

Composition of Venezuelan honeys from stingless bees (Apidae: Meliponinae) and *Apis mellifera* L

P Vit¹, S Bogdanov^{2,*}, V Kilchenmann²

¹ Dpto Ciencia de los Alimentos, Facultad de Farmacia, Universidad de Los Andes, Mérida, Venezuela;

² Bee Department, Federal Dairy Research Station, 3097 Liebefeld, Bern, Switzerland

(Received 29 March 1993; accepted 11 August 1993)

Summary — Forty stingless-bee and 21 *Apis mellifera* honeys from Venezuela were analysed for their essential composition. The stingless bees comprised 3 *Melipona* and 5 *Trigona* species. The moisture content of the honeys from the different stingless-bee species was significantly higher than that of the *A mellifera* honeys. Generally, the stingless-bee honeys had a higher acidity than the *A mellifera* honeys. The honeys from the *Melipona* species had lower diastase activity than the *Trigona* species. There were also differences in the acidity and the ash and nitrogen content of the honeys of the different stingless-bee species, but these differences might also be due to a different floral origin. While the *A mellifera* honeys fulfilled the quality requirements set by the *Codex Alimentarius*, the honeys from the stingless bees failed to do so for several parameters, especially the quality factors such as water content, reducing sugars, acidity, and ash content.

***Apis mellifera* / stingless bees / Meliponinae / honey / physico-chemical analysis / Venezuela**

INTRODUCTION

Apidae is the family to which honey bees and stingless bees belong; they have been assigned to separate subfamilies, the Apinae and the Meliponinae, respectively (Culliney, 1983). "The Meliponinae comprises 5 genera, the most extensive being *Trigona* and *Melipona*. The *Trigona* species occurs in every continent except Europe,

whereas *Melipona* does not occur outside the Americas. Over 500 species of stingless bees are known, the majority are in South America and relatively few occur in Africa, Asia and Australia; they make honey as *Apis* species do and can be kept in hives as *Apis mellifera* and *Apis cerana*" (Crane, 1992). The classification of the Meliponinae subgenera adopted in the present work is that suggested by Camargo (Vit and Camargo, 1988).

* Correspondence and reprints.

Stingless bee culture (meliponiculture) was formerly developed by the Maya civilisation, especially with *Melipona beecheii*, which is not found in Panama to the South (Weaver and Weaver, 1981; Crane, 1992). Unlike honey bees, stingless bees cannot sting and keep their honey in ellipsoidal pots made with cerumen (a mixture of wax and propolis) which vary in size with the species.

In Venezuela, there are many species of stingless bees but they and their products have scarcely been studied. The highest yields of Venezuelan stingless-bee honeys are given by *M favosa favosa*, *M compressipes compressipes* and *M trinitatis*. However, honey is also harvested from the *Trigona* species (Vit and Camargo, 1988). Stingless-bee hunting is also a common practice in the central and eastern plains of the country. Our work can be seen as a specific contribution on stingless-bee honeys, while some more general work on Venezuelan meliponiculture have previously been published (Stejskal, 1962; Rivero, 1972, Bracho, 1993, Pulido, 1993).

The first report on the composition of stingless-bee honeys was given by Nogueira-Neto (1953) for one sample of *M quadrifasciata*. Gonnet *et al* (1964) observed higher water content, invertase and acidity, lower pH and the lack of diastase for meliponin honeys when compared with *A mellifera* honeys from Brazil. Roubik (1983) analysed the sugar content of honey stores from stingless bee from Panama. In 1991, Cortopassi-Laurino and Gelli compared Brazilian honeys from Africanized honey bees and from stingless bees; they found that moisture was the characteristic which best differentiated the 2 groups, while in colour both ranged between amber and light amber. Klink (1992) analysed water content, sugars, pH, acidity and enzymes of stingless-bee honeys from Costa Rica. Besides the physico-chemical composition, the specific taste of stingless-bee honeys

has also been mentioned (Schwarz, 1948; Nogueira-Neto, 1953; Wille, 1983).

Even if the therapeutic use of stingless-bee honeys is stated in the Maya Pharmacopea and their medicinal properties are still highly appreciated in numerous communities of Brazil, Colombia, Costa Rica, Guatemala, Mexico and Venezuela, there are no regulations for their quality control.

The aim of this study was to achieve a first physico-chemical characterisation from different species of Venezuelan stingless-bee honeys, to compare those with *A mellifera* honeys from Venezuela. We also wanted to see to what extent these native honeys fulfilled the honey quality requirements suggested by the *Codex Alimentarius* Commission (1969) and by the Venezuelan regulations for honey (COVENIN 2136-84 and COVENIN 2191-84).

MATERIALS AND METHODS

Samples

Forty stingless bee honey samples, each sample varying from 50 to 2 000 g, were harvested from sealed honey pots in different locations of Venezuela in 1987-1988. Stingless-bee samples were also collected for the identification of the species. The 21 *A mellifera* honeys were of commercial origin.

The species of the Venezuelan stingless bees chosen for honey analysis here are listed in table I, as well as their common name and geographical origin. *M compressipes compressipes* has a grey colour and is found in the west, while *M trinitatis* has a brown colour and is found in the east; both of these species are called 'guanotas'.

Due to the restricted number of samples, which was not greater than 2 for some species, we can only refer separately to *M compressipes compressipes*, *M trinitatis*, *M favosa favosa* and *Frieseomelitta officinalis varia*. The honeys of the other *Trigona* species were grouped together and were not considered for the statistical analysis

Table I. Species of the Venezuelan stingless bees whose honey was analysed in this work.

Stingless bees	Common name	Geographical origin
<i>Melipona</i>		
<i>Melipona compressipes compressipes</i> (Fabricius)	Guanota	Guardatinajas (Guarico) 1; Acarigua (Portuguesa) 1; Via Elorza (Apure) 1; Guasdaluito (Apure) 1; Bobare (Lara) 1
<i>Melipona favosa favosa</i> (Fabricius)	Erica	Barrancas (Barinas) 1; Bobare (Lara) 1; Caserio Sampai (Bolívar) 3; Guasipati (Bolívar) 3; Vericallar (Sucre) 2; Las Manoa de Cariaco (Sucre) 2; Salamanca (Nueva Esparta) 2; Guardatinajas (Guarico) 1; Guasdaluito (Apure) 1; Via Elorza (Apure) 1
<i>Melipona trinitatis</i> (Cockerell)	Guanota	Potrерito (Monagas) 2; Soro (Sucre) 2; Marabal (Sucre) 2; Salamanca (Nueva Esparta) 2
non- <i>Melipona</i> *		
<i>Plebeia (Scaura) latitarsis</i> (Friese)		Chaveru (Bolívar) 3; Santa Ana (Tachira) 2
(<i>Plebeia</i>) sp	Mosquito	El Pauji (Bolívar) 3; San Francisco de Macanao (Nueva Esparta) 2
<i>Scaptotrigona</i> sp <i>aff</i> <i>deplis</i> (Moure)	Guaracho	San Francisco de Macanao (Nueva Esparta) 2
<i>Trigona (Frieseomelitta) nigra paupera</i> (Provancher)		La Guanota (Monagas) 2
<i>Trigona (Frieseomelitta) sp aff varia</i> (Lepelletier)	Angelita	Santa Elena de Uarién (Bolívar) 3; El Pauji (Bolívar) 3 Puy (Bolívar) 3; La Tuquerena (Tachira) 1; Santa Ana (Tachira) 1
<i>Trigona (Frieseomelitta) angustula angustula</i> (Latreille)	Españolita	Acarigua (Portuguesa) 1; Bobare (Lara) 1

For practical purposes, the Venezuelan territory was divided into regions: 1 (western); 2 (eastern); 3 (southern). The states of the locations are in parentheses. * See note at the end of article.

because of the high interspecific variations. However, their results are included in the discussion.

Analytical methods

Water content, reducing sugars, sucrose, ash and the acidity were measured according to the *Codex Alimentarius* methods of analysis for honey (1969), which are basically the same as those suggested in the Venezuelan regulations for honey (COVENIN 2136-84). The diastase activity of the stingless-bee honeys was measured with the Phadebas test (Bogdanov, 1989), while that of the *A mellifera* honeys was determined by a qualitative iodine/starch method (Rodriguez and Martin, 1980). The nitrogen content was determined by the micro-Kjeldahl technique (AOAC, 1990).

A semiquantitative method based on the Fiehe reaction described by Rodriguez and Martin (1980) and the colour scale suggested by Vit (1988) was used to detect hydroxymethylfurfural (HMF) in the stingless-bee honeys. For that purpose, 2 ml ether were added to 2 ml of a 50% (w/v) honey solution and thoroughly shaken. The ether extract was transferred into a test-tube and 3 drops of 1% (w/v) resorcinol in hydrochloric acid was added. The colour developed in 1 min was compared with that of HMF concentration of the standards. The readings 1, 2 and 3 correspond to honeys with HMF < 20, 20-40 and > 40 mg HMF/kg honey.

The differences between the chemical parameters of the honeys of the different species were determined with Systat software using the Tukey test.

RESULTS AND DISCUSSION

Table II shows the physico-chemical composition of Venezuelan stingless-bee honeys and *A mellifera* honey. In table III the statistical significance of the interspecies differences in the chemical parameters is given (*P* values) as determined by the Tukey test. The missing values and parameters mean that the *P* values were higher than 0.05.

Water content

The water content of the *A mellifera* honeys was significantly lower than the honeys from the *Melipona* and the different *Trigona* species, except for *F officinalis varia*. In the latter group it was observed that the moisture content varied with the geographical origin of the samples. The samples from the south (BOLIVAR) had an average water content of 16.16%, while the samples from the west (TACHIRA) had an average of 24.87%. This fact cannot be explained at present, since a more detailed sampling procedure in different tropical seasons is required. It is certainly interesting to discover stingless-bee honeys with even lower water content than *A mellifera* honeys, which was not previously reported. Even if we are not concerned with evolutionary subjects, we may suggest that in Venezuela *F officinalis varia* shows a possible intraspecific adaptation for honey moisture.

The high water content of stingless bee honeys compared with that of the *A mellifera* honeys has already been mentioned by Schwarz (1948), Nogueira-Neto (1953), Gonnet *et al* (1964), Cortopassi-Laurino and Gelli (1991), Crane (1992) and Klink (1992). Crane (1992) pointed out that honeys from stingless bees are generally more acid and contain more water than *A mellifera* honeys, and that, for reasons that are not yet clear, they are fairly resistant to spoilage by unwanted fermentation. It is suggested that the resins present in the cerumen used to build up the storage pots could be present in honey and may serve as biocidal agents, preventing fermentation (Michener, 1974; Roubik, 1983). We suggest that specific moisture limits for stingless-bee honeys be set in the honey regulations. The *Codex Alimentarius* commission (1969) suggests a honey water content lower than 21%, while according to the Venezuelan regulations (COVENIN 2191-84), the moisture content

Table II. Physico-chemical analysis of stingless bees and *Apis mellifera* honeys from Venezuela. The value are averages \pm standard error, minimum and maximum values are in brackets.

	Melipona compressipes (n = 5)	Melipona trinitatis (n = 4)	Melipona favosa (n = 14)	Frieseomelitta aff varia (n = 7)	Other non-Melipona stingless bee species (n = 10)	Apis mellifera (n = 21)
Moisture %	23.4 \pm 1.1 (20.9 – 26.8)	25.7 \pm 1.1 (22.5 – 27.5)	25.5 \pm 0.7 (22.1 – 30.2)	19.9 \pm 1.8 (14.8 – 26.1)	22.3 \pm 1.0 (19.3 – 27.3)	16.7 \pm 0.05 (14.9 – 19.0)
Reducing sugars %	75.67 \pm 1.23 (72.35 – 79.94)	73.66 \pm 1.58 (71.34 – 78.25)	72.14 \pm 1.25 (61.57 – 78.55)	61.01 \pm 3.67 (48.89 – 73.21)	63.44 \pm 3.20 (48.18 – 72.69)	73.6 \pm 0.11 (68.4 – 77.5)
Sucrose %	1.57 \pm 0.19 (1.01 – 1.98)	1.48 \pm 0.13 (1.09 – 1.66)	1.46 \pm 0.18 (0.52 – 2.86)	4.82 \pm 1.73 (0.66 – 10.60)	4.55 \pm 1.62 (1.09 – 12.30)	2.31 \pm 0.06 (0.42 – 5.20)
Ash %	0.30 \pm 0.05 (0.16 – 0.48)	0.12 \pm 0.04 (0.08 – 0.24)	0.29 \pm 0.05 (0.04 – 0.61)	0.76 \pm 0.12 (0.33 – 1.10)	0.67 \pm 0.14 (0.12 – 1.49)	0.22 \pm 0.07 (0.04 – 0.58)
HMF (semiquant)	1 \pm 0 (1 – 1)	1.3 \pm 0.3 (1 – 2)	1.2 \pm 0.6 (1 – 3)	1.1 \pm 0.1 (1 – 2)	1.1 \pm 0.1 (1 – 2)	1.3 \pm 0.01 (1 – 2)
Diastase (Gothie units)	1.1 \pm 0.2 (0.7 – 2.0)	1.0 \pm 0.1 (0.7 – 1.2)	0.9 \pm 0.1 (0.7 – 1.5)	7.8 \pm 1.5 (3.7 – 12.8)	6.8 \pm 2.3 (0.9 – 20.2)	positive ²
Acidity (meq/kg)	48.38 \pm 11.51 (33.93 – 94.12)	24.24 \pm 4.83 (12.92 – 35.30)	62.93 \pm 14.60 (18.63 – 228.80)	73.00 \pm 15.35 (41.90 – 138.55)	79.65 \pm 21.78 (16.92 – 248.52)	27.0 \pm 7.0 (13.9 – 40.3)
Nitrogen (mg/100 g)	48.94 \pm 5.83 (30.97 – 67.41)	47.82 \pm 4.36 (41.71 – 60.32)	40.66 \pm 5.81 (14.61 – 92.57)	134.12 \pm 8.32 (94.56 – 156.04)	175.80 \pm 34.34 (41.91 – 335.31)	57.1 \pm 11.8 (34.6 – 87.3)

¹ Honeys from other non-Melipona stingless bee species (see note at the end of article), *Tetragonisca angustula angustula*, *Frieseomelitta nigra paupera*, *Scaptotrigona aff depilis*, *Scaura latifarsis* and *Plebeia* sp. ² Determined with qualitative colorimetric iodine/starch test.

Table III. Differences between the honeys of the various bee species.

	AM/MC	AM/MT	AM/MF	AM/FO	MC/FO	MT/FO	MF/FO
Moisture	0.001	0.001	0.001	0.021		0.048	0.001
Reducing sugars			0.005				
Ash				0.001	0.01	0.001	0.001
Nitrogen				0.001	0.001	0.009	0.001

The data shown in table II was subjected to the Tukey test. Only *P* values smaller than 0.05 are given. Differences in other parameters between the different honeys proved to be insignificant. Abbreviations: AM: *A mellifera*; MC: *M compressipes compressipes*; MT: *M trinitatis*; MF: *M favosa*; FO: *F aff varia*.

should be lower than 20%. The lower limit helps to decrease the fermentation danger in commercial honeys.

The stability to fermentation of the stingless-bee honeys could have something in common with the high antibacterial activity reported for *Melipona* honeys (Vit *et al*, 1992, Cortopassi-Laurino and Gelli, 1992).

Reducing sugars and sucrose

The amount of reducing sugars in some *Melipona* honeys were similar to *A mellifera* honeys, but a lower average was found for *F officinalis varia* and for the different *Trigona* species. However, only the difference between the *F officinalis varia* honeys and the *A mellifera* honeys was significant. For all the stingless-bee honeys, the reducing sugar content varied from 48.18 to 79.94%, which is wider and generally lower than the 68.4–77.5% found for *A mellifera* honeys.

The sucrose content was somewhat lower in *Trigona* than in *Melipona* honeys and also showed a wider range of 1.09–12.30% when compared with 0.52–2.86% for *Melipona* and 0.42–5.20% for *A mellifera* honeys, but the difference was not significant.

Honey is a natural product with known variable sugar composition in which more than 20 di- and trisaccharides have been identified besides the main fraction of monosaccharides, glucose and fructose (Doner, 1977). The sugar composition of honey depends on the sugars present in the botanical source, and also on their transformation by the enzymes secreted by bees.

Since here we are dealing with the general quality criteria for Venezuelan stingless-bee honeys, only the reducing sugars and the sucrose content is discussed. In another paper (Bogdanov and Vit, unpublished data) we consider the sugar spectrum of these samples.

Ash

The ash content of the *Melipona* honeys was significantly lower than that of the *Trigona* honeys, with ranges of 0.04–0.61 for *M favosa favosa* versus 0.33–1.10 for *F aff varia*. Moreover, *A mellifera* honeys had a significantly lower content than the *Trigona* honeys. These differences could be attributed to the botanical origin, since the ash content depends strongly on the honey source. In another publication, the floral origin of the samples as determined by pollen

analysis will be discussed (Vit and Ricciardelli d'Albore, manuscript in preparation). In the microscopic preparations of the samples used in the present study very few honeydew particles were encountered. The higher values observed for *F aff varia* and for different *Trigona* species, could suggest some botanical preferences for specific sugar sources. During the field work, it was observed that some stingless bees collected fruit juices that did not attract honey bees. Fruit juices generally have a higher ash content than nectar. Feeding with fruit juices would thus raise the normal values for this parameter.

Since the botanical origin of honeys in Venezuela has not been studied, there is no differentiation for the ash content of honeys with different botanical origin in the national regulation for honeys (COVENIN 2191-84). It is required that honeys have an ash content lower than 0.5%; commercial honeys from Venezuela with ash values higher than 0.5% are considered 'altered' (Vit, 1988). Boiled sugar cane syrup, which is sometimes sold as honey, has a higher ash content than 0.5%. For this reason, the *A mellifera* honeys, with more than 0.5% ash are not included in this study. A higher maximal value for the ash content should be considered not only for stingless-bee honeys but also for *A mellifera* ones.

Hydroxymethylfurfural

The HMF content was generally lower than 20 mg/kg, with the exception of one sample of *M favosa favosa* honey with a value higher than 40 mg/kg.

HMF is known as a honey fraud indicator in developing countries, where it is a common practice to sell boiled sugar cane syrup as genuine honey. The *Codex Alimentarius* Commission (1969) specifies an HMF content for honey lower than 40 mg/kg, but the Venezuelan regulations just specifies a 'neg-

ative' result for the Fiehe reaction. For this reason a semiquantitative method was used in this work.

It would be interesting to study the evolution of HMF content in stingless-bee honeys kept in common market conditions, since the high water content and acidity values could increase the HMF content to a greater extent than the *A mellifera* honeys.

Diastase activity

Our results showed that *Melipona* honeys had almost no diastase activity, while the *Trigona* honeys had normal, somewhat low diastase activities with average values of about 7 Gothe units. These activities lie within the range found in some *A mellifera* monofloral honeys with low enzymatic activity (Persano-Oddo *et al*, 1990).

The diastase origin in honey is attributed to the salivary secretions of bees and not to the honey source, because this enzyme was found in honeys of sugar-fed bees (Stadelmeier and Bergner, 1986). Thus it can be concluded that *Melipona* species lack this enzyme. Gonnet *et al* (1964) also found no diastase activity but a normal invertase activity in *Melipona* honeys.

Acidity

There was no significant difference between the acidity values of stingless-bee honeys and that of *A mellifera* honeys. However, in table II shows that *M trinitatis* and *A mellifera* had similar and lower acidity, while the acidity of *M compressipes compressipes*, *M favosa favosa* and *Trigona* honeys was generally higher.

As previously mentioned, stingless-bee honeys are organoleptically known as acid or sour honeys (Schwarz, 1948; Nogueira-

Neto, 1953; Gonnet *et al*, 1964; Rivero, 1972; Espina Perez and Ordex, 1981; Wille, 1983; Crane, 1992). This characteristic is also reflected in the high acidity values of these honeys.

In Venezuela, honeys from 'guanotas' are generally known as being sweeter than honeys from 'ericas', and both of these *Melipona* honeys are widely relished. Honeys from *Trigona* are mainly used for medicinal purposes. As Cortopassi-Laurino and Gelli (1991) suggested, the high acidity of stingless-bee honeys should have an important implication by itself in the high antibacterial activity reported for this honeys when compared with *A mellifera*.

The difference in acidity between *M compressipes compressipes* and *M trinitatis* could be a matter for a deeper study on the strategies used by these species of the same genus to keep their honey unspoiled at high moisture contents. If high acidity is not developed in honeys of *M trinitatis*, other substances could be present for the prevention of fermentation.

Nitrogen

In tables II and III it can be observed that *F aff varia* honeys had higher and significantly higher nitrogen content than the *Melipona* and the *A mellifera* honeys, respectively, their values ranging from 94.6 to 156, compared with 14.6–92.6 (*Melipona*) and 34.6–87.3 (*A mellifera*) mg N/100 g, respectively.

The nitrogen content is not included in the Venezuelan regulations for honey, but it was found as a useful honey fraud indicator since genuine honeys have higher nitrogen content than honey frauds (Vargas, 1983; Vit, 1987). The honey nitrogen is derived from the proteins and amino acids of honey. Generally, flower honeys have lower nitrogen content than honeydew honeys (White,

1962). The values found in the *Trigona* honeys are similar to those found in honeydew honeys.

Botanical origin

The results show that *Trigona* honeys had a more 'honeydew-like' character (lower reducing sugar content, higher ash, acidity and nitrogen content) than the *Melipona* and honeys. However, the typical honeydew sugars melezitose and raffinose were not detected in the 'honeydew-like' samples (Bogdanov and Vit, unpublished data). Also, microscopic examinations of the samples revealed only very few honeydew particles in the honey samples, suspected to have a honeydew origin. As was mentioned earlier, it was observed that stingless bees are attracted by fruit juices, while *A mellifera* are not. We think that the melissopalynological analysis (Vit and Ricciardelli d'Albore, unpublished data) could help to determine the botanical origin of stingless-bee honeys. Melissopalynological analysis of Venezuela *A mellifera* honeys was done by Ricciardelli D'Albore and Vit (1990). One general approach on the bee flora of Venezuela has been made by Lòpez-Palacios (1976).

CONCLUSIONS

Stingless-bee honeys have higher water content than *A mellifera* honeys. These differences are probably due to the differences between these bee subfamilies. *Melipona* and *A mellifera* honeys had generally a lower reducing sugar content and a higher saccharose content than *Trigona* honeys, but these differences were not significant. The ash content was higher in *Trigona* honeys than in *Melipona* and *A mellifera* honeys. The HMF content of all samples was lower than 20 mg/kg. The diastase activity was lacking in *Melipona* honeys when com-

pared with *Trigona* honeys, which had a diastase activity of about 7 Gothe units. *Trigona* honeys had higher acidity than *Melipona* honeys, while *M favosa favosa* honeys had the highest acidity among *Melipona* honeys. Generally *A mellifera* honeys had a lower acidity than stingless bee honeys with the exception of the *M trinitatis* honeys. The nitrogen content of *Trigona* honeys was higher than in *Melipona* honeys and *A mellifera* honeys.

The observed differences in all parameters, except the water content, could be due to differences of the floral source or the bee species or to both of these factors. We are also aware that the analysed sample size was restricted and that the resulted 'significant differences' of the statistical analysis should not be overestimated. Further specific studies with more samples with stingless-bee honeys in Venezuela are necessary to determine the exact cause of these differences.

The quality factors, water content, reducing sugars, acidity and ash content of the stingless-bee honeys did not fulfil the *Codex Alimentarius* quality standards. For those, specific quality criteria should be established. For Venezuela, we would suggest to chose *Melipona* honeys only, because of their significant yields when compared with *Trigona* honeys, with, at least, the 2 already known denominations of 'guanotas' and 'ericas'.

ACKNOWLEDGMENTS

We gratefully acknowledge the support of this research by CONICIT (S1-1966) and CDCHT-ULA (FA-76-86). Some samples were kindly provided by Venezuelan beekeepers and meliponicultors. We are indebted to J Camargo from the University of Sao Paulo in Brazil, for the stingless bee identification; to T Ivanov from the Experimental Station of Beekeeping of Sofia in Bulgaria, for his helpful comments on the manuscript; and to D Pulido from the Eastern University in Venezuela, for his valuable help to

provide old stingless-bee references. We thank D Vit for his help in the field work.

Résumé — Composition des miels vénézuéliens de méliponinés (Hymenoptera, Apidae) et d'*Apis mellifera* L.

Quarante miels de méliponinés (3 espèces de *Melipona* et 6 espèces de *Trigona*) et 21 miels d'*Apis mellifera* ont été analysés (tableau I). Les résultats des analyses chimiques sont donnés dans le tableau II et les tests statistiques dans le tableau III. Le taux d'humidité des miels de méliponinés (moyennes de 19,9 à 25,7%, min 14,8%, max 30,2%) est significativement plus élevé que celui des miels d'*A mellifera* (moyenne 16,7%, min 14,9%, max 19,0%). Dans l'ensemble, les miels des méliponinés présentent une acidité plus élevée que ceux d'*Apis mellifera*. La teneur des miels de méliponinés en sucres réducteurs, en saccharose et en cendres est respectivement de 48,9 et 79,9%, 0,5 à 12,3% et 0,04 à 1,49%. Ils renferment 14,61 à 335,51 mg d'azote par 100 g de miel et leur teneur en hydroxyméthylfurfural (HMF) est inférieure à 20 mg/kg. L'acidité varie de 12,92 à 248,52 meq/kg et l'activité diastasique de 0,7 à 20,2 unités Gothe. L'activité diastasique des miels de méliponinés (moyennes de 0,9 à 1,1 unités de Gothe) est plus faible que celle des miels de trigones (moyennes de 6,8 à 7,8 unités de Gothe). On a trouvé en outre des différences dans l'acidité et la teneur en cendres et en azote entre les miels des différentes espèces de méliponinés. Mais ces variations pourraient être dues à des différences au sein de la flore. Alors que les miels d'*A mellifera* ont satisfait aux critères de qualité définis par le *Codex Alimentarius*, les miels des méliponinés n'ont pas rempli les exigences pour certains paramètres tels que l'acidité et les teneurs en eau, en sucres réducteurs et en cendres.

***Apis mellifera* / Meliponinae / miel / composition chimique / Venezuela**

Zusammenfassung — Zusammensetzung der venezolanischen Honige von stachellosen Bienen (Hymenoptera, Apidae) und *Apis mellifera* L. Vierzig Honige von stachellosen Bienen und 21 Honige von *Apis mellifera* aus Venezuela wurden auf ihre Zusammensetzung analysiert. Die untersuchten stachellosen Bienen umfasste 3 *Melipona*- und 5 *Trigona* Arten (Tabelle I). Die Resultate der chemischen Analysen der Proben sind in Tabelle II, diejenigen der statistischen Analyse in Tabelle III wiedergegeben. Der Wassergehalt der Honige der verschiedenen stachellosen Arten war signifikant höher (Durchschnittswerte 19,9 bis 25,7%, Min 14,8%, Max 30,2%) als derjenige der *Mellifera*-Honige (Durchschnittsgehalt 16,7%, Min 14,9% Max 19,0%). Im allgemeinen hatten die Honige der stachellosen Bienen einen höheren Säuregrad als die *Apis mellifera*-Honige. Die *Melipona*- und *Trigona*-Honige wiesen folgende chemische Zusammensetzung auf: reduzierende Zucker 48,89 bis 79,94%, Saccharose 0,52 bis 12,30%, Asche 0,04 bis 1,49%, Säure 12,92 bis 248,52 mval/kg, Diastaseaktivität 0,7 bis 20,2 Gothe-Einheiten, Stickstoff 14,61 bis 335,51 mg/100 g Honig, Hydroxymethylfurfural (HMF): weniger als 20 mg/kg Honig. In den *Melipona*-Honigen war die Diastase-Aktivität tiefer (Durchschnittswerte 0,9 bis 1,1 Gothe Einheiten) als in den *Trigona*-Honigen (Durchschnittswerte 6,8 bis 7,8 Gothe Einheiten). Beim Säuregrad und beim Asche- und Stickstoffgehalt traten auch Unterschiede zwischen den Honigen der verschiedenen Arten der stachellosen Bienen auf, die aber auch durch unterschiedliche Flora bedingt sein könnten. Während die Honige von *A mellifera* den Qualitätsanforderungen des Codex Alimentarius entsprachen, erfüllten die Honige der stachellosen Bienen verschiedene Qualitätskriterien nicht, vor allem in Bezug auf Wassergehalt, reduzierende Zucker, Säuregrad und Aschegehalt.

***Apis mellifera* / Meliponinae / Honig / chemische Zusammensetzung / Venezuela**

REFERENCES

- Association of Official Analytical Chemists (1990) *Official Methods of Analysis*. 15th ed AOAC, Arlington, USA
- Bogdanov S (1984) Honigdiastase: Gegenüberstellung verschiedener Bestimmungsmethoden, *Mitt Gebiete Lebensm Hyg* 75, 214-320
- Bracho ME (1993) Habitos en cuanto a recolección de polen, néctar materiales de construcción y agua en abejas del género *Melipona* (Hymenoptera, Apidae), Memorias I Concencion Nacional de Apicultura, Merida, 1986 (in Spanish)
- Codex Alimentarius Commission (1969) Recommended European Regional Standard for Honey. FAO/OMS, CAC/RS 12, Rome
- Comisión Venezolana de Normas Industriales (1984) *Miel de Abejas. Métodos de Ensayo*. COVENIN 2136-84, CT 10 S/14, Caracas (in Spanish)
- Comisión Venezolana de Normas Industriales (1984) *Miel de Abejas*. COVENIN 2191-84, CT 10 S/14, Caracas (in Spanish)
- Cortopassi-Laurino M, Gelli DS (1991) Analyse pollinique, propriétés physico-chimiques et action antibactérienne des miels d'abeilles africanisées *Apis mellifera* et de *Méliponinés* du Brésil. *Apidologie* 22, 61-73
- Crane E (1992) The past and present status of bee-keeping with stingless bees. *Bee World* 73, 29-42
- Culliney TW (1983) Origin and evolutionary history of honeybees *Apis*. *Bee World* 64, 29-38
- Doner LW (1977) The sugars of honey. A review. *J Sci Food Agric* 28, 443-455
- Espina Perez D, Ordex G (1981) *Apicultura Tropical* (Tropical Apiculture). Editorial Tecnologica de Costa Rica, Cartago, Costa Rica (in Spanish)
- Gonnet M, Lavie P, Nogueira-Neto P (1964) Étude de quelques caractéristiques des miels récoltés par certains *Méliponines* brésiliens. *CR Acad Sci Paris* 258, 3107-3109
- Klink M (1992) Onderzoek naar fysische en chemische aspecten van siukervoedingshoning en Costa Ricaanse angelloze bijenhoning (Physical and chemical aspects of honeys of sugar fed honeybees and from stingless bees from Costa Rica). PhD thesis. Rijksuniversiteit, Utrecht, The Netherlands (in Dutch)
- Lopez-Palacios S (1976) *Catálogo para una Flora Apícola Venezolana* (Catalog for a Venezuelan Bee Flora). Consejo de Publicaciones. Universidad de Los Andes, Mérida, Venezuela (in Spanish)
- Michener CD (1974) *The Social Behaviour of the Bees*. Harvard University Press, Cambridge, USA
- Nogueira-Neto P (1953) *A Criacao de Abelhas Indigenas sem Ferrao (Meliponinae)*. Editora Chacaras e Quintais, Sao Paulo, Brazil (in Portuguese)
- Persano-Oddo L, Baldi E, Accorti M (1990) Diastatic activity in some unifloral honeys. *Apidologie* 21, 17-24

- Pulido D (1993) Actividad inhibitoria de mieles, propolis y germicidas domesticos, Memorias I Convencion Nacional de Apicultura, Merida, Venezuela, 1986 (in Spanish)
- Ricciardelli D'Albore GC, Vit P (1990) Apicultura nel Venezuela e spettro pollinico dei mielli che vi si producono (Beekeeping in Venezuela and pollen spectra for honeys). *Apicultura* 6, 71-104 (in Italian)
- Rivero R (1972) *Abejas Criollas sin Aguijòn* (Creole stingless bees). Colección Científica Monte Avila, Caracas (in Spanish)
- Rodriguez B, Martin E (1980) *Anàlisis de Alimentos* (Food Analysis). Central University, Caracas (in Spanish)
- Roubik DW (1983) Nest and colony characteristics of stingless bees from Panama (Hymenoptera: Apidae). *J Kansas Entomol Soc* 56, 327-355
- Schwarz H (1948) Stingless Bees (*Meliponidae*) of the Western Hemisphere. *Bull Am Mus Natl Hist* 90, 1-546
- Stadelmeier M, Bergner KG (1986) Protein des Bienenhonigs. VII. Eigenschaften und Herkunft der Honigamylase. *Z Lebensm Unters Forsch* 182, 196-199
- Stejskal M (1962) Duft als 'Sprache' der tropischen Bienen (Scent as language of tropical bees). *Südwestdtisch Imker* 14, 271 (in German)
- Vargas T (1983) Estudio fisico-quimico de miel en el estado Aragua, su aplicaciòn en el control de fraudes (Physico-chemical study of honeys from the state of Aragua, its application to control frauds). Internal Report Central University of Venezuela, Maracay, Venezuela (in Spanish)
- Vit P (1987) Utilidad de la determinaciòn del contenido de nitrògeno en el control de calidad de mieles venezolanas (Use of nitrogen determination for honey quality control in Venezuela). *Acta Cient Venez* 39, 210 (in Spanish)
- Vit P (1988) Clasificaciòn de mieles comerciales venezolanas segùn sus características fisico-químicas y organolépticas (Physico-chemical and organoleptic classification for Venezuelan commercial honeys). Internal Report, University of the Andes, Mérida, Venezuela (in Spanish)
- Vit P, Camargo J (1988) Estudio bromatològico de las mieles de abejas sin aguijòn producidas en Venezuela (Bromatological study of stingless bee honeys produced in Venezuela). *Acta Cient Venez* 39, 210 (in Spanish)
- Vit P, Rios M, Novoa ML, Reinosa J, Camargo J (1992) Antibacterial activity and mineral content of Venezuelan stingless-bee honeys. Abstracts Fifth International Conference on Apiculture in Tropical Climates, Trinidad
- Weaver N, Weaver EC (1981) Beekeeping with the stingless bee *Melipona beecheii* by the Yucatecan Maya. *Bee World* 62, 7-19
- White, J (1962) Composition of American honeys, *Tech Bull* No 1261, US Department of Agriculture
- Wille A (1983) Biology of stingless bees. *Annu Rev Entomol* 28, 41-64

Note added in proof:

In the literature, stingless bee systematics is apparently a controversial subject. Crane (1992) stated "The Meliponinae comprises 5 genera, the most extensive being *Trigona* and *Melipona*". But that same year, Camargo and Menezes Pedro published a mini-review on the systematics of Meliponinae, in *Apidologie* 23, 509-522, where discriminative characters were not simplified and considerably enlarged the subfamily genera number up to 21. What we called *Trigona* spp in our work were simply non-*Melipona* spp stingless bees. This correction was made in tables I and II.