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Preliminary research on the mineral profile of honey

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Abstract The main objective of this paper is to determine the content of essential minerals: Ca, Fe, Mg, Mn, Cu and Zn of three types of honey: acacia, polyflower and lime. The samples come from local Romanian producers from Caraş Severin, Arad and Alba counties. Given that botanical and geographical authentication has become a significant feature of national and international honey trade, various conformity assessment and research laboratories in Romania have taken steps to evaluate a wider portfolio of parameters to be used for the classification of samples honey, including the traceability of geographical origin. The results obtained show that, among all mineral elements, the concentration of Ca ions varies greatly. Lime honey registered the highest calcium content, irrespective of the geographical area of origin, followed by polyflower honey and acacia honey (with the lowest content). We note that lime honey and polyflower honey have an appreciable content of magnesium, acacia honey having a lower content. Linear modeling of our obtained data values corresponding to the heavy metal concentrations highlights that the two metal ions as Ca and Mg can be used to check the typical fingerprints of the honey types.

Key words

honey, trace elements, human nutrition

Honey has antiseptic, antimicrobial and antifungal properties, properties due to increased sugar content, along with other factors, such as low pH, presence of hydrogen peroxide, flavonoids, phenols, terpenes, etc. Honey uses include the adjuvant in the healing of wounds and burns.

The importance of honey is also due to the content in the macro and essential microelements.

Using in vitro bioavailability test by simulated gastrointestinal juice, Pawel Pohl demonstrated that very large fractions (80-100% of the total concentrations) of minerals in the analyzed honey are bioavailable [5].

Given that botanical and geographical authentication has become a significant feature of national and international honey trade, various conformity assessment and research laboratories in Romania have taken steps to evaluate a wider portfolio of parameters to be used for the classification of samples honey, including the traceability of geographical origin.

Material and Methods

In order to achieve the established objectives, three types of honey: lime, acacia and polyflower, from the production of 2016 year, were taken from producers from different areas within the three counties: Caraş Severin, Alba and Arad, honey coming from pastoral areas.

To determine the ash content, 2.50 g of each sample was dried in oven at 105°C for three hours to prevent foaming loss. After cooling, the honey samples were calcined in a Nabertherm 3000 furnace at 550°C in two rounds of 5 hours.

Determination of mineral elements was made by atomic absorption spectrometry. The method is based on measuring the absorbance of metals contained in the nitric acid extract obtained from the ash of honey samples. We used spectrophotometer by flame atomic absorption type Varian 240 FS.

Results and Discussions

The experimental results obtained (table 1 and figure 1) in the determination of the mineral elements from the honey samples taken from the unpolluted pastoral areas in Caraş Severin, Arad and Alba counties are within the limits of this type of food product found after the study of the literature in the field [1,3,4,7].

All the honey samples fall within the limits imposed by legislation [10], on the maximum permitted content of Cu (2mg/kg) and Zn (5mg/kg).

Table 1

Honey minerals content (mg/kg fresh matter)

Honey type	County	Element					
		Ca	Mg	Fe	Mn	Zn	Cu
Acacia honey	Alba	17.40	6.97	0,76	0.34	1.14	0.32
	Arad	21.10	8.32	1,48	0.48	3.03	0.24
	Caraş Severin	15.80	5.45	1,12	0.63	2.41	0.36
Lime honey	Alba	57.6	14.3	4.36	0.97	2.1	0.19
	Arad	54.8	15.4	5.64	1.53	2.45	0.25
	Caraş Severin	60.1	16.1	2,98	1.31	1.57	0.38
Polyflower honey	Alba	47.3	16.3	4,94	3.28	4,2	0.12
	Arad	53.4	17.2	6,32	1.61	4,9	0.20
	Caraş Severin	50.2	18.0	3,84	2.37	4,7	0.15

From the data obtained we observe that the dominant element in all types of honey is calcium, followed by magnesium. Calcium recorded values between 15.8 mg/kg (acacia honey- Caras Severin) and 60.1 mg/kg (lime honey-Caras Severin).

Magnesium content of the samples oscillated between 5.45 mg/kg (acacia honey-Caras Severin) and 18 mg/kg (polyflower-Caras Severin).

The lowest iron content (0.76 mg/kg) recorded the acacia honey- Alba County, and the highest value (6.32 mg/kg) recorded polyflower honey-Arad County.

Compared to the other two types of honey, polyflower honey registered the highest values of zinc content, irrespective of the county. This parameter displays values between 1.14 mg/kg and 4.9 mg/kg.

Copper has recorded similar values for all types of honey regardless of the geographical area of origin. These values range from 0.12 mg/kg and 0.38 mg/kg.

The determined manganese content ranges between 0.34 mg/kg and 3.28 mg/kg.

Analyzing the figure 1, we note that among all mineral elements, the concentration of Ca varies greatly. Lime honey has the highest calcium content, irrespective of the geographical area of origin, followed by polyflower honey and acacia honey (with the lowest content).

We note that lime honey and polyflower honey have an appreciable content of magnesium, acacia honey having a lower content.

The cluster analysis (figure 2), carried out using the WARD algorithm and the Euclidean similarity function, has a correlation coefficient equal to 0.974, showing the following: the three honey types have distinctive similar Euclidean distances for each category indifferent of the area of origin.

Acacia honey has distinct characteristics probably because it does not show large variations of metal ions regardless of the region, unlike honey and polyflower honey whose heavy metal concentrations vary from one region to another.

The linear modeling of the value data for heavy metal concentrations (figure 3) highlights the large differences between lime honey and polyflower honey, on the one hand, and acacia honey, on the other.

These two types of honey (honey and lime), apparently different, are in fact similar, and there is the possibility that both categories may be of the same type or predominate honey harvested in areas with lime flowers abundance, other flowers having a reduced influence. Therefore, the two metal ions Ca and Mg can be used to check the typical fingerprints of honey.

Another observation is based on the use of the equation described by the applied mathematical model, namely, $y = 0.24455x + 2.8526$. Thus, using this equation, if we know the Mg content in honey samples, we can calculate the Ca content.

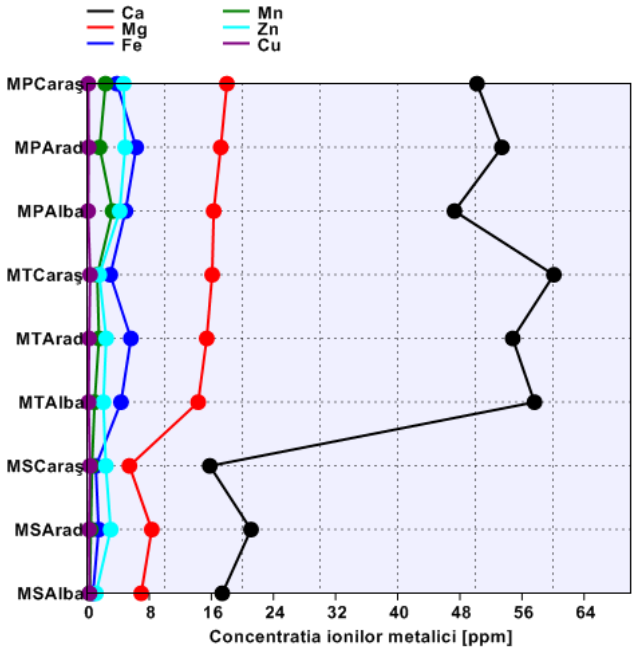

Figure 1. Graphical representation of variation in metal ion concentrations (Ca,Cu,Mg,Fe,Mn,Zn) honey samples
Legend: MS – Acacia honey; MT – Lime honey; MP - Polyflower honey

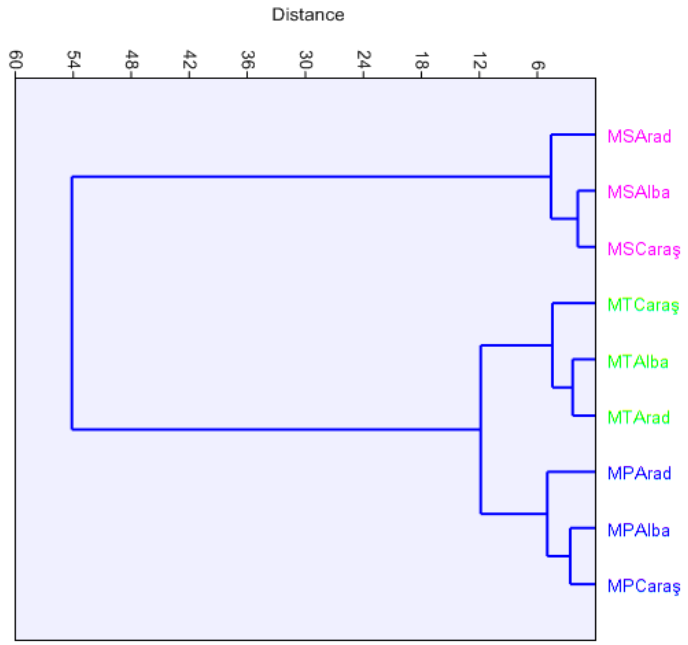

Figure 2. Representing clusters by honey categories
Legend: MS – Acacia honey; MT – Lime honey; MP - Polyflower honey

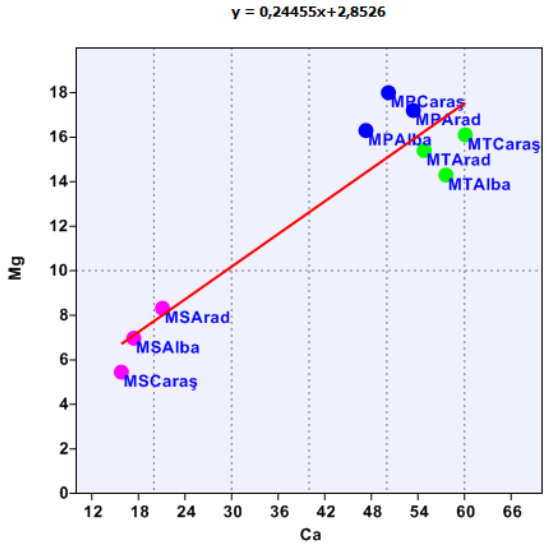

Figure 3.Linear modeling of data values corresponding to heavy metal concentrations

Legend: MS – Acacia honey; MT – Lime honey; MP - Polyflower honey

Conclusions

The experimental results obtained in the determination of the mineral elements from the honey samples taken from the unpolluted pastoral areas in Caraş Severin, Arad and Alba counties are within the limits of this type of food product found after the study of the literature in the field.

From the data obtained it is observed that the dominant element in all types of honey is calcium, followed by magnesium.

Lime honey registered the highest calcium content, irrespective of the geographical area of origin, followed by polyflower honey and acacia honey (with the lowest content).

We note that lime honey and polyflower honey have an appreciable content of magnesium, acacia honey having a lower content.

Linear modeling of the data values corresponding to the heavy metal concentrations highlights that the two metal ions as Ca and Mg can be used to check the typical fingerprints of the honey types.

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