

Sensorial profile of *Apis mellifera* honeys produced by familiar farmers in Iguape Bay, Bahia, Brazil

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Abstract: Sensory proprieties of the honeys are amongst the main parameters for its quality determination, with sensory analysis working as a tool for measurement and quantification of the product characteristics by human senses. Sensorial quality control considers attributes as color, scent, flavor and consistency. These attributes are always interlinked and depend on volatile substances that are related to the original scents of flowers where the nectar was collected. Scent and flavor are directly related to honey's color and mainly depend on its floral origin. This work had the objective to discern the sensory profiles of *Apis mellifera* honey produced by familiar farmers from the Iguape bay, in Bahia, Brazil. A total of 11 *A. mellifera* honey samples were obtained from beekeepers and processed in the Laboratory of the Nucleus for Insect Studies (INSECTA) of the Centro de Ci ncias Agr rias, Ambientais e Biol gicas at Universidade Federal do Rec ncavo da Bahia in Cruz das Almas, Bahia. The sensorial analysis performed by the 50 consumers, revealed that the acceptance of honey was higher in the Caonge's community and significantly different from the obtained in the Engenho Vit ria's community.

Key words: aroma, bee, crystallization, fluidity, flavour.

Perfil sensorial dos m is de *Apis mellifera* produzido por agricultores familiares na Ba a do Iguape, Bahia, Brasil

Resumo: As propriedades sensoriais do mel encontram-se entre os principais par metros na determina o da sua qualidade, sendo a an lise sensorial um instrumento que mede e quantifica as caracter sticas do produto pelos sentidos humanos. O controle de qualidade sensorial considera atributos como cor, aroma, consist ncia e sabor. Estes atributos est o sempre interligados e dependem de subst ncias vol teis que se relacionam com a fragr ncia original das flores onde o n ctar foi recolhido. O aroma e sabor est o relacionados diretamente com a cor do mel e dependem maioritariamente da sua origem floral. O presente trabalho teve por objetivo avaliar o perfil sensorial dos m is de *Apis mellifera* produzido por agricultores familiares da Ba a do Iguape, Bahia, Brasil. Foram analisadas 11 amostras de m is de *A. mellifera*, obtidas diretamente de apicultores e encaminhadas para o Laborat rio do N cleo de Estudos dos Insetos do Centro de Ci ncias Agr rias, Ambientais e Biol gicas da Universidade Federal do Rec ncavo da Bahia em Cruz das Almas, BA. Por meio da an lise sensorial realizada por uma equipe de 50 consumidores, verificou-se que a aceitabilidade do mel foi superior na comunidade de Caonge e significativamente diferente da obtida na comunidade de Engenho Vit ria.

Palavras chave: aroma, abelha, cristaliza o, fluidez, sabor.

Introduction

Honey is used since the most remote times, mainly as a natural sweetener. Its rich flavours and aromas have also been recognized and appreciated (Lorente et al., 2008). It also has an excellent therapeutic potential, since it has antiseptic, antimicrobial, anti-rheumatic and diuretic effects, besides its important role in the prevention of digestive and respiratory disorders (Marcucci et al., 1995). Recently, it has proven effective in healing wounds and burns (Ramalhosa et al., 2011). Honey contains about 200 different substances (K c k et al., 2007), being the

carbohydrates the most predominant, followed by minerals, proteins, vitamins, lipids and organic acids (Finola et al., 2007). The composition of this natural product is strongly dependent on the nectar of the source botanic specie, which determines honey's specific characteristics. The climatic condition, the handling and techniques of the beekeeper have less influence in those characteristics (Marchini et al., 2005).

The great diversity of plants available in Brazil allows obtaining different types of honey, each one with its organoleptic particularity, which is always related with the flora explored by bees. However, that diversity of flavours and aromas is hardly found, since few studies have focused on the development of precise and specific vocabulary to describe it (Guyot-Declerck, 2001).

The assessment of the organoleptic parameters was carried out using sensorial analyses. This methodology allows determining the acceptability of a commercial product and promoting the development of new products having into account the individual preferences of the consumers. For such, studies concerning the specific taste and preferences of consumers have to be done (Pedrão and Coró, 1999; Teixeira, 2007). In fact, the sensorial analysis is the only one carried out by the consumers, which is the reason why it is so important to perform before selling.

Honeys' sensorial analysis distinguishes the botanical origin of the product and allows the identification and quantification of some undesirable defects as: fermentation, presence of certain impurities, aromas and non-characteristic flavours. It is also an essential part of the studies about the preference/acceptability of the "target public". In particular, the sensorial evaluation is important in the verification of the monofloral honeys' conformity, since it may reveal the presence of other botanic species based on the changes on the typical sensorial characteristics (Piana et al., 2004).

In Iguape Bay, region of Recôncavo da Bahia, beekeeping significantly contributes to the increase of the familiar profits. Despite the lack of information about the sensorial quality of Brazilian honey, its determination will contribute to achieve greater commercial value.

The objective of this work was to study the sensorial profile of *Apis mellifera* honeys, produced by familiar farmers in Iguape Bay, Bahia, Brazil.

Material and Methods

Eleven samples of honey were directly harvested by beekeepers of eleven different familiar farms, located in Iguape Bay, Bahia, Brazil, in February 2010, totalling 11 samples.

Table 1 - Geographic coordinates of the apiaries from which the samples were harvested.

Locations	Sample Number	Latitude (S)	Longitude (O)
Calembá	1	12°38'52.2"	38°51'34.1"
Calolé	1	12°38'32.2"	38°53'06.7"
Caonge	1	12°39'04.1"	38°50'48.5"
Dendê	1	12°39'24.1"	38°50'57.8"
Engenho da Ponte	1	12°38'25.3"	38°51'42.0"
Engenho da Praia	1	12°38'17.8"	38°52'11.5"
Engenho Novo	1	12°35'21.8"	38°50'51.8"
Engenho Vitória	1	12°36'42.3"	38°59'39.2"
Imbiara	1	12°39'11.9"	38°53'38.9"
Santiago do Iguape	1	12°41'26.5"	38°51'13.5"
São Francisco do Paraguaçu	1	12°44'19.7"	38°51'53.8"
TOTAL	11		

The sensorial characteristics of honey samples were analysed on the Núcleo de Estudos dos Insetos (INSECTA) do Centro de Ciências Agrárias, Ambientais e Biológicas of the Universidade Federal do Recôncavo da Bahia.

The assessment of the sensorial profile included an acceptability test, with non-expert tasters of both sexes; including students, teachers and staff of the Universidade Federal do Recôncavo da Bahia. The age ranged from 17 to 53.

The samples (approximately 10 g) were served at the room temperature in plastic cups, coded with three digits, being the order of presentation aleatory. To clean the palate, the tasters drank mineral water and "salt and water" crackers, according to the reported by Ferreira (2000). The tests were carried out between 8:00 to 12:00 am and 14:00 to 18:00 pm, followed the methodology reported by Grosso (2006). The parameters determined were: fluidity, colour, aroma, crystallization, flavour and acceptability (Figure 1).

Sensorial analysis of honey

Taster: _____ Date: ____/____/____ Sample: _____										
Fluidity										
0	1	2	3	4	5	6	7	8	9	10
Liquid					Little dense			Very dense		
Colour										
0	1	2	3	4	5	6	7	8	9	10
White					Amber			Black		
Aroma										
0	1	2	3	4	5	6	7	8	9	10
Unpleasant					Pleasant			Very pleasant		
Crystallization										
0	1	2	3	4	5	6	7	8	9	10
Without crystals					Small crystals			Big crystals		
Flavour										
0	1	2	3	4	5	6	7	8	9	10
Weak					Little intense			Intense		
Acceptability										
0	1	2	3	4	5	6	7	8	9	10
None					Little acceptance			Much acceptance		

Figure 1 - Evaluation sheet used for the sensorial analysis (Grosso, 2006).

All the samples were analysed in triplicate. The analysis of the sensorial profile was done using a "spider graphic". Results are shown as mean values and standard deviation. Prior to the statistical analysis, normality tests (Shapiro-Wilk, Anderson-Darling, Lilliefors and Jarque-Bera) were carried out, considering each harvest independently or the three harvests as a whole. We verified that the results follow a normal distribution. For the statistical treatment of the results an one-way analysis of variance (ANOVA), followed by Tukey's HSD Test with $\alpha=0.05$.

Results and Discussion

The results of the assessment of honeys sensorial profile are presented in Table 2 and Figure 2.

Table 2 – Medium of the sensorial attributes of the *Apis mellifera* honeys.

Communities	Sensorial attributes					
	Fluidity	Colour	Aroma	Crystallization	Flavour	Acceptability
Calembá	5.64±2.34 ab	4.28±2.34 b	6.52±1.80 ab	1.54±2,13 b	6.62±1.84 ab	7.02±1.84 abc
Calolé	4.58±2.00 bcde	5.98±1.16 a	6.94±1.92 a	0.76±1,46 c	7.00±2.33 a	7.14±2.15 abc
Caonge	5.32±2.70 b	5.30±0.86 a	6.42±1.70 ab	1.02±1,86 bc	7.04±1.97 a	7.44±1.74 a
Dendê	5.36±2.34 ab	6.08±1.05 a	6.46±1.84 ab	1.04±1,68 bc	6.62±1.99 ab	6.66±1.81 bcd
Engenho da Ponte	3.38±2.51 e	4.36±0.99 b	6.82±1.99 ab	0.82±1,73 c	6.82±1.96 a	6.92±2.15 abc
Engenho da Praia	4.06±2.16 cde	3.90±1.10 b	6.58±1.85 ab	0.74±1,34 c	6.08±1.93 b	6.50±1.79 cd
Engenho Novo	5.02±2.47 bcd	5.46±0,84 a	6.22±2.01 ab	1.00±1,97 bc	6.42±1.97 ab	6.86±2.15 abc
Engenho Vitória	5.16±2.57 bc	4.22±1.09 b	4.98±2.09 C	1.12±1,95 bc	5.20±2.26 c	4.96±2.41 e
Imbiara	6.56±2.11 a	4.12±0,92 b	5.84±2.28 bc	4.30±2,59 a	6.38±2.59 ab	6.18±2.41 d
Santiago do Iguape	3.88±2.05 de	4.08±0.99 b	6.30±2.56 ab	0.68±1,33 c	7.00±2.08 a	7.24±2.06 ab
São Francisco do Paraguaçu	5.58±2.03 ab	4.32±0.91 b	6.82±1.75 ab	0.98±1,85 bc	6.96±2.04 a	7.12±1.97 abc

The letters (a, b, c, d and e) represent which honeys are different by the Tukey test with a significance of p=0.05.

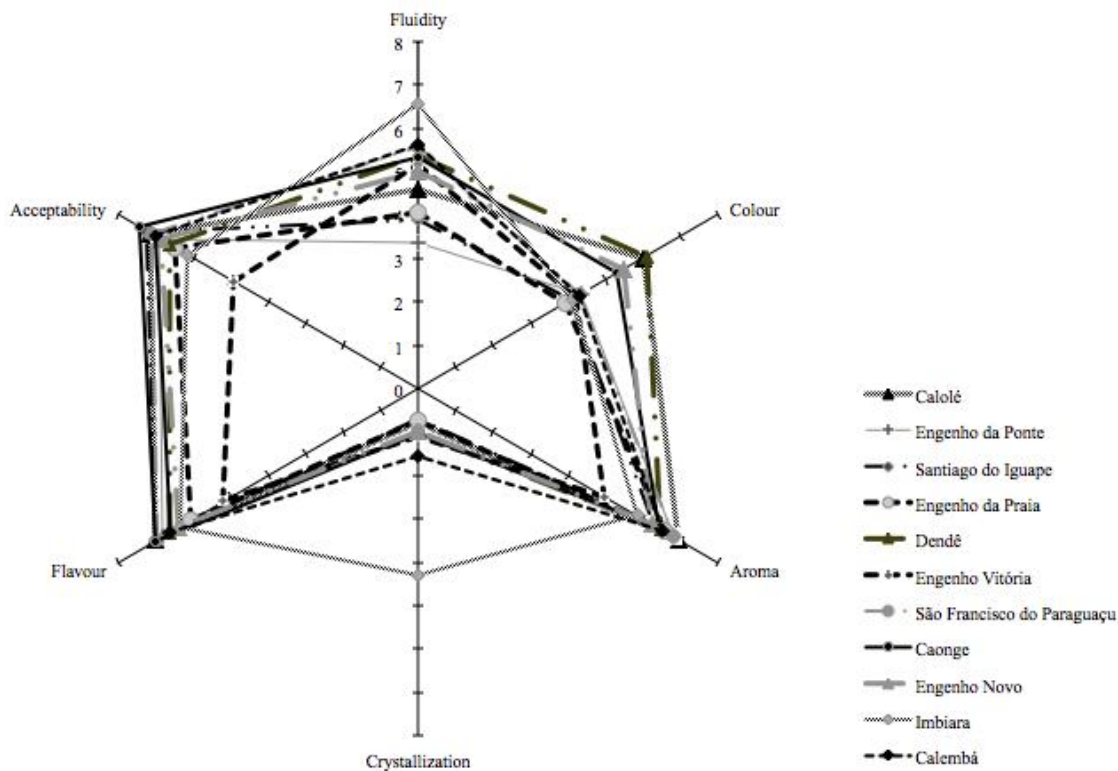


Figure 2 - Sensorial profile of the honey samples.

From the analysis of the Table 2, it can be seen that the honey harvested in the Imbiara community, had the highest medium value for fluidity (6.56 ± 2.11). It weren't observed statistical differences, with a level of significance of $p=0.05$ between the fluidity of this honey and the one of Dendê, São Francisco do Paraguaçu and Calembá. On the other hand, significant differences ($p<0.05$) were found amongst the product from Imbiarra and the others under analysis.

The honey harvested in the community of Engenho da Ponte was the one with highest density (less fluidity - 3.38 ± 2.51). However, no significant differences were observed between the honey from Engenho da Ponte and the products from Calolé and Santiago do Iguape. The variations noted on honeys' fluidity could be related to the botanical origin, climatic conditions, handling and processing (Küçük et al., 2007). The results obtained in this study were identical to the reported by Sodrê et al. (2008), who analysed honeys from stingless bees, submitted to different processes of conservation.

About the flavour, the honey collected in Engenho Vitória presented the lowest medium value (5.20 ± 2.26) and the product from Caonge the highest (7.04 ± 1.97). Significant differences were observed ($p<0.05$) between this product and that one from Engenho da Ponte, Santiago do Iguape, Engenho da Praia, Dendê, São Francisco do Paraguaçu, Caonge, Engenho Novo, de Calolé, Imbiara e Calembá. According to Della Modesta (2007) besides colour and aroma, flavour is very important in the qualitative classification of honey. In fact, this parameter is generally adopted by importers, processors and consumers in the choice of honey.

The centre of "spider graph" represents the zero in the scale and the intensity increases from the centre to the periphery. The medium attributed by the tasters to each parameter (fluidity, colour, aroma, crystallization, flavour and acceptability) is symbolized in the correspondent axe, being the sensorial profile the result of the points' connexion (Figure 2).

Honeys' colour, besides flavour and aroma, is one of the characteristics that allow identifying its floral origin. It can range from white to black. The colour of the analysed samples varied between light amber and amber. The sample from Calolé, Dendê, Caonge and Engenho Novo didn't differ significantly ($p>0.05$), being all amber. The other samples were light amber and didn't show statistical differences among them ($p>0.05$). The colour is one of the characteristics that most influences the choice of the consumers. In fact, their preference usually meets light honeys, because of their appearance. In this context light honeys have greater commercial value. However, dark honeys are generally richer in minerals, vitamins B and C and possess a stronger aroma (Montenegro, 2005). This parameter can be modified with the age and storage conditions (Maillard reactions), reason why it is considered a quality indicator. Characteristic aroma and flavour are conferred by the presence of volatile compounds. In honey, the most pleasant are the ones with lower boiling point (Bastos et al., 2002).

Concerning the aroma, which is strongly affected by the floral origin of the product, the higher medium values (6.94 ± 1.92) were obtained in Calolé samples. It weren't verified statistical differences between the samples from Engenho da Ponte (6.82 ± 1.99), Santiago do Iguape (6.30 ± 2.56), Engenho da Praia (6.58 ± 1.85), Dendê (6.46 ± 1.84), São Francisco do Paraguaçu (6.82 ± 1.75), Caonge (6.42 ± 1.79), Engenho Novo (6.22 ± 2.01) and Calembá (6.52 ± 1.80) (Table 2 e Figure 2).

Concerning the crystallization the obtained values ranged from 0.68 ± 1.33 (Santiago do Iguape) to 4.30 ± 2.59 (Imbiara). The sample from Imbiara was significantly different from the others ($p<0.05$). In fact, the standard deviation obtained for the crystallization is big, what may be related to the lack of expertise of the tasters. Honeys' crystallization is related to the separation of the glucose, which is less soluble than fructose, and consequent formation of glucose hydrates. When crystallization occurs, the product changes colour and the occurrence of undesirable fermentations are more probable (Lengler, 2001). This process is dependent on many factors, like the concentration of sugars, amount of water, botanical origin, handling and storage's condition (Conforti et al., 2006).

It was observed that the Caonge's honey was the better accepted (7.44 ± 1.74), even though no significant differences were found between this honey and the product from Calembá (7.02 ± 1.84), Calolé (7.14 ± 2.15), Engenho da Ponte (6.92 ± 2.15), Santiago do Iguape (7.24 ± 2.06), São Francisco do Paraguaçu (7.12 ± 1.97) and Engenho Novo (6.86 ± 2.15). The honey with worse acceptability was the one from Engenho Vitória (4.96 ± 2.41), being statistically different from the others under analysis.

Conclusion

The parameters that played the most important role in the assessment of the sensorial quality were the flavour and the aroma. The crystallization of the product was of minor importance. The honey from Caonge was the best accepted, followed by the product from Santiago do Iguape and Calolé. The least appreciated was the honey from Engenho Vitória.

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