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Honey physicochemical properties of three species of the Brazilian *Melipona*

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ABSTRACT

Physicochemical analyses were carried out to evaluate 27 samples of honeys from three species of the Brazilian genus *Melipona* (*M. capixaba*, *M. rufiventris* and *M. mondury*) from Espírito Santo and Minas Gerais States. The parameters water activity (A_w), percentage of soluble solids (Brix %), pH, acidity (meq/Kg) and moisture (%) were evaluated. The honey characteristics obtained from these samples were very similar to the ones from other *Melipona* species. However, regarding the honey from *Apis* (honey bee), only the pH values were similar. The low pH value and the high acidity detected in *Melipona* honey are potential factors for increasing the honey shelf life because they do not provide favorable conditions for the microbial development. On the other hand, the high level of water activity favors the growth of microorganisms, especially yeast, which demands a more careful handling and storage. The observed differences between *Melipona* and *Apis* honey reinforce the need for specific quality settings for stingless bee honey.

Key words: Honey, *Melipona*, Meliponini, Physicochemical data.

INTRODUCTION

This work shown differences in values of water activity, Brix, pH, acidity and moisture between *Melipona* and *Apis* honey and reinforce the need for specific quality settings for stingless bee honey.

The Brazilian social bees, sub-tribe Meliponini, are considered the main pollinator agents of the Brazilian trees (Kerr et al. 1996). There are more than 200 different Meliponini species, including the stingless bee, and some of them are frequently raised for honey production.

The honey physicochemical characteristics of these bees are not very well known, mainly in the

tropical regions where there is a great flora diversity associated to high temperature and moisture. It is estimated that honey comes from more than 2.500 types of flowers from different plants; therefore their characteristics vary widely. Honey composition depends on several factors, such as nectar composition, source location, harvesting, season, management and especially bee species (Carvalho et al. 2006).

The aim of this work was to study the honeys of three species of the genus *Melipona* through physicochemical analyses. Honey from *M. capixaba* (n=9) was collected in May 2008 from hives in the Atlantic Forest at the cities of Alfredo Chaves, Domingos Martins and Venda Nova do Imigrante (Espírito Santo State). Honey from *M. rufiventris*

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(n=7) was collected from April 2003 to May 2004 in the Brazilian savannah at the cities of Guimarães, Patrocínio, Brasília de Minas and Dom Bosco. Honey from *M. mondury* (n=11) was collected during the same months interval in the Atlantic Forest at the cities of Rio Vermelho and Diogo de Vasconcelos (Minas Gerais State). All samples were analyzed immediately after the collection.

The parameters water activity (A_w), percentage of soluble solids (Brix %), pH, acidity (meq/Kg) and moisture (%) were analyzed. The analyses were carried out following the Analytical Standards from Instituto Adolfo Lutz - Métodos Físico-Químicos para Análise de Alimentos (Instituto Adolfo Lutz 2005). Table I shows the physicochemical data of the studied honeys.

TABLE I
Physicochemical analysis of three *Melipona* species. The values are standard error of averages. Minimum and maximum values are in brackets.

Species/ Bioma	Water activity (Aw)	Moisture (%)	pH	Soluble solids (%)	Acidity		
					Free (meq/Kg)	Lactonic (meq/Kg)	Total (meq/Kg)
<i>Melipona capixaba</i>							
(Atlantic forest) (n = 9)							
Range	(0.69-0.77)	(25.84-36.04)	(3.30-3.80)	(62.20-72.8)	(25.0-107.0)	(7.0-17.50)	(34.0-118.50)
Mean ± standard error	0.73±0.03	30.51±3.55	3.62±0.15	68.23±3.55	67.94±33.20	11.33±3.24	79.28±33.37
<i>Melipona rufiventris</i>							
(Brazilian savannah) (n = 7)							
Range	(0.59-0.65)	-	(4.05-4.50)	(7.0-77.0)	(1.0-52.0)	(10.0-17.0)	(3.5-69.0)
Mean ± standard error	0.62±0.02	-	4.24±0.19	74.12±1.86	2.43±10.74	1.57±2.30	42.0±12.31
<i>Melipona mondury</i>							
(Atlantic forest)(n = 11)							
Range	(0.69-0.79)		(3.17-5.67)	(63.0-71.0)	(2.07-122.50)	(1-15.38)	(30.5-132.50)
Mean ± standard error	0.74±0.03	-	4.19±0.81	68.09±2.84	52.77±31.93	8.73±4.50	61.51±33.2
Maximum accepted Brasil 2000		not more than 20%	3.3 - 4.6				not more than 50 meq/Kg

The water content is one of the main differences between honey from stingless bees and *Apis*. In general, it has been showed that the water activity values of honey from *Apis* (honey bee) ranged from 0.49 to 0.60 aW (Alcalá and Gómez 1990). This represents a non-satisfactory condition for the activity of several microorganisms that depend on a higher amount of free water for growth and survival. However, most honey showed water activity values (0.59 to 0.79 aW – Table I) higher than those from honey bees. The moisture content of honey is highly important for its shelf life (Pérez-Arquillué et al.

1994). In general, high moisture content causes honey fermentation, spoiling and flavor losing, leading its loss of quality (Costa et al. 1999).

The moisture levels of *M. capixaba* honey (25.84 to 36.04% - Table I) exceeded the limits specified by the National and International legislations (20%). High moisture values have also been reported for honey from other *Melipona* species: 26.80% to 32.00% for *M. asilvai* (Souza et al. 2004), 23.14% to 32.50% for *M. mandacaiá*, (Alves et al. 2005), 24.8% to 30.6% for the Amazon *Melipona* (*M. compressipes manaoense* and *M. seminigra merribae*) (Almeida-

Muradian et al. 2007) and recently, for *M. scutellaris* (Ilha de Itaparica, Bahia State), and 25% and > 30% for *M. quadrifasciata* (Costa do Sauípe, Bahia state) (Carvalho et al. 2009). This feature deserves care in handling. On the other hand, the high moisture content is directly related to the flavor of the product that is much appreciated because it is less sweet and nauseating.

The honey of these three *Melipona* species showed a content of soluble solids ranging from 62.2% to 77.0% (Table I). This result corroborated Souza et al. (2006) who studied the honeys from *M. compressipes triplaridis* (67.0 to 75.5%), *M. fuliginosa* (68.0 to 75.0%) and *M. panamica* (57.2 to 75.0%). However, the brix value from *Apis* honey is higher (example, 78.8 to 84%; Terrab et al. 2004). Moreover, according to Anupama et al. (2003), there was a high negative correlation between brix % and moisture content in *Apis* honey. So, the lower content of soluble solids from *Melipona* honey may be related to their higher moisture content.

The pH values of *Melipona* honey ranged from 3.17 to 5.67 (Table I). This pH variation was previously reported by Almeida-Muradian et al. (2007) in the Amazon *Melipona* (mean value of pH 3.41), for *M. scutellaris* and in *M. quadrifasciata* honey, both from Ilha de Itaparica (mean values of pH 3.71 and 3.67, respectively) and from Costa do Sauípe (mean values of pH 6.64 and 3.74, respectively) (Carvalho et al. 2009). These values are comparable to those reported for *Apis* honey from different countries. For example, it was 3.5 for the Italian honey (Esti et al. 1997), 4.2, 3.99 and 4.02 for the Spain honey (Terrab et al. 2004, Lópes et al. 1996).

The total acidic is the sum of free and lactic acidities, and the maximum value accepted by the Brazilian legislation is 50 meq/Kg (Brasil 2000). Regarding *Melipona* honey, the total acidic values ranged from 30.5 to 132.5 meq/Kg (Table I) and this honey acidity is higher than the maximum recommended (Brasil 2000). It seems that high acidity is common for *Melipona* honey. For example, Vit et

al. (1994) also reported elevated acidic values for *M. compressipes* (33.93 - 94.12) and *M. favosa* (18.63 - 228.80) honey. On the other hand, *M. trinitati* honey presented acidity values ranging from 12.92 to 35.30 (Vit et al. 1994), *M. scutellaris* and *M. quadrifasciata* honey from Ilha de Itaparica presented acidity mean values of 25.75 and 55.0 and from Costa do Sauípe had acidity mean values ranging from 6.25 and 28.0 (Carvalho et al. 2009). Almeida-Muradian et al. (2007) also reported for the Amazon *Melipona* acidic values below 50 meq/Kg (20.63 to 27.82). These last ones matched the reported data for *Apis* honeys from different geographical locations (e.g. Lópes et al. 1996, Esti et al. 1997, Terrab et al. 2004, Downey et al. 2005). As mentioned above, *Melipona* honey can present high levels of total acidic. Although high acidic is a feature that makes the honey attractive to consumers, it can indicate the state of honey maturity rising with fermentation.

The variations found in honey from *Melipona* species might be due to different honey sources, since the honey samples came from different biomas and sites. According to Carvalho et al. (2006), honey composition may vary depending on the flora, location, harvest season, management and especially the bee species that produced the honey. The low pH value and the high acidity represent a potential increasing of the honey shelf life because these conditions do not favor the microbial growing. On the other hand, it can be inferred that the high acidic values indicated the presence of undesirable fermentation, especially if honey presents higher contents of water activity and moisture. This might favor the microbial growing, specially yeasts, which suggests that this kind of honey needs to be handled and stored carefully to avoid microbiologic contamination. The observed differences between *Melipona* and *Apis* honey reinforce the need for specific quality settings for stingless bee honey. Moreover, further research is needed for the establishment of quality patterns for the management of honey from native bees.

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RESUMO

Análises físico-químicas foram realizadas para avaliar vinte e sete amostras de mel de três espécies do gênero *Melipona* (*M. capixaba*, *M. rufiventris* e *M. mondury*) coletadas nos Estados do Espírito Santo e de Minas Gerais. Os parâmetros atividade de água (aW), porcentagem de sólidos solúveis (Brix %), pH, acidez (meq.Kg⁻¹) e umidade (%) foram avaliados. As características do mel dessas amostras foram muito similares às do mel de outras espécies de *Melipona*. Entretanto, para o mel de *Apis* apenas os valores de pH foram similares. O baixo valor de pH e a elevada acidez detectados no mel de *Melipona* são fatores potenciais para uma maior vida útil do mesmo por não oferecerem condições favoráveis ao desenvolvimento microbiano. Por outro lado, o alto teor de atividade de água favorece o crescimento de microrganismos, especialmente de leveduras o que requer maior cuidado no manuseio e armazenamento do mel. As diferenças observadas entre o mel de *Melipona* e o de *Apis* reforçam a necessidade de estabelecimento de padrões de qualidade específicos para o mel de abelhas sem ferrão.

Palavras-chave: Mel, *Melipona*, Meliponini, Dados físico-químicos.

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