

## Mineral content of the honey produced in Zulia state. Venezuela

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**SUMMARY.** The mineral content of the honey produced in five zones of the Zulia state, Venezuela, during dry and rainy seasons was determined. The analyzed elements were: sodium, potassium (by emission spectroscopy), calcium, magnesium, copper, iron, manganese (by atomic absorption spectroscopy), phosphorus (phosphate ions, by colorimetric method), and ash content of raw honey samples directly collected from different beekeepers. The mean values for Na, K, Ca, Mg, Cu, Fe, Mn, and P were 353+84; 1774+138; 237+66; 52+24; 0.76+0.43; 13.5+10.23; 0.92+0.42 and 1642+323 mg/kg respectively. The mean ash content was 0.431+0.15%. Potassium was the most abundant of the elements determined. This results confirm that Zulian honey can be considered a good source of minerals.

**Key words:** Honey, mineral content, Zulia state, AAS.

**RESUMEN. Contenido de minerales en las mieles producidas en el estado Zulia. Venezuela.** El contenido mineral de la miel producida en cinco zonas del estado Zulia, Venezuela, durante las estaciones de sequía y de lluvia, fue determinado. Los elementos analizados en las muestras de miel cruda, recogidas directamente de varios apicultores fueron: sodio, potasio (por espectroscopía de emisión), calcio, magnesio, cobre, hierro, manganeso (por espectroscopía de absorción atómica), fósforo (iones de fosfato, determinado por colorimetría). Los valores promedios para el Na, K, Ca, Mg, Cu, Fe, Mn y P fueron: 353+84; 1774+138; 237+66; 52+24; 0,76+0,43; 13,5+10,23; 0,92+0,42 y 1642+323 mg/kg respectivamente. El contenido promedio de cenizas fue de 0,431+0,15%. El contenido de potasio fue el más abundante de los elementos determinados. Estos resultados confirman que las mieles producidas en el estado Zulia pueden ser consideradas una buena fuente de minerales.

**Palabras clave:** Miel, contenido mineral, estado Zulia, absorción atómica.

### INTRODUCTION

The Zulia state is a region of 63.355 km<sup>2</sup>. It is located in the north-western part of Venezuela, surrounded by the Venezuelan gulf on its north side. The total annual precipitation exceeds 501.7 mm. The average temperature is 28.5°C during the year.

The greatest part of the honey comes from the dry and wet tropical forests, where *Citrullus vulgaris*, *Curcubita maxima*, *Achras sapota*, *Passiflora sp*, *Annona muricata*, and *Persea americana* are the predominant species. Honey annual production, year 2001, in Venezuela was 296 ton. (1).

Mineral content in honey has been widely studied in several countries: Spain, Saudi Arabia, Poland and Italy (2-5). There are some profiles of components which could probably be used for the detection of the geographical origin (e.g. aroma compounds, oligosaccharides, amino acids, minerals and trace elements, etc.), as well as an indication of environmental pollution (minerals and trace elements), and the combination of methods could be an approach to prove authentic. (4, 6, 7).

Previous research (8) has been made to establish the mineral content of honey in ten of the twenty two Venezuelan states, but the mineral content has not been studied in the Zulia state, the North-west part of the country. Therefore, the objective of this work was to determine this parameter in Zulian honeys.

### MATERIALS AND METHODS

#### Samples

The samples were 30 raw, strained, liquid honeys collected from different beekeepers in five zones of the Zulia state, during dry and rainy seasons, in the North-western region of Venezuela. See Figure 1.

#### Ash determination

The ash content was determined by heating 10 g of honey until sample was completely black. Foaming was prevented by adding a few drops of olive oil, and calcination was obtained at 600°C. This method is suggested in the Venezuelan regulations for honey quality (9).

#### Mineral analysis

Solutions containing sodium, potassium, calcium, magnesium, copper, iron, and manganese, were obtained by dis-

solution of the ash in 10 ml of hydrochloric acid (0.1 N) and subsequent dilution to 100 ml with distilled water. The analyzed elements were: sodium, potassium (by emission spectroscopy), calcium, magnesium, copper, iron, manganese (by atomic absorption spectroscopy), using a Perkin Elmer 3110 equipment (Table 1). Phosphorus (phosphate ions) was determined by measuring the yellow color developed by the reaction in acid medium of phosphates with molybdate-vanadate reagent at 465 nm (AOAC, 1980). All determinations were made by triplicates.

FIGURE 1

Zulia State map. North-west region of Venezuela

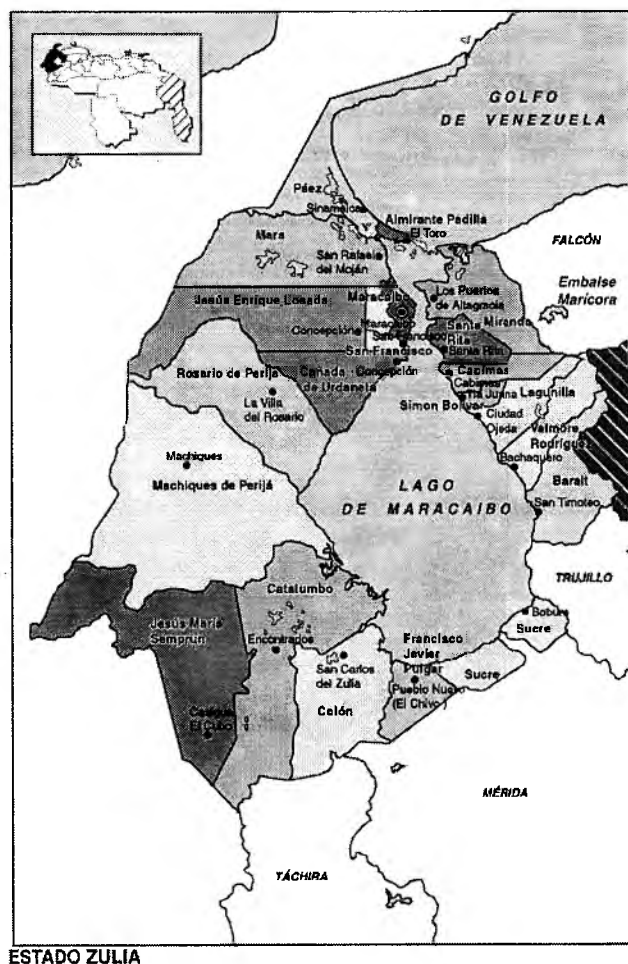


TABLE 1

Standard operation conditions for spectroscopy analysis

Minerals	Flame	$\lambda$ nm	Standard, ppm
Ca	Air-acetilene	422.7	500
Mg	Air-acetilene	285.2	1000
Na	Air-acetilene	589.0	1000
K	Air-acetilene	766.5	1000
Fe	Air-acetilene	248.3	1000
Cu	Air-acetilene	324.8	1000
Mn	Air-acetilene	279.5	1000

RESULTS AND DISCUSSION

Data from results of the seven minerals determined in honey samples are summarized in Table 2. The variability of results for all minerals is large, reflecting the wide variation in the composition of honey samples. The ash content is near the maximum value (0.5%) established for Venezuelan standard (11), which is lower than Italian and Saudi Arabian standards (12,13). Honey normally has low ash content and this value depends on the floral type used by bees during foraging (3).

Table 2  
Mineral content (mg/kg) and ash content (g/100g) of the Zulian honeys

Minerals	Number of samples	Mean	Range	S.D.	C.V.
Na	30	353	155-444	84	0.24
K	30	1774	379-5071	138	0.78
Ca	30	237	144-367	66	0.28
Mg	30	52	26-120	24	0.47
Cu	30	0.76	0.3-1.67	0.43	0.57
Fe	30	13.5	3.5-39.0	10.23	0.76
Mn	30	0.92	0.4-1.84	0.42	0.46
P	30	1642	1304-2274	323	0.20
Ash	30	0.431	0.352-0.643	0.15	0.46

S.D.: Standard deviation , C.V.: Coefficient of variation

The ash content for Zulian honey was similar to the one reported for north-west Spanish honey (14), but higher than the value reported for honeys from Molise, Italy (12), Anatolia (15), Saudi Arabia (13), and south-east Spain (16).

Mineral content in Zulian honey turned out to be, in decreasing order: K, P, Na, Ca, Mg, Fe, Mn, and Cu, most of them are similar to that reported for central and eastern regions of Venezuela: K, Ca, Mg, Na, Mn, Fe, and Cu (8).

Potassium, represents 41% of the total ash content, being the most abundant mineral determined in this work; the mean content of 1774mg/kg is twelve times higher than that reported for honey from central and eastern regions of Venezuela (8). Saudi Arabian honey (13) also has potassium as the highest constituent of the ash content, although K reported value is five times lower than K in Zulian honey. Other works in honey from north-west Spain (Galicia) and from south-eastern Anatolia (14, 15) reported K values around 12% and 83%, respectively, which were lower than the value obtained in this work.

The next most abundant mineral was phosphorus with a mean value of 1642 mg/kg, this value is lower than the minimum value reported for Saudi Arabian honey (13150 – 3080 mg/kg) (3).

Sodium, calcium and iron content were higher than the values reported in the literature, while copper and manganese content were lower (3, 13- 16).

Magnesium content was similar to the one reported for Saudi Arabian honey (3); it was lower than the one reported for north-west Spanish honey (14), and higher than that for Anatolian honey (15). The results obtained in this work show that the Zulian honey can be considered a good source of minerals.

#### ACKNOWLEDGMENT

The authors wish to thank the Universidad del Zulia and its Consejo de Desarrollo Científico y Humanístico (CONDES) for its financial support.

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Recibido:17-12-2003

Acceptado:21-06-2004