PHYSICO-CHEMICAL CHARACTERISTICS OF SOME BULGARIAN HONEYS

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Abstract: Eight honey samples from Bulgaria with different geographical and botanical origin have been studied in terms of their quality characteristics and element composition. The moisture, determined by a moisture analyzer was found to be 19.0 g $100g^{-1}$ at maximum. The ash content was quantified by incineration in a muffle furnace varied from 0.23 to 0.89 g $100g^{-1}$. The protein, carbon and nitrogen were defined by combustion at 949 °C TruSpec CN. The protein in honey was found to be between 0.17 and 0.40 %, where as carbon exceeded 19 %, and nitrogen was not more than 638 mg kg^{-1}. In addition, another four macroelements i.e. potassium, sodium, phosphorus, and magnesium, were quantified. The most abundant appeared to be potassium achieving values of 1044 mg kg^{-1}, followed in almost all samples by sodium, phosphorus and magnesium. In three samples magnesium was not detected. From the microelements, zinc was quantified (0.6÷4.9 ppm).
Key words: honey, quality evaluation, minerals, protein

INTRODUCTION

Honey is a traditional product of production and consumption in Bulgaria (Obreshkov et al., 2012b) with an annual production of more than 10 thousand tons. Being a natural product, honey is a product of high interest and its quality characteristics are subject of analyses by many authors (Bobis et al., 2005; Bobis et al., 2006; Bobis et al., 2007; Bobis et al., 2008; Chirife et al., 2006; Pridal and Vorlova, 2002). The pH values influence the texture, stability and shelf life of honey (Terrab et al., 2004). Some minerals in honey like cadmium, lead and zinc serve as environment pollution markers (Przybylowski and Wilczynska, 2001). Recently, the mineral composition of honeys has been determined by Yurukova et al. (2008), Bogdanov et al. (2007), and Lazarova and Yurukova (2007).

The aim of the present study is to determine honey properties related to its mineral composition as well its total protein content.

MATERIAL AND METHODS

Honey samples

Eight honeys – H1 (registration number #60620072), H2 (#81830075), H3 (#41750444), H4 (not available, from the region of Strandzha mountain), H5 (#83190012), H6 (#62270155), H7 (#70820373), and H8 (#86770159) were bought directly from various local beekeepers located in different parts of Bulgaria. The type of honeys was defined by the producers themselves. The honeys were stored at room temperature (20±2 °C) in glass jars until analyses.

Determination of pH

The pH of honey was determined according Bogdanov (2009). Briefly, an aliquot of 10 g of honey was diluted in 75 mL double-distilled water (TOC = 4 ppb; 18.2 MΩ 10^{-2} m) and the pH values were read by inoLAB pH720 (WTW, Weilheim, Germany).

Moisture determination

The moisture was determined using Mettler balance & moisture analyser, model LJ16, Type PJ300MB supplied with LC-P45 printer (Mettler-Toledo). The results were expressed in g $100g^{-1}$.

Determination of protein, carbon and nitrogen

The protein, carbon and nitrogen were determined at 949 ^{o}C, using Hellium flow-through carrier gas by TruSpec CN (Leco Corporation, USA). The apparatus was calibrated with EDTA calibation sample (Leco Corporation, USA). The results were expressed as g $100g^{-1}$.

Ash content determination

The ash content of honey was determined after incineration in Muffle furnace Nabertherm (L15/11, Lilienthal, Germany) and was expressed as g $100g^{-1}$ honey (Bogdanov, 2009).

Phosphorus determination

Phosphorus was colorimetrically determined based on the vanadomolybdate procedure by Stuffins (1967). The method included incineration at 550 ^{o}C, solution in 1N nitric acid. Then, the absorbance was read by Specord 200 spectrophotometer (Analytic Jena, Germany). The data was processed by WinASPECT® 1.2 software (Analytic Jena, Germany) and the results were expressed as g $100g^{-1}$.

Determination of K, Na, Mg and Zn

The minerals were determined by flame atomic absorption spectrometer (Model AAS 5-FL, Analytik Jena AG, Germany) equipped with an AS 52 autosampler (Analytik Jena AG, Germany). A calibration standard by Merck (Germany) ICP multi-element standard solution IV (23 elements in diluted nitric acid) was used. The data were processed by WinAAS ver.3.80.

Data processing

The data were processed with the stated software packages. In addition, MS Excel (Microsoft Corporation, USA) was used.

RESULTS AND DISCUSSION

The pH values are presented in Table 1. The pH range is between 3.89 and 4.70. The average value is 4.36 that is in compliance with Yurukova et al. (2008) who reported similar values (4.29 ± 0.20) for Bulgarian honeydew honeys. Vela et al. (2007) reported pH values between 4.00 and 5.08 of Spanish honeys.

Table 1. Characteristics of Bulgarian honeys

	pH	Moisture	Ash	Protein
	-	g $100g^{-1}$	g $100g^{-1}$	g $100g^{-1}$
H1	4.68 ± 0.02	14.8 ± 0.3	0.89 ± 0.04	0.29 ± 0.00
H2	4.34 ± 0.01	19.0 ± 0.1	0.77 ± 0.04	0.31 ± 0.01
H3	4.70 ± 0.01	13.8 ± 0.2	0.65 ± 0.11	0.22 ± 0.00
H4	4.46 ± 0.01	14.0 ± 0,2	0.82 ± 0.05	0.27 ± 0.00
H5	4.23 ± 0.01	14.1 ± 0.2	0.84 ± 0.03	0.26 ± 0.01
H6	3.89 ± 0.01	18.0 ± 0.1	0.69 ± 0.08	0.40 ± 0.00
H7	4.61 ± 0.00	14.1 ± 0.1	0.79 ± 0.07	0.17 ± 0.01
H8	4.00 ± 0.01	12.6 ± 0.3	0.23 ± 0.01	0.23 ± 0.01

The moisture content in all honey samples is below 20 g $100g^{-1}$ (Table 1), thus meeting the national legislation requirements in Bulgaria. The honey from the region of Burgas shows the lowest moisture content (12.6 g $100g^{-1}$). Meanwhile, Yurukova et al. (2008), analyzing samples from different parts of the country, found that the honey from the region of Burgas is characterized also with the lowest moisture (14.3 %).

The minimal ash content is 0.23 (H8). Rodrıguez (2004) studied the ash in Venezuelan multifloral honeys that ranged within the limit of 0.19 and 0.50. The honey sample H1 from the region of Stara Zagora demonstrates a rather high ash content of 0.89 g $100g^{-1}$ (Table 1).

Although, honey is predominated by carbohydrates (Obreshkov et al., 2012a; Obreshkov et al., 2012b), it contains small quantities of protein. Lee et al. (1990) reported 0.19, 0.21 and 0.23 g protein per 100g of honey. The highest protein content is showed by honey is 0.40 g $100g^{-1}$ (H6). The most frequent value for the protein is between 0.2 and 0.3 g $100g^{-1}$ (Table 1).

Table 2 shows the content of carbon and nitrogen. Carbon varies between 19 and 24 %. These results could be explained with the high amounts of carbohydrates contained in the honey (Obreshkov et al., 2012a; Obreshkov et al., 2012b). The nitrogen in honey is found to be within the limits of 0.0277 and 0.0638 %.

In addition, the macroelements phosphorus, potassium, sodium, and magnesium are also determined (Table 2). According to the Bulgarian national legislation, there are no stated limits for the mineral composition of honey. In all cases, the most abundant is potassium reaching values of 1044 ppm. In almost all cases, the descending order of elements is potassium > sodium > phosphorus > magnesium. The only exception is honey sample H3 where phosphorus (134.4 ppm) exceeds sodium (109 ppm).

Magnesium was not detected in three samples. The only quantified microelement is zinc (Table 2). The range is rather wide varying from 0.6 to 4.4 mg kg^{-1}. Similar to the protein content, the highest zinc content is found in sample H6 (4.4 ppm).

Table 2. Element composition in Bulgarian honeys

	C	N	P	K	Na	Mg	Zn
	g $100g^{-1}$	mg kg^{-1}	mg kg^{-1}	mg kg^{-1}	mg kg^{-1}	mg kg^{-1}	mg kg^{-1}
H1	21.13	462	63.6	1044	185	50	2.0
H2	24.35	496	46.2	656	180	29	3.3
H3	20.37	354	134.4	819	109	44	1.7
H4	20.58	436	106.5	852	180	27	2.9
H5	22.00	422	53.9	238	91	nd	0.6
H6	21.77	638	40.8	158	97	nd	4.9
H7	18.81	277	94.7	638	167	41	4.4
H8	19.52	375	34.9	117	81	nd	0.8

nd – not detected

RSD is highest 3.21 %.

CONSLUSION

Honey is an acidic product with pH below 7. Concerning their moisture, all samples meet the requirements of the country (not more than 20 %). Only one sample demonstrated ash content below 0.50 %. In general, the honey is rich in carbohydrates, there are also found small amounts of protein. Data about carbon and nitrogen are also obtained. The descending order of elements is potassium > sodium > phosphorus > magnesium.

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