CHEMICAL COMPOSITION OF HUNGARIAN AND FOREIGN APICULTURAL PRODUCTS

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Introduction

Honey is a commonly consumed sweetener owing to its nutritional properties, therapeutic effects and unique flavour. It consists mainly of mono- and disaccharides, but also contains significant concentrations of free amino acids, minerals and phenolic compounds (Özcan & Aljuhaimi, 2015). Bee pollen is a less well-known apicultural product, which is consumed mostly by health-conscious individuals. As it is rich in essential macro- and micronutrients, pollen can be used as a dietary supplement (Thakur & Nanda, 2020). The physico-chemical properties of these products depend on the botanical origin of the source plants and are also influenced by the geographical origin, as well as the processing and storage conditions (Camiña et al., 2012). In this research work, some physical and chemical properties of Hungarian and foreign honeys with specific floral origin were examined. In addition, the chemical composition and colour characteristics of monofloral pollens typical to the Hungarian flora were determined.

Materials

The examined honey samples were as follows:

Hungarian honeys	Foreign honeys, provenance
acacia (AC)	thyme, Spain (TH)
linden (LI)	wild lavender, Portugal (WL)
chestnut (CH)	coriander, Bulgaria (CO)
goldenrod (GR)	buckwheat, EU (BW)
rapeseed (RS)	redwood, Czech Republic (RW)
phacelia (PH)	coffee blossom, Guatemala (CB)
wild/forest (WI)	orange blossom, Mexico (OB)
mixed flower (MF)	mixed flower, Ghana (MFG)

Pollen samples were obtained from Hungarian beekeepers and retail stores. Pollen loads of 8 different plant species were sorted by colour, then each colour fractions were identified by microscopic pollen analysis. Honey and pollen samples were kept in a dark place at room temperature until use.

Methods

The dry matter content of honeys was determined by using an Abbe refractometer (MSZ 6943-1:1979). For measuring the pH, a Radelkis universal pH meter (OP-204/1) was applied (MSZ 6943-3:1980). The HMF content was measured after the White method (MSZ 6943-5:1989, Bogdanov, 2002). The reducing sugar content was examined by Schoorl-Regenbogen method (MSZ 6943-4:1982). The determination of amino acid content was performed with an Amino Acid Analyser (Ingos AAA 400). Moisture content of pollen samples was determined by vacuum drying oven method (ISO 12824:2016). For protein determination, classical Kjeldahl method was applied. Total lipid content was determined by Soxhlet extraction (ISO 12824:2016). Ash content was analysed by incineration according to the ISO 763:2003 standard. Colour properties of the samples were measured by a Minolta CR-100 device. The results were expressed using the CIE-Lab system. The L (lightness), a* (redness) and b* (yellowness) values were determined. All experiments were performed in triplicate.

Results and discussion

Honey samples

Colour

The shade of honeys ranged from dark brown to light yellow. The darkest samples were the buckwheat (BW) and Ghanaian mixed flower (MFG) honeys, while linden (LI) and phacelia (PH) honeys were the faintest with their pale yellow colours. Fig. 1. shows the colour properties of the honey samples.

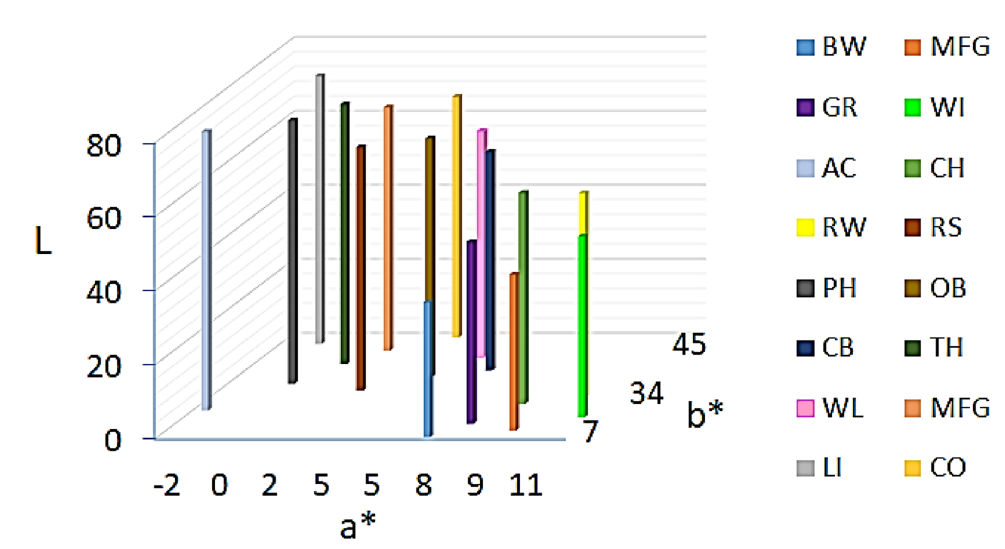

Figure 1. The colour properties of honey samples

pH

Honey contains a number of different acids, including about 18 amino acids, different organic acids, as well as aliphatic and aromatic acids. The pH of the honey samples ranged from 2.85 to 4.60. Phacelia honey (PH) possessed the lowest, while wild honey (WI) the highest pH value (Fig. 2.).

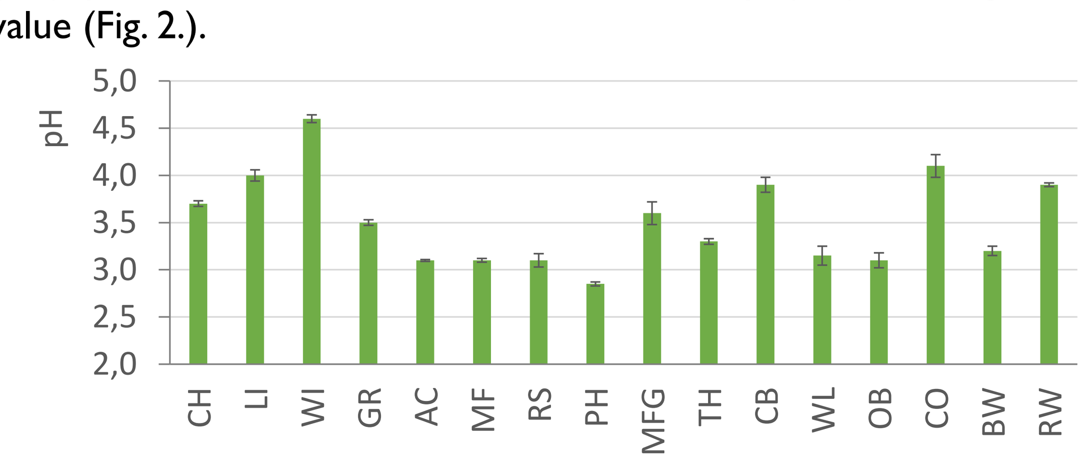

Figure 2. The pH of honey samples

HMF

The 5-hydroxymethylfurfural (HMF) content differed widely (Fig. 3.). In acacia honey (AC) its amount was 3.98 mg/kg, while the Ghanaian honey (MFG) contained it in extremely high concentration (140.42 mg/kg). In case of goldenrod (GR) and Ghanaian mixed flower (MFG) honeys, HMF can be responsible for the dark shade. The HMF content of the Hungarian honeys met the Hungarian and EU requirements (40 mg/kg), while its concentration in Ghanaian honey exceeded those determined for tropical honeys (80 mg/kg).

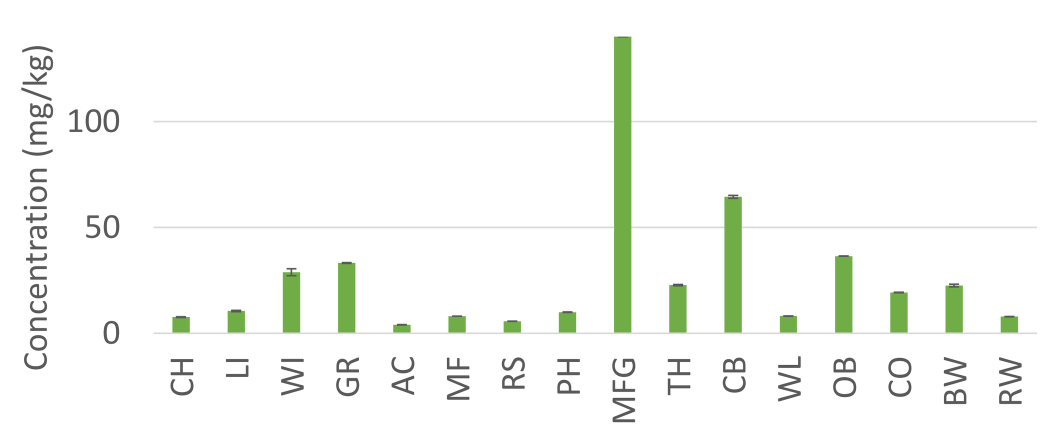

Figure 3. The HMF content of honey samples

Dry matter content

The dry matter content of the honey samples were between 78.2 and 82.5% (Fig. D). The average moisture content of honeys from Central Europe is about 17%, while honeys from tropical countries possess usually lower moisture content than those deriving from humid and cool climate. The moisture content of mixed flower (MF), rapeseed (RS) and buckwheat (BW) honeys exceeded 20% threshold stated in the Hungarian Food Codex (1-3-2001/100).

Reducing sugar content

About 95% of honey dry weight content are sugars. Reducing sugars are the major constituents in honey, which account for 85-95% of all honey sugars. The reducing sugar content of the honey samples were quite similar (Fig. 4.).

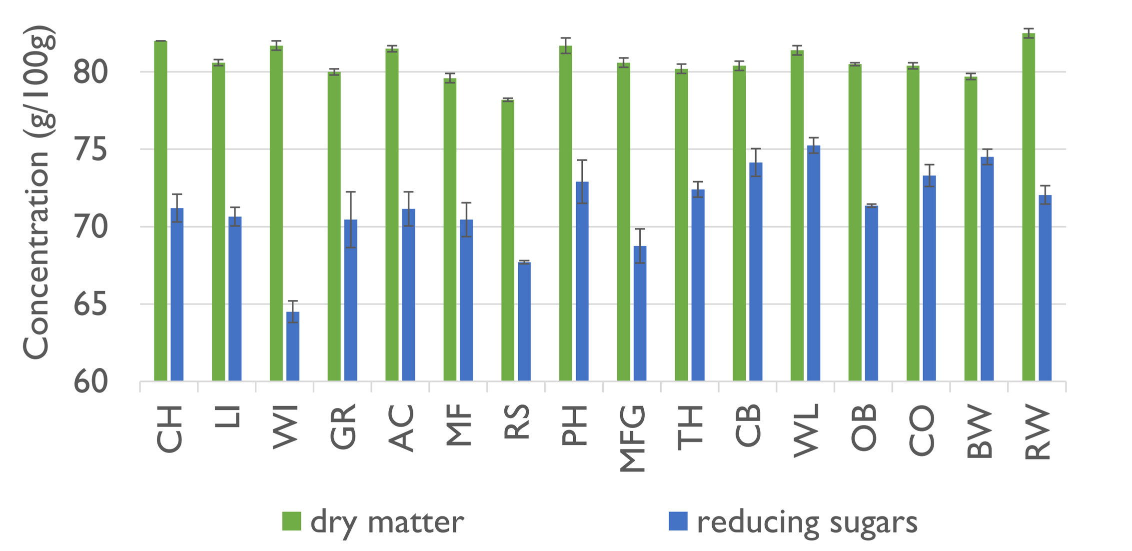

Figure 4. The dry matter and reducing sugar content of honey samples

Amino acids

Honey usually contains at the most 0.7% amino acids, from which proline is the most significant. The proline content of normal honeys should be more than 200 mg/kg (Bogdanov, 2016). The average amino acid content of our honey samples was 663.3 mg/kg. The amount of amino acids in the foreign honeys on average was slightly higher (787.6 mg/kg) than that of the Hungarian honeys' (539.0 mg/kg). Coriander honey possessed the highest (1349.5 mg/kg), while acacia had the lowest (162.2 mg/kg) amount. Proline was the dominant amino acid in the honeys, its ratio was above 42% in all cases (Fig. 5.).

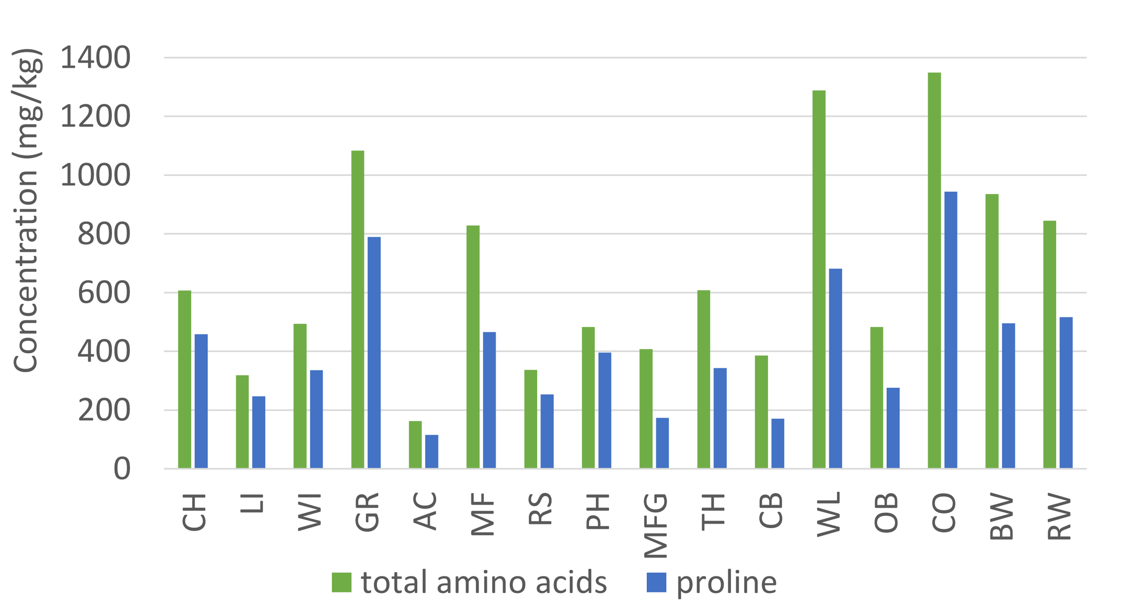

Figure 5. The ratio of proline to the total amino acid content in honey samples

Pollen samples

Botanical origin

Results of the microscopic pollen analysis confirmed that the proportion of the dominant pollen type was over 80% in all samples and therefore can be considered monofloral. The following plant species were identified: rapeseed (*Brassica napus* L.), sunflower (*Helianthus annuus* L.), phacelia (*Phacelia tanacetifolia* Benth), cherry (*Prunus avium* L.), blackberry (*Rubus fruticosus* L.), red poppy (*Papaver rhoeas* L.), dandelion (*Taraxacum officinale* Web.) and dropwort (*Filipendula vulgaris* L.)

Colour

The colour of pollen loads were various (yellow, orange, green, dark brown, purplish-blue). Fig. 6. shows the colour properties of pollen samples. The greatest similarity was shown by sunflower and dandelion pollens, which can be characterized by a bright orange colour. The greenish colour of cherry and blackberry pollens were also quite similar.

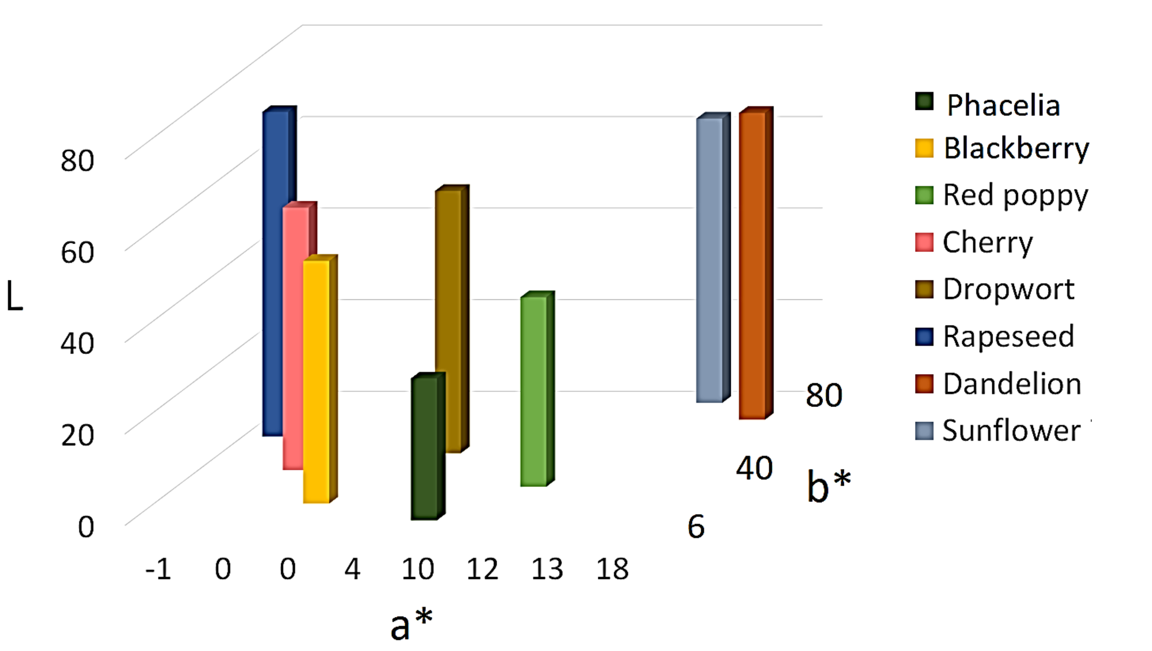

Figure 6. Colour properties of pollen samples

Macronutrient content

The moisture content of pollen samples varied between 4.9 and 7.9%. Each sample was rich in protein, especially phacelia and rapeseed pollen. The amount of lipids is below 5% in most cases, but dandelion pollen contained an outstanding amount of this nutrient. Ash content of the samples were quite similar with values between 1.4 and 3.2%. Cherry pollen contained the highest amount of inorganic substances. Our results (Table 1.) are in compliance with the literature data (Thakur & Nanda, 2020).

Table 1. Macronutrient content of bee pollen samples

Pollen	Water (%)	Protein (%)	Lipid (%)	Ash (%)
Rapeseed	6.2±0.1	26.0±0.2	7.1±0.3	2.8±0.1
Sunflower	4.9±0.3	15.8±0.4	3.8±0.6	1.4±0.1
Phacelia	7.9±0.1	26.7±0.6	1.4±0.3	2.5±0.2
Cherry	6.5±0.1	24.4±0.2	1.9±0.3	3.2±0.1
Blackberry	6.0±0.1	20.0±0.2	2.8±0.4	2.3±0.1
Red poppy	7.3±0.1	24.2±0.1	2.9±0.2	2.5±0.1
Dandelion	5.4±0.2	15.7±0.1	10.5±0.3	1.4±0.2
Dropwort	5.2±0.2	16.4±0.3	4.5±0.4	2.5±0.1

Conclusions

The honey samples usually corresponded with the Hungarian and international regulations concerning their chemical composition. The extremely high HMF content of the Ghanaian honey can be the result of the tropical climate and/or improper handling. The chemical content of the pollen samples were in accordance with the literature data. The standard determining the composition of these products are under preparation.

Acknowledgement

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