

ORIGINAL RESEARCH ARTICLE



Sensory perception of tropical honeys by Spanish consumers, using free choice profile

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Summary

Five types of pot honeys produced in Australia, Bolivia, Brazil, Mexico and Venezuela by *Melipona*, *Scaptotrigona* and *Tetragonula* species were described by a Spanish untrained sensory panel. The free-choice profile (FCP) method consents consumers to use their own words to describe and to quantify the sensory attributes of the product: Appearance, odour, flavour and mouth and throat trigeminal sensations. Data were processed with Generalized Procrustes Analysis (GPA). The first and second dimensions accounted for 60% of the variance. The first dimension was explained by the amber colour, sour and bitter tastes, mellow, nuts and medicinal aromas, and the refreshing trigeminal sensation. The second dimension was explained by suspended particles, fermented odour and aroma, and floral odour. The bidimensional plot separated *Melipona* from *Tetragonula* honeys, with intermediate *Scaptotrigona* according to the second dimension, similarly to previous findings based on physicochemical compositional factors. Assessors differentiated five types of pot honey. The free choice profiling was helpful to picture consumer perception of Meliponini pot honey. Additionally, the GPA generated a handy bidimensional plot positioning honey according to the entomological genus of origin.

Keywords: Sensory evaluation, Spanish honeys, free choice profile.

Introduction

Evaluating the genuine quality of honey is compulsory due to its properties as a nutraceutical. Therefore, visible information about the botanical and the geographical origin must be clearly worded in the labels of honey pots (González-Viñas *et al.*, 2003). In this work, the entomological origin of stingless bee honey was considered instead of the botanical origin. Pots of honey produced by meliponines delighted tropical America before Columbus (Schwarz, 1948) when comb honey was unknown. Almost 400 species-groups of stingless native bees (Meliponini) have been described in America (Camargo and Pedro, 2007). The significant pollination of crops and forests is based on such a great biodiversity (Nates-Parra, 2005), demanding accurate warnings to protect this apifauna (Villanueva *et al.*, 2005) and to value the honey they produce (Vit, 2008).

Characterization of pot honey is not as abundant as the unifloral and polyfloral bibliography available for comb honey. Composition of Argentinian and Paraguayan (Vit *et al.*, 2009), Australian (Oddo *et al.*, 2008), Brazilian (Gonnet *et al.*, 1964; Souza *et al.*, 2004; Anacleto *et al.*, 2009), Guatemalan (Dardón and Enríquez, 2008), Peruvian (Rodríguez-Malaver *et al.*, 2009) and Venezuelan (Vit *et al.*, 1994) stingless bee honeys generated a reference database based on their entomological origin (Vit, 2007) mostly physicochemical, with some bioactive and melissopalynological records, that needs to be complemented with sensory descriptions. To our knowledge, the Colombian regulation on honey (NTC, 2007) is the first one to introduce a definition of native bee honey produced by species originated in tropical America with sensory and physicochemical characteristics distinctive for each species. In the annex B is included an extract of the temporary

compositional standards for some species of meliponine, as reviewed in 2006 by Souza *et al.*

The melissopalynological analysis (Louveaux *et al.*, 1978) and the physicochemical composition obtained following harmonized methods (Bogdanov *et al.*, 1997) are used to authenticate the botanical origin of honey. Sensory characteristics and defects of honey (Gonnet and Vache, 1984) were determined in the first consistent approach to tackle the consumers' perception of honey. Oddo *et al.* (1995) characterized honeys by visual, olfactory and taste attributes, for 18 unifloral and two honeydew European honeys (Oddo and Piro, 2004). Anupama *et al.* (2003) analysed Indian honeys by quantitative descriptive analysis (QDA). Galán-Soldevilla *et al.* (2005) used fifteen honey descriptors, in categories of odour, flavour, texture and trigeminal sensations, selected by Principal Component Analysis (PCA). Piana *et al.* (2004) suggested an odour-aroma wheel for *A. mellifera* honey with sensory families, subfamilies and descriptors, which was adapted to Meliponini honey two years later (Vit, 2007).

Sensory evaluation of honey is also necessary for stingless bees. A Quantitative Descriptive Analysis (QDA) was carried out by a Latin American panel at Universidad de Los Andes (Vit, 2008), but the Free Choice Profiling (FCP) approach (Williams and Langron, 1984) is an option to simplify the consumers perception (Murray *et al.*, 2001). Instead of score cards based on a demanding reference sensory lexicon, the FCP uses a list of descriptors elicited by a non experienced sensory panel. In both methods the assessors have to differentiate samples verbally and quantitatively (Oreskovich *et al.*, 1991).

FCP was useful to describe passion fruit juices by consumers who had never tried this product before, unusual in the UK (Deliza *et al.*, 2005). We decided to apply the same hypothesis to pot honey, assuming that a honey with a new entomological origin could be described and differentiated by Spanish consumers who have never tasted it before, in a repeated assessment. In this study, the Free Choice Profile (FCP) analysis was used to test the ability of a panel familiar and fond of *Apis mellifera* honey but unfamiliar with Meliponini honey. Our aim was to provide a FCP sensory baseline for five commercial pot honeys from Australia, Bolivia, Brazil, Mexico and Venezuela, generated by Spanish assessors not familiar with honey produced by stingless bees.

Materials and methods

Honey

Commercial honeys of five different species of stingless bees from Venezuela (*Melipona favosa*) "erica" (1), Bolivia (*Scaptotrigona polysticta*) "suro negro" (2), Mexico (*Scaptotrigona mexicana*) "pisilnekmej" (3), Australia (*Tetragonula carbonaria*) "carby" (4),

and Brazil (*Melipona fasciculata*) "uruçú" (5) were evaluated. All samples were received in plastic, glass and ceramic containers used for marketing. Honeys were kept frozen prior to the sensory analysis, and were defrosted two hours before every sample preparation.

Assessors

A group of eight honey consumers, six females and two males, aged between 24 and 47 years old, from staff and students at the University of Burgos in Spain, were selected for their nutritional interest, commitment and motivation. Five of them had previous experience with sensory analysis, but none of them had knowledge of FCP and had never tasted stingless bee honey before. Their sense of smell was not altered by smoking, allergies, respiratory conditions, or insomnia. The sessions took place two hours after lunch. Their participation was voluntary and not rewarded. An informed consent form was completed prior to the sensory sessions.

Sensory evaluation

In the first session, assessors received a brief outline of the FCP procedure and were asked to describe the overseas honeys in terms of attributes for appearance (colour and consistency), odour, flavour (taste and aroma) and other sensations in their mouth and throat, using their own vocabulary. Precise instruction was given to each assessor to choose objective attributes and not to use comparative terms. The five honeys were presented with a request to list sensory perceptions in order to characterize each honey. For this purpose, 4.0 ± 0.1 g of honey were presented in clear plastic cups coded with three-digit numbers, in a day-light individual sensory booth of the taste room. Mineral water and toast were served to rinse the mouth and to reset the palate between samples. For the second session, individual score cards were prepared to evaluate 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 marked the intensity on top of the line.

Statistical analysis

The data acquired by FCP were processed by Generalized Procrustes Analysis (GPA), to generate an optimized consensus matrix by mathematical transformations, according to Arnold and Williams (1986), to reach a minimal overall deviation able to summarize the information about the samples and replace the panel mean (Williams and Langron, 1984). Correlations between the sample score of each attribute and the corresponding sample score principal component, allow the selection of important attributes.

associated with fermentations. The *Melipona* spp (honeys 1 and 5) and the *Scaptotrigona polysticta* (honey 2) were in the upper rectangle, whereas the *Scaptotrigona mexicana* (honey 3) was between both groups. However, looking at the x axis dimension 1, both *Scaptotrigona* honeys from from Bolivia and Mexico are grouped together. This dimension is explained by several attributes, including sour taste, as both honey 2 and 3 have a distinctive sour taste.

The data in Figure 3 gives the residuals by object after the transformations. We can see that the *Scaptotrigona* honey 3 has the smallest residual. This indicates that there is most probably a consensus between assessors.

Figure 4 shows the plot of samples in a two-dimensional distribution where the first component in the x axis accounts for 32.75% of the observed variability between the samples, and the second component explains 27.25% of the variations in the y axis. Important descriptors had coefficients ranging from less than -0.6 to more than 0.6, obtained by the GPA analysis for each one of the 24 honey attributes, as listed in Table 1. In this consensus configuration obtained with the investigated honey sensory descriptors, two groups of honeys arise. The upper group with the American species (*Melipona* spp. and *Scaptotrigona* spp.), and the lower group with the Australian species *Tetragonula carbonaria*. A further grouping of the two *Melipona* species (*M. fasciculata* and *M. favosa*,) and the two *Scaptotrigona* species (*S. mexicana* and *S. polysticta*) is also visible. *Melipona* honeys were characterized by hive odour, bitter and savoury tastes, the very distinctive floral, mellow and citrus fruit aroma besides the medicinal perception associated with the odour and aroma of cough syrups. *Scaptotrigona* honeys were typified by refreshing and astringent trigeminal sensations, sweet and bitter tastes, and fruity odour and aroma. The amber colour *Tetragonula* honey was perceived with fermented odour and aroma, spicy in the mouth, and floral in the nose, with suspended particles.

Discussion

Vocabulary

As previously observed by Ferreira *et al.* (2009), the vocabulary developed to describe stingless bee honey by FCP, is similar to descriptors of appearance, odour, flavour, and trigeminal sensations used to describe *A. mellifera* honey by QDA (Vit, 1993; Anupama *et al.*, 2003; Oddo and 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

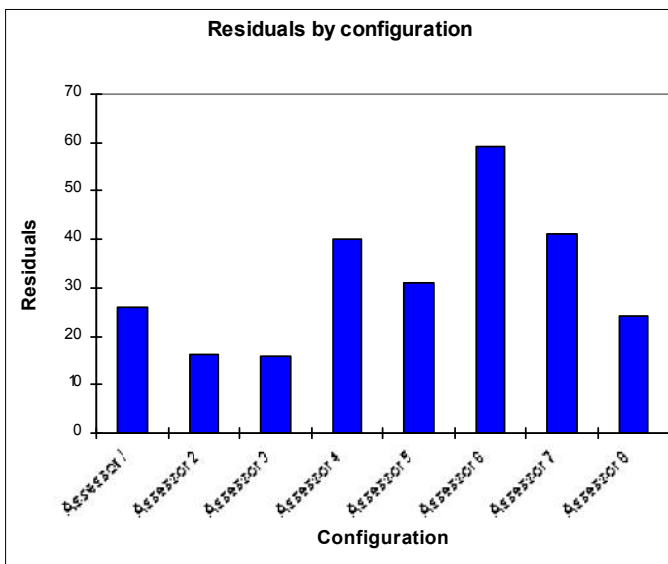


Fig 1. Residual variance for each assessor.

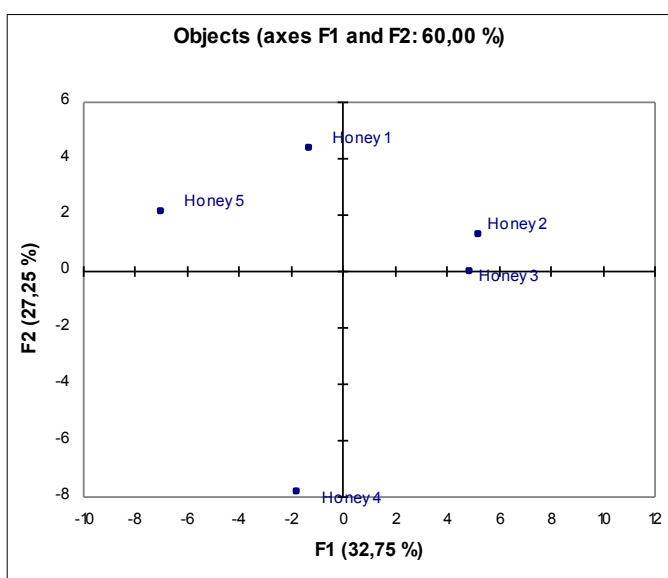


Fig 2. The five honey positions, defined by the first two dimensions of the consensus configuration.

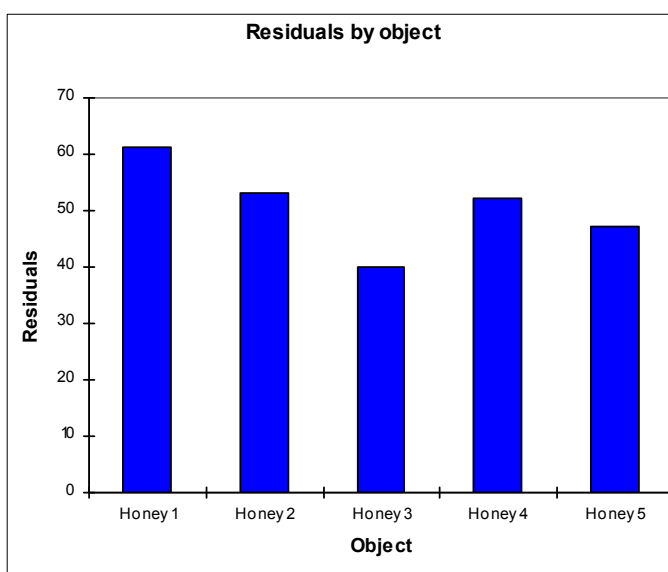


Fig 3. Residual variance for each honey.

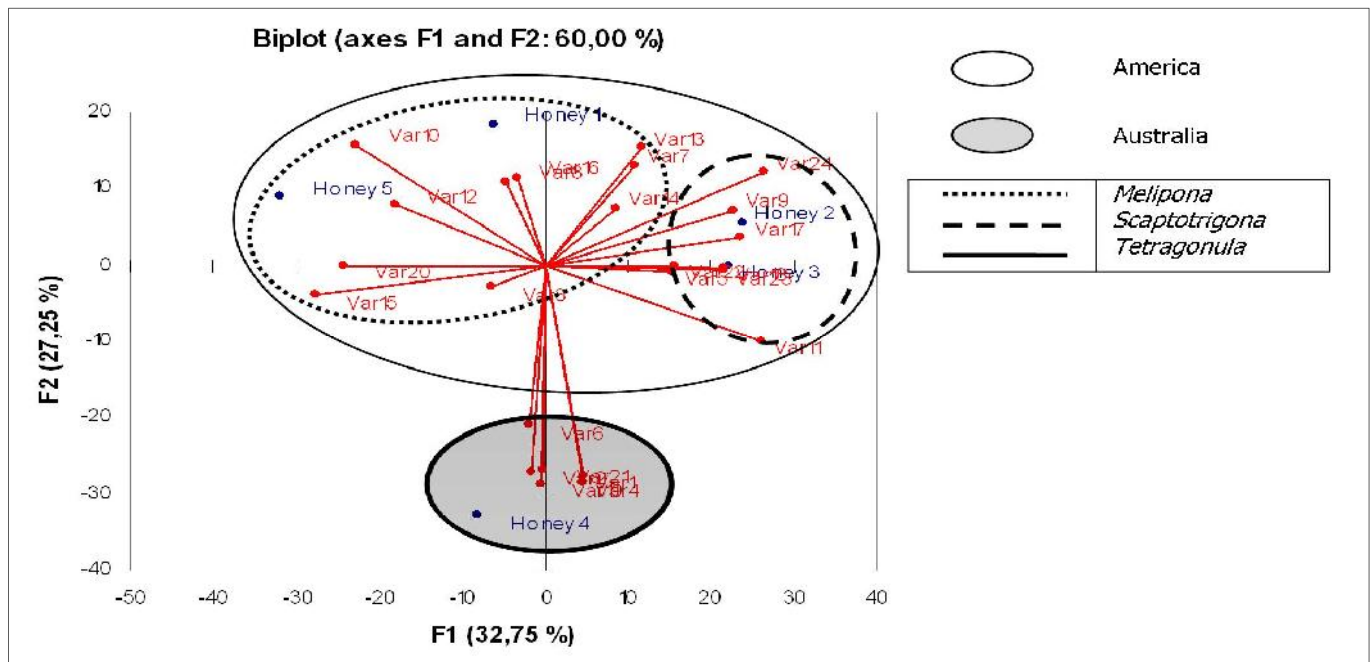


Fig 4. Plot of the significant correlation between all the sensory attributes of pot honeys (see Table 1) along the first two dimensions after GPA. Pot honey produced in Australia by *Tetragonula carbonaria* (4) and in America by the Brazilian *Melipona fasciculata* (5), the Venezuelan *Melipona favosa* (1), the Bolivian *Scaptotrigona polysticta* (2), the Mexican *Scaptotrigona mexicana* (3).

Trigona tend 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. Also, the fermented descriptors are somehow distinctive in pot honey.

Honeys

The very distinctive *Scaptotrigona* honeys in Figure 3 had the strongest sour taste compared with *Apis*, *Melipona* and *Trigona* (Vit, 2000).

A separation of pot honeys into groups according to the Meliponini genera (illustrated in Figure 4) was an earlier outcome after a multivariate analysis of classic physicochemical honey quality factors, suggested as a new avenue to identify the entomological origin (Vit *et al.*, 1998). In a recent research, the Amazonian *Melipona fuscipilosa* and *Tetragona clavipes* pot honeys from Venezuela were also spread in distinctive positions by the two first dimensions after GPA (Vit *et al.*, 2011), and well separated from *Apis mellifera* and false honeys sold as "angelita" which is the local name given to the *Tetragonisca angustula* stingless bee in Venezuela (Vit *et al.*, 2004).

Compared to the genus of *Apis*, which has 11 species, stingless bees have some 60 genera, and are the only group of social bees with a Cenozoic fossil record (Rasmussen and Cameron, 2010). Therefore, more variability is expected in the pot honey they produce, due to the differences attributed to their entomological origin, and associations to microorganisms such as *Bacillus* (Gilliam *et al.*, 1990) and yeasts (Rosa *et al.*, 2003). Spanish assessors who

had never tasted stingless bee honey before, successfully characterized honey according to their sensory attributes. Additionally, with the statistical GPA, the elicited attributes and their quantification was scored in diverse sets of most importantly correlated sensory attributes to characterize each honey type.

Honey is a complex bee matrix with encapsulated information on botanical and geographical origin, physicochemical quality indicators, bioactive properties and symbiotic microorganisms. This apparently homogeneous medicinal food has been characterized and differentiated according to its entomological origin by processing perceptions elicited by human sensory organs. Groups at the genus level were made after GPA using the FCP method. It remains an enigmatic product made by the bees (Vit, 2005), unfolding new facets to different disciplines of research.

Our work is a useful contribution intended for the initial collection of knowledge and further sensory approaches of honey stored in pots. The great biodiversity of stingless bees demands more awareness of the consumer, to protect pot honey against non authentic stingless bee honeys that could be *Apis mellifera* honeys or any other sugary surrogate, sold at a lower price. In tropical countries where pot honey is mostly produced, honey labelling regulations are limited. A well-informed end user might benefit from their appropriate medicinal application. Additionally, if any medicinal property would be demonstrated for a honey, particularly produced by certain Meliponini species, the consumer should become acquainted with their sensory attributes in order to associate the entomological origin with the alleged remedy.

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