

Physicalchemical Characteristics of Honey from Apicultural Production in the Paraná River Islands in Guaira-PR/ Brazil

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Abstract— The aim of this study was to perform physicochemical analyzes of honey in terms of moisture content, pH, hydroximetifurfural (HMF), acidity, diastasis, sugars and sucrose. The reason of comparing the results obtained in the physicalchemical analysis of honey according to the established standards for honey of *Apis mellifera*, in accordance with the requirements of the national or international regulatory agencies, to verify the quality of honey produced. The physicalchemical analysis included among the maturity indicators of honey: moisture, pH, acidity and HMF. The research was done with data collection to evaluate the main honey producers of the Paraná River Islands with delimitation comprising the population of the Ayrton Senna da Silva bridge to the village called Porto Morumbi (Mato Grosso do Sul State, Brazil). The volume of higher honey production was analyzed, having as sample 06 beekeepers, where their coordinates were observed identifying the points obtained through the (Global Positioning System) GPS device. The physicochemical analysis of the minimum, maximum and average showed that the humidity is was least 18:95; maximum 23:70 and average 21:60, which according to the normartive n° 11 of 2000, are above the allowed.

Keywords— Averages, Beekeepers, Honey, Honey maturity indicators.

I. INTRODUCTION

Brazil has a great beekeeping potential, due to the fact that its flora is very diversified, due to its territorial extension and climatic variability, which makes it possible to produce honey all year round. This aspect already sets it apart from other countries that normally harvest honey once a year. However, despite this advantage, there is a great variation in the characteristics of the honeys produced [1].

Bees breeding currently represents an important agricultural activity in Brazil, representing work and income for many families of small and medium rural producers. Honey is the most important of honey bee products, being the main objective of the Brazilian beekeeping [2].

In Brazil, the main producers of honey are small farmers where beekeeping is added to other economic activities and the main producing region is the South Region, with 49% of Brazilian production. Rio Grande do

Sul State is the largest national producer with 20%, Paraná State with 16.2% and Santa Catarina with 12.9% [3].

According to the Brazilian Institute of Geography and Statistics [IBGE], in 2012 Brazilian honey production generated R\$ 40 million and grew 24% in the last six years. By volume were approximately 33,931 tons [4].

Because of their great diversity in their composition, studies aimed at the characterization of the honeys produced are of extreme importance for the creation of quality standards according to plant, soil and climatic factors. regions in which they are produced, subsidizing their quality improvement and giving product guarantees to the consumer by controlling possible fraud [1].

The qualitative characterization of honeys, or of any food, is essential as part of the valorization strategies of the product, since it confers a regional identity, besides adding value to it [5].

It is known that the characterization and standardization are entirely linked to the quality of a product. In this way, the concern with the maintenance of the quality of the honey produced in Brazil is increasing, as well as the knowledge of the variation of the characteristics that are used as quality requirements. Therefore, it is of great importance to study and quantify the behavior of parameters that indicate quality in all stages of the production flowchart, thus obtaining information where it is possible through them to decrease the chances of deterioration and thus, increase the shelf life of this product [6].

There is great interest in guaranteeing the quality of honey and the various apicultural products, and the physicalchemical characterization serves as a tool for this control, where through this one can guarantee the standardization of honeys marketed and offered to consumers, even consumed in nature or when they are used as ingredients in new products [7],[8],[9].

In this sense, the region under study presents excellent conditions for beekeeping, considering that the climate is favorable and also because of the richness of flowers in its vegetation. The objective of this study was to perform physicalchemical analyzes of honey considering the moisture contents, pH, HMF, acidity, diastasis, sugars and sucrose.

II. MATERIAL AND METHODS

The research was done through data collection with a survey of information to evaluate the main honey producers of the Paraná River Islands, with a delimitation comprising the population of the Ayrton Senna da Silva Bridge to the village of Porto Morumbi. The volume of higher honey production was analyzed, having as sample 6 beekeepers, where their coordinates were observed identifying the points obtained through the GPS device.

The target region of the study is of subtropical climate, with mild temperatures and has small part in the tropical climate region. (Köppen classification).

2.1 Research Design

The study encompasses a completely randomized experimental design, totaling 31 samples of honey (Figure 1). The “R” statistical and programming environment version 3.0.2 (R Foundation, Vienna, Austria) was used.

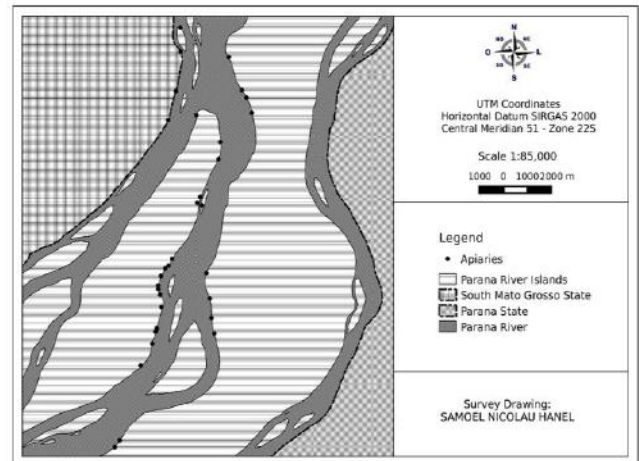


Fig. 1: Georeferenced map of location of apiaries, 2016, Paraná River.

2.2 Collection of Samples

The 31 honey collected samples correspond to the 2015 harvest and were purchased directly from beekeeper's apiaries in 350 ml bottles sterilized, wrapped in a plastic bag for first-time food. The collection period was given on 17-19 April 2015.

The samples were sent to the Laboratory of Physicalchemical Analysis of the Insecta research group, belonging to the Federal University of the Recôncavo da Bahia (UFRB).

The physicochemical analyzes included the indicators: reducing sugars, moisture, sucrose, acidity, diastase activity, HMF and pH. All analyzes were performed in duplicate, following the methods recommended by Brazilian legislation (Brasil, 2000). The procedures used are in accordance with the methodology of the Association of Official Analytical Chemists [10].

III. RESULTS AND DISCUSSIONS

The results of the study of the physicalchemical characteristics of the 31 samples of bee honeys of the Paraná River micro-region presented indexes with higher moisture content 25g/100g; for sugars were all the results of the analyzes in accordance with the Normative, being of 65g/100g; for sucrose, the maximum is 6g/100g and with the analyzes it was verified that only 06 samples exceeded the value, as determined in the regulations. As for the acidity indexes, it was verified that all the analyzed analyzes were within the legal parameters of Normative Instruction n° 11; and on HMF, in the analyzes only one sample exceeded the permitted one, being 119.91 mg/kg; and the allowed maximum of 60 mg/kg.

Regarding the analyzes of the diastase activity, it was verified that only one analysis was below the allowed parameters being 7.90 mg/kg and the allowed value must be at least 8 mg/kg. As far as pH is concerned, all analyzes were in accordance with the Honey Production Regulation. These values are shown in Tables 1, 2 below.

Table 1. Basic statistical data of samples of honey harvested in and around Perucia Island in the Paraná River, from April 17 to 19, 2015.

	Average	Standard Deviation	If (mean) of the mean	Standard error	Percentage 50%	Percentage 95%
Moisture	21,60	1,08	0,19	0,19	21,75	22,80
PH value	3,68	0,15	0,03	0,03	3,67	3,97
Acidity	11,80	1,31	0,24	0,24	11,85	14,70
Hydroxymetilfurfural	22,37	23,81	4,27	4,27	15,27	66,73
Dwell	18,66	6,12	1,10	1,10	17,71	27,33
Sugars	73,37	2,68	0,48	0,48	72,61	77,81
Sucrose	3,31	1,79	0,32	0,32	3,20	6,03

Table 2. Basic Statistical data of samples of honey harvested in and around Perucia Island in the Paraná River, from April 17 to 19, 2015.

	Moisture	PH	Acidity	HFM	Diastasis	Sugars	Sucrose
Minimum	18.95	3.410	8.65	2.69	8.00	68.90	0.610
1° Quartile	21.35	3.580	11.16	11.82	13.99	71.28	1.885
Medium	21.75	3.670	11.85	15.27	17.71	72.61	3.200
Average	21.60	3.683	11.80	22.37	18.66	73.37	3.310
3° Quartile	22.23	3.735	12.32	23.39	22.23	75.19	4.545
Maximum	23.70	4.030	14.99	119.91	36.43	80.12	7.880

The moisture content is an important characteristic to determine the quality of the honey, not lower than 16.8% and not more than 20%, according to Instruction n° 11 of October 20, 2000, which establishes as maximum value of moisture 20g per 100g of honey, this parameter being considered indicative of maturity. In honey composition, water constitutes the second component in quantity, depending on the climate, floral origin and harvest before complete dehydration [11].

According to data from the physicochemical analysis of the minimum, maximum and average averages, it was found that the humidity is at least 18:95; maximum 23:70 and average 21:60, which according to Normative No. 11 of 2000, are above permitted. The result is justified because, in the majority of cases, the samples were with the honeycomb in the process of maturing the honey, and in this stage the high moisture content in these samples is justified. Moisture is the second highest percentage component in honey. With regard to the moisture content of honey, it was verified of the 31 samples, only four were within the standards of Normative Instruction No. 11 of October 20, 2000. The indices with the highest moisture content were 25g/100g.

The content of water has a direct influence on the viscosity, color, specific gravity, maturity, crystallization, conservation and palatability [12]. The difference in humidity may be due to the bee's handling in the honey,

since, in general, the bee *Apis Opercula* (closes) the honey when it presents around 17% to 18% of humidity, which operates honey jar with humidity variations around 24% [8]. Another factor is the osmophilic microorganisms present in the bodies of bees, nectar, soil and areas of extraction and storage of honey, and when present in honey multiply with increasing humidity, favoring the fermentation process [13].

In general, honey can compromise honey humidity are the location of apiaries (near the water source and or in very humid environments), harvesting honey ahead of time ("green" honey), or on cloudy, rainy days, the use of permeable and semipermeable packages that allow the exchange of moisture between the honey and the environment (Pereira et al., 2003). Mature honey generally has a moisture content of 18%. This is important, because the moisture content has an influence on other characteristics, such as: viscosity, weight, conservation, flavor and crystallization [14].

As for the coloring of the honey, it involves the characteristics of the origin of the flower, being able to be light, red, gold or dark. Depending on the type of coloring, honey has a difference in flavor and the aroma manifests changes, preserving the nutritive value. The darker the honey, the more minerals it has, but the lower the commercial value, because the light color is more accepted in the world market, being sold at a higher price. The different botanical origins of honey were identified with a predominance of light to dark color [15].

Of the 31 analyzed samples that had different values from those established by Brazilian legislation, HMF was above the maximum accepted values, even reaching 119.91 mg/kg, with a maximum of 60 mg/kg being allowed. For sugars, all the results of the analyzes were in accordance with the Normative, being of 65g/100g; for sucrose, the maximum is 6g/100g; and with the analyzes it was verified that only 6 samples exceeded this value, as determined by the Normative.

As for the acidity indexes, it was verified that all the analyzes performed are within the legal parameters of Normative Instruction n° 11. In the diastase activity, only one sample presented a slight change in the result verified in its physicalchemical characteristics. In the first laboratory test the value found was 7.90mg/kg, which in turn, was below the limit allowed by the Legislation, which is 8.00mg/kg. The second analysis performed in the laboratory test of this sample, resulted in 8.10mg/kg that in turn was within the standards required by the Legislation. If you consider this small variation, you can

say that all the samples are within the standard required by the Legislation.

IV. CONCLUSION

With the basic statistical data of the samples of the honeys of Perucia Island and the surroundings of the Paraná River, harvested in the periods of April 17 to 19, 2015, it was concluded that the results of the physicalchemical analyzes, the comb was in the process of maturing and at this stage the high moisture content in these samples is justified.

The pH, as well as the acidity, in all samples, where the analyzes were carried out in duplicate, presented values within the parameters of Normative Instruction No. 11 of October 20, 2000. The results of the HMF, after analysis of the samples in duplicate, showed that only one sample in question went from the maximum allowed by the Normative Instruction. The maximum permitted value is 60mg/kg and the result of this sample was 119.91mg/kg. This result is also justified, because this sample suffered the interference of contact with the sun, causing a fermentation process to develop.

As regards the reducing sugars data, all samples are in compliance with the legislation, both for the first time and also for their duplicate analyzes. In the whole process of the physicalchemical analysis, including the duplicate process, it was found that only 6 results were above the allowed by the legislation, which is 6g/100g, giving us a parameter satisfactory result from legislation.

In this sense, it was concluded that after the physicalchemical analysis of the samples of the honeys harvested in the Paraná River Islands and that are resized within the region of the present study, it was possible to obtain an excellent parameter of honey quality, since it is according to Normative Instruction No. 11 of October 20, 2000 (Brasil, 2000).

In other studies, with the product, it is suggested to develop a line of research aimed at the certification of an organic product, which would add in a lot the commercial value of the same, for a market in rapid expansion.

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