

PHYSICOCHEMICAL PROPERTIES OF BULGARIAN MULTIFLORAL HONEY SAMPLES

Rositsa Shumkova¹, Ralitsa Balkanska^{2*}

¹ Agricultural and stockbreeding experimental station – Smolyan, Bulgaria

² Institute of Animal Science – Kostinbrod, Bulgaria,

*Corresponding author: r.balkanska@gmail.com

Abstract

Honey has been always considered a food with healing capabilities and nutritive values. In the recent year, due to its high nutritive value, honey usage is increasing also in medicine and cosmetic products. The aim of the study was to evaluate the quality of multifloral honey samples from the point of view of physicochemical properties. Twelve honey samples from Bulgarian beekeepers were analyzed for parameters such as color, water content, reducing sugars, sucrose, diastase activity electrical conductivity, hydroxymethylfurfural (HMF), pH, specific optical rotation and insoluble matter. Melissopalynological analyses were carried out for characterization of the honeys. They showed that all honey samples can be classified as multifloral. The mean values and the standard deviations of the analyzed honeys were: colour 30.01 ± 7.35 mm Pfund water content $17.55 \pm 0.37\%$, diastase activity 22.41 ± 1.98 Gothe units, electrical conductivity 0.481 ± 0.066 mS/cm, HMF 2.59 ± 0.61 mg/kg, pH 3.96 ± 0.13 , specific optical rotation -17.11 ± 3.74 [α_D^{20}] and insoluble matter $0.06 \pm 0.01\%$. The reducing sugars and sucrose were also analyzed. The multifloral honeys from Bulgaria can be considered as a good level of quality as all honey samples were found to meet the European Requirements for all analyzed parameters. A linear correlation between honey color and electrical conductivity was found ($r=0.760$, $p<0.01$).

Keywords: Bulgaria, linear correlation, multifloral honey, physicochemical properties

Introduction

Honey is a sweet natural product which is consumed for its high nutritive value and its contribution to human health. In the recent year, due to its high nutritive value, honey usage is increasing also in medicine and cosmetic products. For this reason, the quality of honey is very important. Honey consists essentially of various sugars, predominantly fructose and glucose, as well as other compounds and substances such as organic acids, enzymes, mineral elements (Rybak-Chmielewska, 2004; Kirs et al., 2011).

The unifloral and multifloral honeys differ significantly as to the sensory as well as chemical composition that is reflected by their physicochemical parameters. The properties and composition of honey are known to widely vary depending on the region, season and plant source of nectar. Depending on the number of possible floral sources, it is clear that no honey is completely the same as another (Viuda-Martos et al., 2010). This is especially true for the multifloral honeys.

At the same time, the International Honey Commission (IHC) provides information on descriptive sheets for the Main European unifloral honeys (Persano Oddo and Piro, 2004). It is well known that some of the physicochemical parameters of honey are significantly

influenced by its botanical origin. The physicochemical quality criteria of honey are well specified in Directive 2001/110 (EU, 2001). The major criteria of interest are moisture content, electrical conductivity, ash content, sugars, free acidity, diastase activity and hydroxymethylfurfural (HMF) content (Alvarez-Suarez et al., 2010).

Honey production in Bulgaria has very long traditions dating back to ancient times. However, a few studies include detailed information and physicochemical properties of Bulgarian multifloral honeys. In this respect, the objective of this study was to evaluate the quality of multifloral honey samples from Bulgarian beekeepers from the point of view of physicochemical properties.

Material and methods

A total of 12 honey samples obtained directly from Bulgarian beekeepers in 2014 and 2015 were analyzed. The samples were collected from apiaries in South Central region (Plovdiv, Asenovgrad, Dimitrovgrad, Karlovo), North West region (Vratsa, Montana) and South West region (Blagoevgrad, Sofia). These honeys were stored in a controlled temperature ($18 \pm 2^\circ\text{C}$) in glass containers until further analysis.

The physicochemical properties were determined according to the Harmonised methods of the European Honey Commission (Bogdanov et al., 1997).

Pollen analysis was carried out using the method established by Bulgarian State Standard for Bee Honey (3050-80).

The color of honey samples was measured according to the Pfund scale. Briefly, each homogeneous honey sample was transferred into cuvette with a 10 mm light path until the cuvette was approximately full. The cuvette was inserted into a Lovibond Honey Colorpod. The color grades were expressed in millimeter (mm) Pfund grades when compared to an analytical-grade glycerol standard.

Evaluation of data

The statistical analysis was performed by using SPSS Statistical Package, (version 21 for Windows). The values were expressed as mean $\pm$ standard deviation, minimum and maximum values. A correlation was established using Pearson's correlation coefficient (r).

Results and discussion

First, the botanical origin and quality of honey were certified. Pollen analysis was used to specifically identify and confirm the botanical origin of the honey samples. In general, all the honeys analyzed could be considered as multifloral according to pollen contribution of the botanic species.

The most abundant pollen type in all honey samples is from *Fabaceae* family: (*Cercis siliquastrum* 7.10 – 10.50%; *Trifolium sp.* 5.60 – 8.70%; *Robinia pseudoacacia* 9.10 – 8.70%; *Laburnum anagyroides* 4.00 – 8%; *Gleditsia triacanthos* 10.60 – 12.20%; *Lotus corniculatus* 5.00 – 9.20%; *Melilotus officinalis* and *Melilotus albus* 5.80 – 10.40%.

From *Asteraceae* family are presented *Helianthus annuus* 16.70 – 33.90% and *Carduus nutans* 7.30 – 10.30%.

The following families are presented only with one plant species: *Brassicaceae* (*Brassica sp.* 7.60 – 22.10%); *Lamiaceae* (*Lamium purpureum* 5.00 – 6.80%); *Gentianaceae* (*Gentiana*

lutea 11.20 – 13.30%); *Boraginaceae* (*Echium vulgare* 6.20 – 12.50%); *Rhamnaceae* (*Paliurus spina-christi* 10.70 – 11.40%); *Apiaceae* (*Coriandrum sativum* 5.60 – 10.20%). As can be seen from the ranges of pollen type no honeys had sufficiently predominant pollen contents from anyone botanical specie to be considered as a monofloral honey.

The results for the main physicochemical properties of Bulgarian multifloral honeys are presented in Table 1.

Table 1. Physicochemical parameters of multifloral honey samples from Bulgaria, (n=12)

Parameters	Mean±SD	Min	Max
Colour, mm Pfund	30.01±7.35	14.70	40.60
Water content, %	17.55±0.37	16.90	18.10
Reducing sugars, %	66.76±1.49	63.79	68.45
Sucrose, %	0.76±0.33	0.25	1.30
Electrical conductivity, mS/cm	0.481±0.066	0.390	0.637
HMF, mg/kg	2.59±0.61	2.00	3.58
pH	3.96±0.13	3.80	4.15
Specific optical rotation, [α_D^{20}]	-17.11±3.74	-21.25	-12.25
Insoluble matter, %	0.06±0.01	0.05	0.08

Honey color is one of the most important parameter which is often related to the consumption patterns and consequently used to make judgments on its quality (Wilczynska, 2014). The results for the honey color are presented in Table 1. A linear correlation ($r=0.760$, $p<0.01$) was found between the honey color and electrical conductivity (Fig. 1).

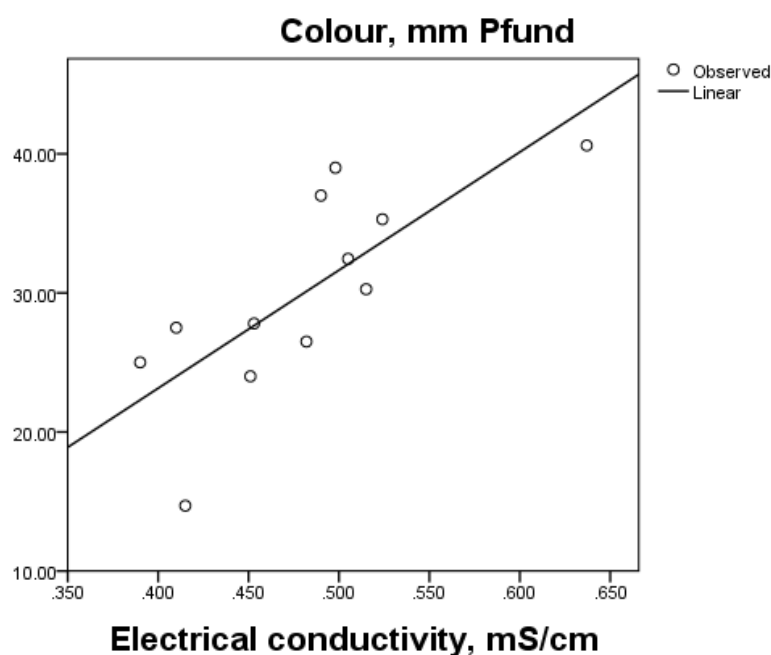


Figure 1. Linear correlation between honey colour and electrical conductivity

The water content value is considered to be a useful parameter for describing moistness and viscosity of the honey. It varied from 16.90 to 18.10% (Table 1). The small variation observed in the water contents of these samples may be due to the similar bee-hive handling practices applied by the Bulgarian beekeepers. In Council Directive 2001/110/EC (2001) the maximum water content value of floral honey is given as not more than 20% in general. Therefore the water content is a good criterion to establish the quality of multifloral honey. It is well known that a higher content can produce honey fermentation during storage. Our results correspond with the results of Bartakova et al. (2007) and Kasperova et al. (2012). They found 15 – 20% water content in honey samples from the Czech Republic and Slovak Republic.

Sugars represent the main components of any type of nectar honey. Reducing sugars (invert sugar), mainly fructose and glucose have been found to be the most abundant in honey (Kucuk et al., 2007). For all samples the reducing sugars are more than 60%. Moreover, for the sucrose content all honey samples exceeded the limit (5%) permitted by the Council Directive 2001/110/EC (2001). The mean values are under 1% (Table 1).

The diastase activity and the HMF content are widely recognized parameters used for evaluating the quality of honey. Furthermore, they are excellence indicators of honey freshness. According to Codex Alimentarius (2001) and Council Directive 2001/110/EC (2001) the HMF content of the honey should be under 40 mg/kg. In this respect, in all analyzed honey samples HMF content is under 4 mg/kg. It is expected because the samples are taken directly from the beekeepers and immediately analyzed. From this point of view all analyzed samples are fresh, and thus, coincide with the information provided by the producers. Besides, this finding is corroborated by the fact that diastase activity is also high in all honeys.

Legal regulation in the European Community has set a minimum value for diastase activity, this is 8 on Gothe's scale. All multifloral honey samples are up this value. Figure 2 presents the box plot diagram of diastase activity.

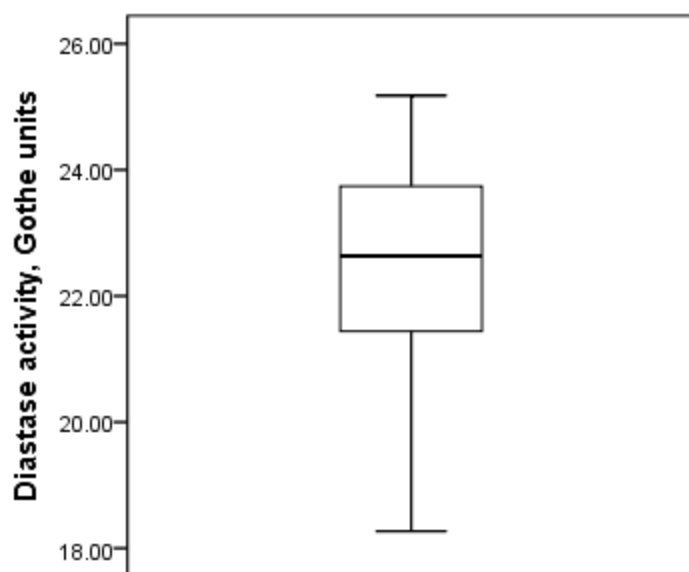


Figure 2. Box plot diagram of diastase activity. The minimum, maximum and median values are shown.

The diastase activity of the honey samples is 22.41 (mean) with a range of 18.27 – 25.18 Gothe units and a standard deviation of 1.98 Gothe units.

The values obtained for HMF and diastase activity are related to its quality and heat processing but have not been related to the floral type of the samples. However, these two parameters are very important for evaluation of quality of multifloral samples.

On the whole, electrical conductivity depends on the mineral content, organic acids, proteins, some complex sugars and polyols, and also varies with botanical origin (Terrab et al., 2003). The electrical conductivity values varied in the ranges of 0.390 – 0.637 mS/cm (Table 1). Our results are comparable to the values described by Kasperova et al. (2012) in multifloral honey samples.

All multifloral honey samples analyzed were found to have an acidic character. Their pH values are presented in Table 1. The low pH of honey inhibits the presence and growth of microorganisms. These values are similar to those previously reported for multifloral and monofloral honey (Abdulkhaliq and Swaileh, 2017; Kasperova et al., 2007, Gomes et al., 2010).

All samples have negative values for specific optical rotation. It is typical for the nectar honeys. Our results for this parameter are similar to those of Pridal and Vorlová (2002). Their minimum and maximum values are between -18.8 and -9.6 [α_D^{20}] for multifloral honey samples.

The measurement of insoluble matter is an important means to detect honey impurities higher than the permitted maxima (Bogdanov et al., 1997). The results are presented in Table 1.

Conclusion

The melissopalynological analyses showed that all samples are mulifloral. The multifloral honeys from Bulgaria can be considered of good quality as all honey samples were found to meet the European Requirements for all analyzed parameters. A linear correlation between

honey color and electrical conductivity was found ($r=0.760$, $p<0.01$). The data obtained in this study presents a pioneer contribution to the Bulgarian multifloral honeys characterisation. Further research should include more samples from different regions of Bulgaria in order to provide more information and set the limits of main quality parameters.

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