# Chapter 27
# Honey of Colombian Stingless Bees: Nutritional Characteristics and Physicochemical Quality Indicators

**Carlos Alberto Fuenmayor, Amanda Consuelo Díaz-Moreno, Carlos Mario Zuluaga-Domínguez, and Martha Cecilia Quicazán**

## 27.1 Introduction

The geographic location of Colombia and its mega-biodiversity have been identified as advantages for beekeeping and for meliponiculture. Beekeeping is a potentially sustainable activity and presents an interesting opportunity to identify new products—mostly yet-to-be-discovered—with unique features related to their natural origin and functional characteristics. There are certainly more than an estimated 900 native bee species in Colombia (Freitas et al. 2009).

As among other Latin American countries, pre-Hispanic cultures that lived in different territories now located in Colombia practiced meliponiculture (especially of the genera *Melipona* and several others), for the extraction and processing of honey and the use of cerumen in metalwork. The European colonization of Central and South America minimized the practice of meliponiculture, introduced beekeeping with hives of *Apis mellifera*, and largely ended meliponiculture in Colombia. More recently, the trends of increased consumption of natural foods and health products have played an important role in the renewed interest in bee products, particularly honey from stingless bee species, and the recovery of traditional knowledge.

Because of this, meliponiculture in Colombia has recently developed. Products such as honey produced by *T. angustula*, called "angelita" ("little angel" in English), is available in traditional markets and commands a significantly higher price relative to *A. mellifera* honey (e.g., because of its scarcity and because it is commonly thought to have medicinal features, the price of *T. angustula* honey can reach over ten times the price of honey from *A. mellifera*) (Rosso and Nates-Parra 2005). Although data on the marketing of pot-honeys in Colombia is not available, this product, known in Spanish as "miel de pote," is mainly sold in natural foods stores.

C.A. Fuenmayor • A.C. Díaz-Moreno (✉) • C.M. Zuluaga-Domínguez • M.C. Quicazán
Instituto de Ciencia y Tecnología de Alimentos—ICTA, Universidad Nacional de Colombia, Carrera 30 # 45-03 Ed. 500-C, Ciudad Universitaria, Bogotá, Colombia
e-mail: amcdiazmo@unal.edu.co

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Beekeepers generally maintain relatively few nests, without financial gain, and often express a desire to make them a source of income, but they often lack knowledge about breeding techniques and maintenance.

Technological and environmental issues, such as complex ecosystem interactions, the susceptibility of some species to human practices and relatively low honey production yields of individual nests, must be studied and overcome in order to make meliponiculture feasible in Colombia. Sustainable meliponiculture must be based on the generation of knowledge about native bee biology, their environment and characteristics of their products; therefore, the assessment of physical and chemical features of various honeys of Colombian stingless bees is of great interest. This chapter summarizes existing information regarding the physicochemical properties, nutritional information and quality of Colombian pot-honey.

## 27.2 Physicochemical Characteristics of Colombian Pot-Honey

Only very recently have data been obtained on composition and physicochemical properties of Colombian pot-honeys. In fact, the Colombian technical standard for *A. mellifera* honey was extended from the stingless bee data published by Souza et al. (2006) and lacks information regarding Colombian stingless bee honeys (ICONTEC 2007). This general lack of knowledge has had several consequences. For example, there are difficulties in regulating the adulteration and falsification of stingless bee honey.

The objective differentiation between authentic pot-honey and adulterated honey is especially interesting. Adulteration is often achieved by mixing pot-honey with common *A. mellifera* honey, and even by using adulterated honey of that species, containing added molasses and fructose syrup. Therefore, physicochemical characteristics are useful for regulating adulteration, and that knowledge will allow the development of regulatory standards.

Previous physicochemical characterization of Colombian pot-honey (Zuluaga et al. 2009) has focused on *T. angustula* or non-compositional analysis (Torres et al. 2004, 2007), or remained unpublished. Information provided in this chapter derives from studies performed in the Institute of Food Science and Technology (ICTA), Universidad Nacional de Colombia, since 2008. The data are compared to those of Zuluaga (2010).

Among the hundreds of Colombian stingless bee species (belonging to more than 13 genera; Nates-Parra 2001; Nates-Parra et al. 2006), the chemical composition of honey from seven genera has been explored. The species for which honey has been analyzed, as well as the number of samples and location for each are shown in Table 27.1. Several samples identified only to taxonomic group, e.g. genus. Often, the small amount of pot-honey that can be harvested at one time limits parameters assessed for a sample; therefore, some physicochemical characteristics are evaluated for few species or samples. In most cases, the analytical methods for

**Table 27.1** Physicochemical composition of pot-honey from Colombia (general information about the samples)

| Taxon | Geopolitical regions | Number of pot-honey samples |
|---|---|---|
| *Frieseomelitta* sp.[a] | Magdalena, Santander, Caldas | 6 |
| *Melipona compressipes* | Santander, Caldas | 12 |
| *Melipona favosa* | Sucre, Magdalena, Cundinamarca | 7 |
| *Melipona eburnea* | Cundinamarca | 7 |
| *Melipona* sp. | Santander | 14 |
| *Nannotrigona testaceicornis* | Santander, Cundinamarca | 3 |
| *Nannotrigona* sp. | Cundinamarca, Boyacá, Sucre, Santander | 4 |
| *Paratrigona opaca* | Santander | 4 |
| *Partamona peckolti* | Santander | 1 |
| *Partamona* sp. | Santander | 1 |
| *Plebeia* spp. | Santander | 1 |
| *Scaptotrigona limae* | Sucre, Santander | 2 |
| *Scaptotrigona* sp. | Cundinamarca, Caldas, Magdalena, Santander | 4 |
| *Tetragona* sp.[a] | Santander | 21 |
| *Tetragonisca angustula*[a] | Magdalena, Santander, Cundinamarca, Sucre, Caldas, Tolima, Huila | 45 |

[a]Previously denominated as a subgenus of *Trigona* (Rasmussen and Cameron 2010)

pot-honey are the same as for *A. mellifera* honey (AOAC 1998). The number of analyzed honey samples varies according to the genus and the species; the largest number of samples corresponds to the genera *Melipona* and *Tetragonisca* because there is ample breeding of those species (see Souza et al. 2006).

### *27.2.1 Main Composition (Water and Sugars)*

The honey from stingless bees, like *A. mellifera* honey, is composed primarily of simple reducing sugars (mainly fructose and glucose), and non-reducing sugars (mainly sucrose and maltose), water and ash. These quality parameters depend on many factors, even for the same species, such as the maturity achieved in the bee nest or hive during the harvesting season, climatic and geographic factors, and other elements affecting floral abundance.

The concentration of sugars and water for Colombian varieties of pot-honey are given in Table 27.2. Mean moisture content values ranged from 24.3 g/100 g for *T. angustula* to 42.7 g/100 g for *Partamona pecktolti*. The high water concentration in the former species is consistent with the relatively low total sugar content (°Brix) reported by Souza et al. (2006); such large moisture values had only been reported for *Melipona quadrifasciata* (Gonnet et al. 1964; Pamplona 1989) and *Plebeia* (Bijlsma et al. 2006; Carvalho et al. 2005). Most honey moisture content values

**Table 27.2** Water and sugar contents of stingless bee honey from Colombia

| Taxon | Moisture[a] (g/100 g) | Fructose[b] (g/100 g) | Glucose[b] (g/100 g) | Fructose + Glucose (g/100 g) | Disaccharides[b, c] (g/100 g) |
|---|---|---|---|---|---|
| *Frieseomelitta* sp.[d] | 33.1 ± 3.3 (6) | 17.1 ± 6.6 (5) | 12.6 ± 7.5 (5) | 29.7 ± 7.5 (5) | 3.1 ± 2.7 (5) |
| *Melipona compressipes* | 25.8 ± 2.0 (12) | 36.9 ± 3.7 (11) | 34.2 ± 4.4 (11) | 71.1 ± 8.1 (11) | 3.4 ± 2.2 (11) |
| *Melipona favosa* | 24.8 ± 1.8 (3) | 39.3 ± 7.0 (7) | 33.5 ± 3.1 (3) | 72.2 ± 7.4 (3) | 3.1 ± 1.8 (3) |
| *Melipona eburnea* | 27.6 ± 2.1 (7) | 39.3 ± 7.0 (7) | 38.5 ± 7.5 (7) | 72.2 ± 7.4 (7) | 3.6 ± 1.5 (7) |
| *Melipona* sp. | 26.2 ± 1.8 (14) | 36.7 ± 3.5 (14) | 30.9 ± 4.0 (14) | 67.6 ± 7.5 (14) | 6.0 ± 2.3 (14) |
| *Nannotrigona testaceicornis* | 27.5 ± 4.2 (3) | 40.1 ± 18.1 (2) | 25.7 ± 17.0 (2) | 65.8 ± 35.1 (2) | 7.9 ± 4.3 (2) |
| *Nannotrigona* sp. | 25.7 ± 1.8 (4) | 33.1 ± 4.1 (4) | 17.7 ± 3.7 (4) | 50.8 ± 7.4 (4) | 9.7 ± 4.3 (4) |
| *Paratrigona opaca* | 26.6 ± 1.2 (4) | 30.9 ± 2.4 (4) | 27.2 ± 10.7 (4) | 58.1 ± 12.4 (4) | 3.9 ± 2.8 (4) |
| *Partamona peckolti* | 42.7 (1) | 26.6 (1) | 14.0 (1) | 40.6 (1) | 6.1 (1) |
| *Partamona* sp. | 28.9 (1) | 29.0 (1) | 9.3 (1) | 38.3 (1) | 13.1 (1) |
| *Plebeia* spp. | 28.6 (1) | 17.4 (1) | 19.3 (1) | 36.7 (1) | 0.9 (1) |
| *Scaptotrigona limae* | 25.8 ± 2.2 (2) | 39.0 ± 0.7 (2) | 28.7 ± 3.4 (2) | 67.7 ± 4.1 (2) | 6.6 ± 4.6 (2) |
| *Scaptotrigona* sp. | 26.9 ± 2.9 (4) | 31.8 ± 2.9 (4) | 23.9 ± 3.1 (4) | 55.7 ± 5.0 (4) | 12.1 ± 7.4 (4) |
| *Tetragona* sp.[d] | 25.8 ± 3.6 (21) | 31.8 ± 3.9 (19) | 29.0 ± 6.8 (19) | 60.8 ± 10.7 (19) | 4.4 ± 5.6 (19) |
| *Tetragonisca angustula*[d] | 24.3 ± 2.3 (44) | 30.1 ± 5.4 (41) | 23.5 ± 6.4 (41) | 53.6 ± 11.8 (41) | 4.2 ± 2.4 (41) |

Mean values, ± standard deviation and (number of samples) are presented

[a]Measured by refractometry according to the AOAC 969.38B standard methodology (AOAC 1998)

[b]Assessed using an HPLC method based on the AOAC 979.23 and 983.22 standard methodologies (AOAC 1998)

[c]Sucrose plus maltose

[d]Previously denominated as a subgenus of *Trigona* (Rasmussen and Cameron 2010)

ranged between 24 and 27 g/100 g; this parameter maybe a promising distinctive criterion for this kind of honey. It is important to mention that this assessment is performed via the indirect refractometric methodology (AOAC 1998), and thus, equations originally developed for *A. mellifera* honey are used as an approximation; the accuracy of this methodology should be scrutinized for each honey. To obtain more reliable data on this important feature, methods such as vacuum drying (an official and a low cost procedure), the Karl-Fischer method, and similar techniques are recommended.

Because of their floral origin, the main sugars present in stingless bee honey are glucose, fructose, maltose and sucrose; other disaccharides and oligosaccharides occur in lower proportion and in trace quantities. The sugar composition shown in Table 27.2 includes the most important sugars, all of which were evaluated using an HPLC (high pressure liquid chromatography) method, which does not differentiate sucrose and maltose. Therefore, the sum of these sugars is presented as disaccharides. Mean glucose content varied between 9.3 g/100 g (*Partamona* sp.) and 38.5 g/100 g (*Melipona eburnea*), mean fructose content between 17.1 g/100 g *Frieseomelitta*, and 40.1 g/100 g (*Nannotrigona testaceicornis*). The disaccharides varied between 0.9 g/100 g (*Plebeia*) and 13.1 g/100 g (*Partamona*). Honey from all *Melipona* had mean glucose content >30 g/100 g and mean fructose content >36 g/100 g. The mean fructose–glucose ratio for all species is >1 with an exception of one sample of *Plebeia*. An exceptionally high fructose/glucose value was found for *Partamona*, accompanied by the lowest total reducing sugars value and a relatively low value of total sugars. The fructose–glucose ratio for this species had not been previously reported as an unusually high value, although the low total sugar content has an antecedent in the study by Roubik (1983) (cited by Souza et al. 2006) in which honey of *P. pecktolti* had the lowest values of total sugars (°Brix) from among more than 25 types of stingless bee honey from Panama. Torres et al. (2004) reported values of fructose (36.1–37.6 g/100 g) and glucose (29.8–31.8 g/100 g) for honey of *T. angustula* from Colombia that are at the higher end of the range shown in Table 27.2.

Unusually low glucose content occurred in honey of *Frieseomelitta* (12.6 ± 7.5 g/100 g) and *Nannotrigona* (17.7 ± 3.7 g/100 g), whereas *M. eburnea* had the highest mean glucose content (38.5 ± 7.5 g/100 g). Moreover, high disaccharide content was found for *Scaptotrigona* (12.1 g/100 g) and *Partamona* (13.1 g/100 g). These values differ from those reported by Santiesteban-Hernández et al. (2003) in Mexico for the former genus (1.1 g/100 g). Such divergent values have high variability and probably too few samples analyzed, and thus, further characterization must be performed to better establish sugar concentration value as an origin denomination criterion, and to set regulatory quality standards.

### *27.2.2 Ash and Minerals*

The ash and mineral contents depend strongly not only on botanical and geographical origin, but also on the species (Vit et al. 1994, 2004, 2005; Vit 2005; Souza et al.

2006). The concentration of ash and some minerals (Na, K, Ca, Mg, Fe, Cu, and Zn) for Colombian pot-honey from four genera is shown in Table 27.3. For Colombian honey known thus far, obvious differences exist between species or genera.

According to mean ash content value, most analyzed honey meets the standard for Codex Alimentarius proposed by Vit et al. (2004), which is a maximum of 0.5 g/100 g (for honey from *A. mellifera*, *Melipona*, *Scaptotrigona* and *Tetragonisca* (formerly labeled a subgenus of *Trigona*), with the exception of honey from *Tetragona*) which had a mean content of 0.495 g/100 g and a standard deviation of ±0.077 g/100 g. This difference implies that some samples would not meet the suggested standard, in spite of authenticity, unless only one decimal place was used. In this case, the value could be approximated as 0.5 g/100 g. Some 40% of the *Tetragona* samples that were characterized exceeded 0.5 g of ash/100 g. Therefore, this suggestion needs to be clarified, at least for pot-honey from this species.

For all types of honey, the most concentrated mineral element yet quantified is potassium (188.3–1,669.4 ppm), and the least concentrated element is copper (0.8–1.2 ppm). Other minerals, in increasing order of concentration, are iron (3.3–49.6 ppm), zinc (6.7–19.6 ppm), magnesium (4.7–85.5 ppm), sodium (63.6–178.3 ppm), and calcium (51.0–267.8 ppm). This order of concentration is the same found for Colombian *A. mellifera* honey (Zuluaga 2010). In general, the honey that exhibits higher ash concentration has higher concentration of each mineral element, as may be expected. High variability indicates that this parameter can be used as a differentiation criterion, since it has been widely used for *A. mellifera* honey, and other apicultural products.

### *27.2.3 Other Physicochemical Quality Parameters*

Physicochemical analyses are important for establishing the identity of each variety of pot-honey, according to bee species and geographical origin, and to provide regulatory organizations with objective tools for preventing honey falsification in commerce. The quality parameters of honey produced by *A. mellifera* are not directly related to nutritive value (i.e., water, sugar and mineral content), but to authenticity, denomination of origin, and safety (pH, acidity, content of hydroxymethylfurfural, diastase activity, specific rotation, conductivity and color). They have been widely assessed for several types of this product, throughout the world. Such characterization, together with the need to avoid adulteration and falsification, have led food regulation agencies to set standards, which are generally very accurate for *A. mellifera* honey but regularly exclude the honey of other species from the legal definition of honey. This situation occurs in several countries, including Colombia. To set accurate quality standards for Colombian stingless bee honey, an extensive knowledge base regarding the behavior of these variables for each species must be gathered in the same manner currently used by other countries such as Venezuela,

**Table 27.3** Ash and mineral contents of Colombian stingless pot-honey

| Taxon | Ash[a] (g/100 g) | Sodium[b] (mg/kg) | Potassium[b] (mg/kg) | Calcium[b] (mg/kg) | Magnesium[b] (mg/kg) | Iron[b] (mg/kg) | Copper[b] (mg/kg) | Zinc[b] (mg/kg) |
|---|---|---|---|---|---|---|---|---|
| *Melipona compressipes* | 0.09 (1) | 63.6 (1) | 299.8 (1) | 55.0 (1) | 20.0 (1) | 4.8 (1) | 1.2 (1) | 10.8 (1) |
| *Melipona favosa* | 0.01 ± 0.01 (2) | – | – | – | – | – | – | – |
| *Melipona* sp. | 0.20 ± 0.00 (2) | 67.7 ± 33.6 (2) | 545.7 ± 138.2 (2) | 150.3 ± 0.9 (2) | 32.5 ± 1.8 (2) | 3.3 ± 0.3 (2) | 0.8 ± 0.4 (2) | 6.7 ± 2.5 (1) |
| *Nannotrigona* sp. | 0.33 (1) | 154.5 (1) | 961.2 (1) | 117.0 (1) | 4.7 (1) | 49.6 (1) | 1.9 (1) | 14.9 (1) |
| *Scaptotrigona limae* | 0.04 (1) | – | – | – | – | – | – | – |
| *Scaptotrigona* sp. | 0.06 (1) | – | 188.3 (1) | 51.5 (1) | 37.4 (1) | 15.1 (1) | 0.6 (1) | 19 (1) |
| *Tetragona* sp.[c] | 0.50 ± 0.08 (5) | 178.3 ± 29.5 (5) | 1669.4 ± 388.8 (5) | 267.8 ± 113.3 (5) | 85.5 ± 7.1 (5) | 6.2 ± 0.8 (5) | 1.2 ± 0.7 (5) | 18.1 ± 3.1 (5) |
| *Tetragonisca angustula*[c] | 0.21 ± 0.70 (12) | 155.0 ± 65.1 (9) | 576.6 ± 177.6 (9) | 199.6 ± 63.4 (9) | 56.0 ± 27.5 (9) | 5.8 ± 2.3 (9) | 0.9 ± 0.3 (9) | 19.6 ± 8.3 (9) |

Mean values, ± standard deviation and (number of honey samples) are presented
[a]Ash content was determined according to the AOAC 920.181 standard methodology (AOAC 1998)
[b]Mineral elements (Na, K, Ca, Mg, Fe, Cu, and Zn) were quantified by atomic absorption spectrometry according to the AOAC 979.23 standard methodology (AOAC 1998)
[c]Previously denominated as a subgenus of *Trigona* (Rasmussen and Cameron 2010)

Mexico, Guatemala, and Brazil (Vit et al. 2004; Souza et al. 2006). In Colombia, little knowledge on these quality parameters is published (Torres et al. 2004; Quicazán et al. 2009). However, such studies signal differences between honey from a stingless bee species in different countries (see Chap. 21). In addition, although our results agree with other reports in most cases, some values fell outside the suggested ranges. Table 27.4 presents the existing information regarding color, pH, acidity, diastase activity, HMF, conductivity and specific rotation of honeys of Colombian stingless bees.

Color was assessed using the Pfund scale, which is the most common color scale for *A. mellifera* honey, using a colorimeter (HI C221 Hanna Instruments). For *Melipona* honey, color is highly variable and may correspond to the particular species. Among the *Melipona*, some lacking current taxonomic certainty have the darkest honey, which can be considered light amber to amber according to the USDA color standard designation, whereas most honey of other *Melipona* ranges from very white to very light amber. *Nannotrigona* honey is considered to be light amber, and *Paratrigona* and *Scaptotrigona* honeys vary from white to light amber (high variability is found for these genera). For the former genus *Trigona* (here considered among the three genera *Tetragona*, *Tetragonisca* and *Frieseomelitta*) the lighter honeys appear to be those of *T. angustula*, even though they range from very white to light amber, and the darker honey is that of *Frieseomelitta*. The free acidity in honey of Meliponini is usually significantly higher than that of *A. mellifera*, reflected in pH, and in the flavor (Vit et al. 1994, 2004, 2005, 2006; Souza et al. 2004, 2006; Sosa López et al. 2004; Zuluaga 2010). This is likely associated with a higher tendency to spontaneously ferment due to a higher water content; fermentation is not necessarily an undesirable process, even though is typically not controlled (Vit et al. 1994, 2004). All of the analyzed Colombian honey meets the standards proposed by Vit et al. (2004) for pot-honey varieties from Venezuela, Guatemala, and Mexico. An unusual value of acidity was found for *M. compressipes*. Such low acidity has only been reported in honey from *Melipona beecheii* and *Melipona scutellaris* (Souza et al. 2006); therefore, because of the low number of samples, further assessment needs to establish whether this is normal in Colombia or only among analyzed samples.

Currently, the diastase activity of Colombian meliponine honey is known for only a few species. *Melipona* and *Scaptotrigona* pot-honey presented lower values than *Frieseomelitta*, *Tetragona*, *and Tetragonisca* for diastase activity, which is consistent with previously reported information (Vit et al. 1994, 2004). Unlike the activities of *A. mellifera* and *Tetragonisca*, these results indicate a lack of high enzyme activity, not due to possible heating of the product. It is important to note that the diastase activity for *Melipona* and *Scaptotrigona* honey was less than 3.0 DN, which is the lower detection limit of the Schade method (Bogdanov et al. 1997) used in this assessment; therefore, the diastase activity is not a standard to be considered for the quality of pot-honey.

The hydroxymethylfurfural (HMF) contents for Colombian pot-honey were much lower than the maximum accepted content for *A. mellifera* (40 mg/kg)

**Table 27.4** Physicochemical quality parameters of Colombian stingless bee honey

| Taxon | Color[a] (mm Pfund) | pH[b] | Free acidity[b] (meq/kg) | Diastase activity[c] (DN) | HMF[d] (mg/kg) | Conductivity[e] (μS/cm) | Specific rotation[e] |
|---|---|---|---|---|---|---|---|
| *Frieseomelitta* sp.[f] | 82 ± 7 (3) | – | – | – | – | – | – |
| *Melipona compressipes* | 42 ± 19 (10) | – | 7.0 (1) | n.d. (2) | 3.0 (1) | 1049 ± 56 (2) | −12.6 ± 2.6 (2) |
| *Melipona favosa* | 36 ± 4 (3) | – | – | n.d. (1) | – | – | – |
| *Melipona eburnea* | 34.4 ± 8 (7) | – | – | – | – | – | – |
| *Melipona* sp. | 45.2 ± 27.8 (13) | – | – | – | – | – | – |
| *Nannotrigona* sp. | 65 ± 4 (2) | – | – | – | – | – | – |
| *Paratrigona opaca* | 36 ± 15 (4) | 4.1 (1) | 31.7 (1) | – | – | – | – |
| *Plebeia* spp. | 62 (1) | – | – | – | – | – | – |
| *Scaptotrigona* sp. | 54 ± 27 (4) | 4.5 (1) | 57.83 (1) | 2.4 (1) | 6.0 (1) | 392 (1) | – |
| *Tetragona* sp.[f] | 70 ± 15 (18) | 4.2 ± 0.3 (4) | 44.3 ± 21.8 (4) | 17.8 ± 5.5 (2) | 1.0 ± 1.1 (2) | 1183 ± 122 (3) | −1.1 (1) |
| *Tetragonisca angustula*[f] | 49 ± 19 (23) | 4.2 ± 0.3 (12) | 39.2 ± 22.9 (12) | 16.7 ± 9.2 (8) | 1.3 ± 2.1 (6) | 658 ± 57 (2) | 2.6 ± 1.3 (3) |

Mean values, ± standard deviation and (number of honey samples) are presented

[a]Estimated photometrically on the Pfund scale using a C-221 colorimeter (Hanna Instruments, USA)

[b]pH was measured at 20 °C (10 g of honey/75 ml water); free acidity was assessed by neutralization according to the AOAC 962.19 standard methodology (AOAC 1998)

[c]Diastase activity assessed by the method of Schade (Bogdanov et al. 1997); DN: diastase number

[d]Hydroxymethilfurfural (HMF) evaluated spectrophotometrically according to the White method as described by Bogdanov et al. (1997)

[e]Electrical conductivity and specific rotation evaluated according to methods described by Bogdanov et al. (1997)

[f]Previously denominated as a subgenus of *Trigona* (Rasmussen and Cameron 2010)

(Table 27.4). It is interesting to note changes of this variable during long-term storage, considering that meliponine honey should be kept refrigerated, and the high moisture content could eventually enhance product appearance. Electrical conductivity has not been commonly assessed for stingless bee honey. In the case of *T. angustula*, conductivity (0.66 ± 0.06 mS/cm) was different from values reported by Vit et al. (1994) for Venezuelan honey (7.32 mS/cm), but similar to the value reported by Santiesteban-Hernández et al. (2003) for Mexican honey of this species (0.78 mS/cm), although there may be several species involved (see Chap. 21). The singular honey of *Scaptotrigona*. for which conductivity has been assessed had a particularly low value (0.39 mS/cm), which to the best of our knowledge is the lowest reported value for any stingless bee honey; a conductivity of 0.49 mS/cm for *Scpatotrigona mexicana* (reported erroneously as *S. luteipennis*) in Mexico was apparently the previous minimum reported value (Santiesteban-Hernández et al. 2003). The specific rotation is also a property that is not widely explored for stingless bee honey. The data presented in Table 27.4 indicate that specific rotation is a potential criterion for differentiating honeys because values for each species seem to stay within a consistent range. This property is related to the concentration of levorotary (as fructose) and dextrorotary (as glucose) compounds. However, the correlation is not known for pot-honey that has been evaluated and may be due to the presence of other sugars that have not been quantified, and other compounds with rotation capacity.

## 27.3 Conclusions

Even though most of the Colombian pot-honey display physicochemical properties within the range of values previously reported for diverse stingless bee species, the values show that physicochemical data can potentially be used as criteria to differentiate the honey from adulterated products, *A. mellifera* honey, other stingless bees honey, and even honey of the same species from different regions. Nevertheless, it is necessary to continue the characterization process that leads to a better knowledge of this valuable product, and the establishment of laws that regulate falsification and adulteration. The result will enable or stimulate sustainable meliponiculture across Colombia. In the Zuluaga-Domínguez et al. chapter of the present book, we tackle a further classification and differentiation of stingless bee honey with multivariate statistical analysis of physicochemical properties and the novel analytical methodology known as an "electronic nose."

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