assessors

Eight assessors elicited an average of 13 attributes (ranging from 10 to 16) of five honey types produced by different species of Meliponini in different countries. The attributes they provided are listed in Table 2. The ability of each assessor seen from the combined attributes of all, is defined in the assessors' plot by principal components of the consensus configuration. Individual performance could be checked by looking at the graphic of residuals (Figure 4). The graphic of residuals for each assessor by configuration after the transformations along with the consensus plot for the five honey types shows that assessor 5 has the highest residual, which means that he gave rates that do not match the consensus.

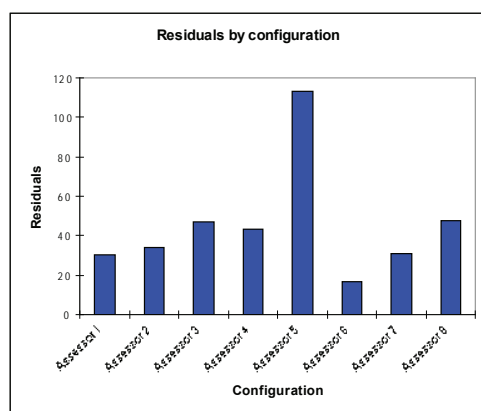


Figure 4. Residual variance for each assessor.

#### Honeys

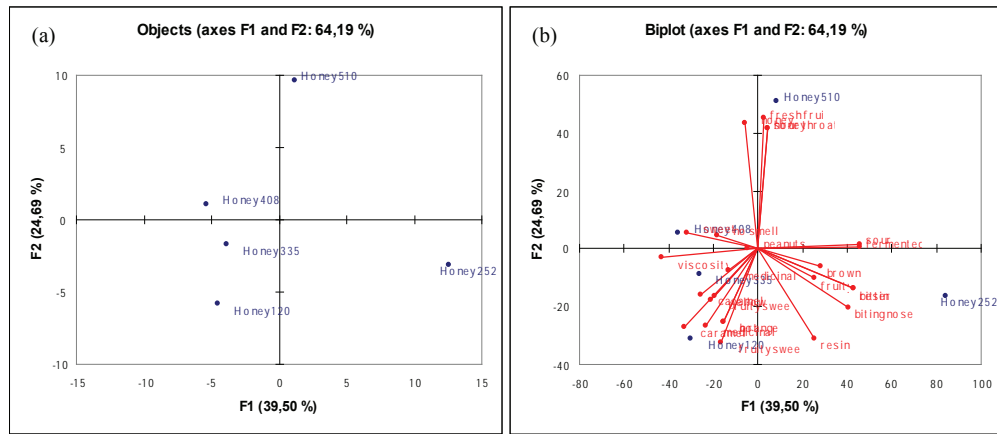
Figure 5 shows the consensus configuration of the five honeys. In Figure 5a, the first dimension explained 39.50% of the variability and separated genuine pot honeys (252, 510) from the other samples. The honeys are widely spread in space. Genuine pot honeys *M. fuscopilosa*

(510) and *T. clavipes* (252) produced by the Paria Grande Piaroa community are grouped on the right, separated from the genuine *A. mellifera* (120) and the false honeys (335 and 408) grouped in the left by the first dimension, with conspicuous contributions of a low viscosity, fermented odor and sour flavor. On the other hand, the second dimension explained 24.69% of the variability, and separated sample 510 from the others. The genuine *Melipona* honey 510 is set apart from the rest in the upper position of the dimension 2, which was explained by fresh fruit, honey, and burns the throat descriptors (Figure 5b). Despite the light and dark color of false honey to imitate genuine pot honey, the artificial dark amber honey 408 is close to the other artificial honey (335) revealing similar sensory characteristics between them. The genuine dark *Tetragona* honey 252 was positioned separately in dimension 1 showing that it was perceived by participants with specific sensory attributes. The color imitation of angelita honey samples (Figure 2) was surpassed by the other sensory attributes that positioned the honeys in opposite compartments. Indeed, the sour taste and intrinsic flavor of the light false honey angelita was more similar to *Apis* honey.

Figure 6 shows the residuals by object after the transformations. We can see that the dark artificial honey 408 has the smallest residual. This indicates that there is most probably a consensus between assessors when evaluating this syrup honey. Whereas the highest residual is for the light artificial honey 335, which is a more elaborated syrup honey with sharper sour taste than traditional false honeys the author has been observing for more than twenty years in the Venezuelan market.

The *Melipona* honey is characterized by the honey in the nose and the mouth, fresh fruit flavor, honey odor and aroma, and the sensation of burning the throat. The *Tetragona* honey is more complex, and was described as having brown color, sour and bitter taste, fermented flavor, peanuts, resin, biting nose. The *Apis* honey was perceived as having the caramel aroma, honey, sweet taste and medicinal aroma. The higher viscosity was attributed to the false honeys, the angelita dark amber had an odorless attribute, while the other angelita light amber was more elaborated medicinal, caramel and sweet.

Figure 7 presents the consensus configuration showing the investigated honey sensory attributes. False honeys are closer to the *A. mellifera* honey, and not distinctive putative yellow and purple blooming was separated from both of them, so only one group of false honey. Pot honeys were spread in distinctive positions by the two first dimensions. The *Melipona* honey was characterized by sour taste, fresh fruit, honey and burns the throat attributes, while the *Tetragona* had more descriptors such as brown color, bitter and sour taste, fermented, fruity, resin, biting nose.



**Figure 5.** The five honeys, defined by the first two dimensions of the consensus configuration, showing (a) Position of honey samples, (b) Sensory attributes. See Table 1 for the identification of honey samples.

**Table 2.** Attributes better correlated with the first two dimensions (D1, D2), and attributes of honeys.

| Assessors                    | 1    |      | 2    |      | 3    |     | 4    |    | 5    |    | 6    |     | 7    |      | 8    |      |
|------------------------------|------|------|------|------|------|-----|------|----|------|----|------|-----|------|------|------|------|
|                              | D1   | D2   | D1   | D2   | D1   | D2  | D1   | D2 | D1   | D2 | D1   | D2  | D1   | D2   | D1   | D2   |
| <b>ATTRIBUTES</b>            |      |      |      |      |      |     |      |    |      |    |      |     |      |      |      |      |
| <b>Appearance</b>            |      |      |      |      |      |     |      |    |      |    |      |     |      |      |      |      |
| 1. yellow color              |      |      |      |      |      |     | -0.8 |    | -0.7 |    |      |     |      |      |      |      |
| 2. orange color              |      |      |      |      |      |     |      |    |      |    |      |     |      |      |      |      |
| 3. brown color               |      | 0.7  | 0.7  |      |      |     | 1.0  |    | 0.7  |    |      |     |      |      |      |      |
| 4. viscosity                 | -0.9 |      | -1.0 |      | -0.9 |     | -0.9 |    | -0.9 |    | -0.9 |     | -0.8 |      | -1.0 |      |
| <b>Odor</b>                  |      |      |      |      |      |     |      |    |      |    |      |     |      |      |      |      |
| 5. fermented                 | 1.0  |      |      | 0.9  | 0.9  |     | 0.9  |    |      |    | 0.9  |     | 0.9  |      |      | 0.9  |
| 6. fruity                    |      | 0.9  |      |      |      |     | 0.8  |    |      |    |      |     |      | -0.7 |      |      |
| 7. fruity sweet              |      |      |      |      |      |     |      |    |      |    | 0.9  |     |      |      |      |      |
| 8. caramel                   |      |      |      |      |      |     |      |    |      |    |      |     |      |      |      |      |
| 9. peanuts                   |      |      |      |      |      |     |      |    |      |    |      |     |      |      |      |      |
| 10. honey                    |      |      |      |      |      |     |      |    |      |    |      | 0.9 |      | 0.9  |      |      |
| 11. resin                    |      | -0.7 |      |      |      |     |      |    |      |    |      |     |      |      |      |      |
| 12. medicinal                |      |      |      |      |      |     |      |    |      |    |      |     |      |      |      |      |
| 13. odorless                 |      |      |      |      |      |     |      |    |      |    |      |     |      |      |      |      |
| <b>Flavor</b>                |      |      |      |      |      |     |      |    |      |    |      |     |      |      |      |      |
| 14. sweet                    | -1.0 |      |      | 0.8  |      |     |      |    |      |    |      |     |      |      |      | 0.9  |
| 15. sour                     | 1.0  |      | 0.9  |      |      |     | 1.0  |    | 0.8  |    | 1.0  |     |      |      | 1.0  |      |
| 16. bitter                   |      |      |      |      |      |     |      |    |      |    |      |     |      |      |      | 0.9  |
| <b>Aroma</b>                 |      |      |      |      |      |     |      |    |      |    |      |     |      |      |      |      |
| 17. hot                      |      |      |      |      |      |     |      |    |      |    |      |     |      |      |      |      |
| 18. candy                    |      |      |      |      |      |     |      |    |      |    |      |     |      |      |      |      |
| 19. fresh fruit              |      |      |      | 0.9  |      | 0.9 |      |    |      |    |      |     |      |      |      | 0.9  |
| 20. fruity sweet             |      |      |      | -0.7 |      |     |      |    |      |    |      |     |      |      |      | -0.7 |
| 21. medicinal                |      |      |      |      |      |     |      |    |      |    |      |     |      |      |      |      |
| 22. resin                    | 0.9  |      | 0.9  |      |      |     |      |    |      |    |      |     |      |      |      | 0.9  |
| 23. honey                    |      |      |      |      |      |     |      |    |      |    |      | 0.9 |      | 0.9  |      | 0.9  |
| <b>Trigeminal sensations</b> |      |      |      |      |      |     |      |    |      |    |      |     |      |      |      |      |
| 24. biting nose              | 0.9  |      |      | -0.7 |      |     |      |    |      |    |      |     |      |      |      | 0.9  |
| 25. burns the throat         |      | 0.9  |      |      |      |     |      |    |      |    |      |     |      |      |      |      |

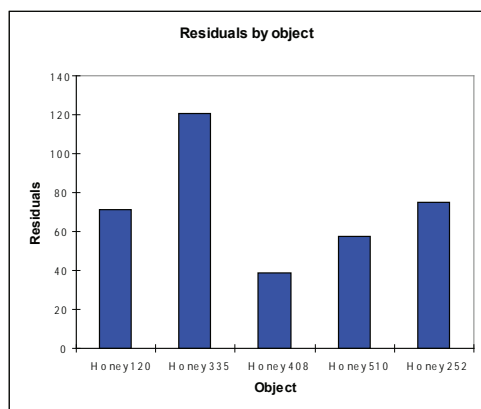


Figure 6. Residual variance for each honey.

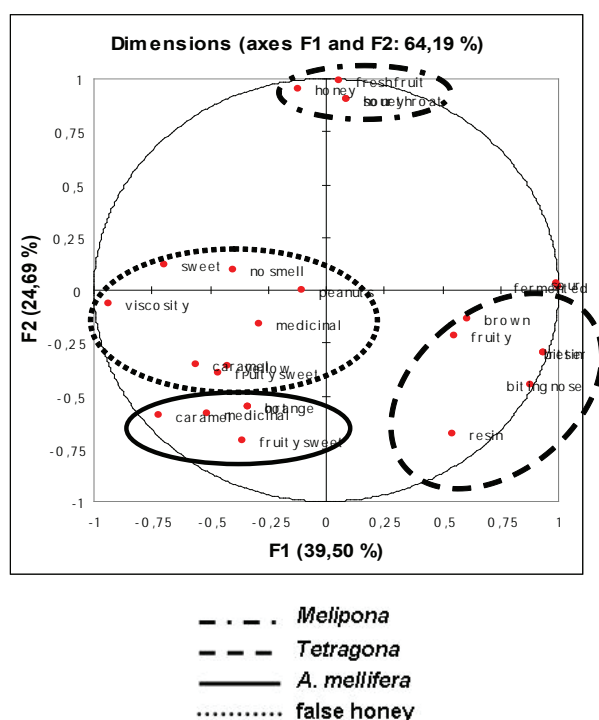


Figure 7. Distribution of the honey attributes along the two first dimensions.

## Discussion

The separation of the bee genera observed in Figure 5 was also obtained by multivariate analysis of physicochemical factors in Venezuelan pot honeys (Vit et al. 1998). However, in this work *A. mellifera* and artificial honeys were incorporated, and the information derived from the FCP was promising for self control of honey authenticity by the Huottuja community. This experience could be wisely extended in schools, so children would learn how to discriminate a honey that is not genuine, from their traditional forest honeys, that are now produced in rational hives. The better knowledge of their products

could protect them with arguments of valorization.

The first dimension was better explained by low viscosity (-0.8 to -1.0), fermented odor (0.9 to 1.0) and sour taste (0.8 to 1.0), also brown color and the resin flavor contributed to it. The second dimension was more related to the fruity and honey odor, sweet, fresh fruit, fruity sweet and honey flavor. The sensation of biting nose was in the first dimension but burns the throat in the second.

Compared to the genus of *Apis*, which has eleven species, stingless bees have some sixty genera, and are the only group of social bees with a Cenozoic fossil record (Rasmussen & Cameron, 2010). Therefore, more variability is expected for the pot honey they produce due to the differences attributed to their entomological origin, additionally to the botanical and geographical origin.

Local names of stingless bees in the Huottuja language, such as “isabitto” (*Melipona fuscopilosa*) and “ajavitte” (*Tetragona clavipes*) are unfamiliar to Spanish speakers. *Melipona* species have common names such as “erica” and “guanota, while *Tetragonisca angustula* is known as “angelita” (Vit et al., 2004). In the honey label, the name of the bee in the tropics could become as important as the name of the botanical source of unifloral honeys in Europe. However, local names of stingless bees in Venezuela have been more used in labels of artificial or false honey, than in the traditional industry of meliponiculture, due to several constraints, - especially the lack of official standards for Meliponini honey, and also the fact that this is a rural practice not organized in cooperatives, which are essential to handle the marketing.

A better sensory knowledge of the forest honey harvested by the Huottuja people followed by the available information would aggregate monetary value to the product, and could contribute to the improvement of the community life conditions. Their cultural values would benefit by assessing the environmental and social roles of meliponiculture, but the suggested price-based and quantity-based techniques of valuation for indigenous cultural heritage, need further economical analysis to improve social welfare concepts (Venn & Quiggin, 2007). Pot honey hunting has been reported for bush honey or sugarbag used by Gunwinggu community (*Trigona* species named “bobitj” and “man.gung”) in Australia (Altman, 1984).

In conclusion, this is the first time a Huottuja community has carried out a honey tasting of the traditional pot honey available in their forest and recently harvested from their stingless bee apiaries. The classic approach of Free-choice profile was successfully handled by the local people of the community area, with the honey we needed to test. Huottuja assessors were interested in the contribution they were giving, and their sensory skills were adequate to accomplish the differentiation of the honey types, as confirmed by the routine statistical test. A more knowledgeable consumer improves the protection

of customers against false honey. Sensory approaches like ours confirm the useful value of sensory evaluation to differentiate diverse entomological origins of honey.

### Acknowledgement

The authors thank Mr. Fini Opa Carrasquel, who provided the genuine pot honey to carry on sensory analysis. To the late meliponine entomologists JMF Camargo, from the Departamento de Biología, Faculdade de Filosofia, Ciências e Letras de Ribeirão Preto, Universidade de São Paulo, Ribeirão Preto, SP, Brazil, for the valuable identification of stingless bees. To CDCHT-ULA project FA-458-09-03-B.

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