Assessment of Honey Quality from the Middle Podrinje Area

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ABSTRACT

The study aimed to examine the quality of honey from the Middle Podrinje area (Bosnia and Herzegovina). The research included a total of 21 samples of honey from the Middle Podrinje area: 12 samples of honey florals (municipalities of Srebrenica and Milići), 9 samples of acacia honey (municipalities of Zvornik and Bratunac). Physico-chemical parameters were determined as the main composition criteria for quality assessment in honey samples: mass fraction of water, total acidity, electrical conductivity, and ash. Samples of honey florals are of poorer quality compared to acacia honey, two samples had values of water content and acidity above the values prescribed by the Regulation. Statistical analysis showed that there is a statistically significant difference between the arithmetic means of the water content for floral honey, the electrical conductivity of acacia honey, and the free acid content for both types of honey. Honey samples that met the criteria prescribed by the Regulation were sensory evaluated by experienced analysts. Two samples of floral honey that did not meet the criteria prescribed by the Regulation were not sensory evaluated. Based on sensory analysis, samples of floral honey from the municipality of Milići had better sensory characteristics compared to the same type of honey from the municipality of Srebrenica. Acacia honey from the municipality of Zvornik was rated better than honey from the municipality of Bratunac.

Keywords- honey, quality, physico-chemical parameters, sensory analysis.

I. INTRODUCTION

Honey production is a significant and profitable economic activity in the study area . Honey is a substance produced by bees from nectar and / or honeydew, and differences in physicochemical properties mainly depend on the plant from which it is produced [1]. The quality of honey depends on the plant source, the chemical composition of these plants, climatic conditions, soil mineral composition [2], and microbiological parameters [3]. The composition and color of honey are variable and largely depend on the type of honey plant, botanical and geographical origin [4,5,6]. Physico-chemical parameters of honey quality are well specified by EC Directive 2001/110 [7] and national regulations [8]. The main criteria for quality control are moisture content, electrical conductivity, ash, reducing sugars, free acidity, diastase activity, and hydroxymethylfurfural (HMF) content [9,10].

Sensory analysis of bee honey is an important tool for determining its floral origin, for subsequent quality control, and determine consumer preferences towards this product. It is used to confirm quality, verify the absence of defects, evaluate the conformity to established sensory profiles of unifloral honeys and also to understand consumer preferences.Many authors emphasize the importance of sensory analysis of honey to confirm quality and distinguished by botanical origin and quality [11,12,13,14,15,16,17,18].

Acacia and floral honey are the most commonly produced types of honey in Bosnia and Herzegovina. Acacia is one of the most honey-bearing trees in our country. Acacia honey has a bright transparent color, and in a young virgin honeycomb, if without other impurities, it is almost colorless. It does not crystallize for a long time, with a pleasant taste [19] and a delicate fine aroma. It crystallizes into a fine-grained mass from white to golden-yellow color [20]. Acacia honey crystallizes slowly, due to the high concentration of fructose it can remain in a liquid state for a long time [21]. It is characterized by a strong aroma, pleasant taste, and smell. Properties, compositions and crystallization of floral honey depend of floral source.

The aim and purpose of the study were to provide an overview of the quality and differences in physicochemical parameters of two types of honey from four municipalities in the Middle Podrinje. Two types of honey, acacia and floral honey, were tested for water content, electrical conductivity, acidity, insoluble matter, and ash. Sensory analysis was performed for samples that corresponded to the parameters prescribed by the Regulation [22].

II. EXPERIMENTAL PART

2.1. Materials

The research included 21 samples of honey (12 samples of floral and 9 samples of acacia) collected from beekeepers in 2018. The samples originate from four

municipalities of the Middle Podrinje (Bosnia and Herzegovina): Srebrenica with a total of six samples of floral honey, Milići with a total of six samples of floral honey, Zvornik with a total of six samples of acacia honey, and Bratunac with a total of three samples of honey.

2.2. Methods
2.2.1. Physico-chemical parameters

Physico-chemical parameters (water content, electrical conductivity, acid content, insoluble matter content, ash content, reducing sugars and sucrose) were determined according to the national regulations [22].

2.2.2. Statistical analysis

Statistical analysis was performed using SPSS software (version 22). The T-test was used to test the significance of differences between the arithmetic means of honey samples concerning area, for physicochemical parameters and sensory analysis, and the Pearson correlation coefficient was used to determine the correlation between physicochemical parameters.

2.2.3. Sensory analysis

Sensory analysis of honey samples was conducted by a group of 5 analysts, who have experience in sensory evaluation of honey. Procedures, condition of preparation and serving of samples performed acording to Araujo et al. [23]. 40 g of each sample was put into a glass vial and covered with a watch glass for sensory analysis. The samples were prepared one hour before tasting to achieve the equilibrium of the headspace and they were served at 20°C. Four samples, labelled with three-digited random numbers, were served, one at a time, over a session. Mineral water and apple was used to cleanse the palate between samples.

Seven sensory attributes were evaluated, three for appearance (color, purity and clarity), one for smell, one for taste and two for aroma (characteristic of honey type and presence (strength) of aroma). The attributes were evaluated with different points: ponts from 1 to 3 for smell and purity, points from 1 to 4 for purity and presence (strength) of aroma, ponts from 1 to 5 for smell and taste and points from 1 to 6 for characteristic of honey type. The minimum sum of points in the overall rating for appearance is 3 points, the maximum is 10 points. The minimum sum of points in the overall rating for aroma is 2 points, the maximum is 10 points.

III. RESULTS AND DISCUSION

The composition of honey, ie the physicochemical characteristics of honey, is closely related to the area from which it originates. Table 1 shows the results of physicochemical analysis of floral and acacia honey samples. Table 2 shows the mean values of sensory analysis of honey samples.

The dry matter content in most of the tested samples was above 80%. Two samples of floral honey from the area of the municipality of Milići had a dry matter content of 79%. National regulation (8) clearly indicates that the water content in fresh bee honey should not exceed 20%, which means that the minimum content of dry matter in fresh honey should be 80%. The main component of the dry matter in honey is sugar, the content of which mainly affects the high dry matter result.

Table 1: Physical and chemical parameters of honey samples from four municipalities in the Middle Podrinje area

Municipality	Dry matter (refr.20°C) (Brix, %)	Water (%)	Electrical conductivity (mS/cm)	Free acid (mmol acid./1000 g)	Ash (g/100g)
Srebrenica	80.60	17.60	0.5000	50.00	0.10
	82.24	16.00	0.7100	49.00	0.10
	81.51	16.80	0.5900	37.00	0.30
	83.50	14.60	0.3300	43.00	0.10
	81.52	17.80	0.6200	43.00	0.30
	83.50	14.60	0.6800	40.00	0.40
Milići	82.00	16.60	1.0450	38.00	0.80
	79.00	21.00	0.7640	32.00	0.30
	81.10	17.00	0.6580	35.00	0.30
	80.20	18.60	0.7070	35.00	0.20
	79.00	19.00	0.6580	34.00	0.20
	80.00	18.60	0.4640	30.00	0.10

	80.50	17.40	0.2420	14.92	0.41
	81.00	16.80	0.3120	17.59	0.42
Zvornik	8.25	17.60	0.2480	13.98	0.30
	80.75	17.20	0.3190	14,69	0.35
	81.00	16.80	0.3210	14,82	0.33
	80.50	17.20	0.2960	13,88	0.48
	81.00	17.80	0.0550	8.00	0.46
Bratunac	81.00	17.80	0.0608	10.00	0.35
	81.50	16.80	0.0654	10.00	0.39

Water is the second most important ingredient in honey and its content can vary from 15 to 23%. Water content affects the quality and some characteristics of honey (viscosity, specific gravity, maturity, taste and crystallization, specific gravity), and depends on climatic conditions, bee varieties, bee colony strength, humidity and air temperature in the hive, processing and storage conditions, such as and the botanical origin of honey [24, 25, 26]. Foral honey samples from the Srebrenica municipality had lower values of moisture content compared to honey from the Milići municipality. One of the samples of floral honey from the municipality of Milić had a moisture content of 21%, and is not in accordance by the national regulations [8]. Another sample from the same municipality had water content of 19%. This value is following the Regulation but there is a possibility of fermentation when the value is greater than 18%. Possibility of fermentation can´t be excluded even when the water content is below 17.1%, although it depends on the amount of yeast in honey, honey temperature, and the distribution and availability of water after crystallization of honey [27]. The T-test showed that there is a statistically significant difference between the arithmetic means of the water content for floral honey (t = 2.584, p = 0.027 <0.05).

Very important factors for classifying honey analyzes according to their geographical origin are water content, electrical conductivity, and free acidity [3]. One sample of floral honey from the municipality of Milići has a higher electrical conductivity than prescribed by the Rulebook on honey and other bee products, this may be related to the higher ash content compared to other honey samples. Other samples are following national regulation [8].

Floral honey samples have higher values of electrical conductivity compared to acacia honey. Similar results were obtained by Bilić-Šobot (2020) in his research [28].

The ash content in all honey samples is in accordance with national regulation [8]. These results indicate the purity of the honey samples. The T-test did not show a statistically significant difference for any type of honey.

There is a statistically significant difference in arithmetic means (T-test) for the electromobility of acacia honey (t = 10.687, p <0.05).

The results for free acid are in accordance with the Ordinance on honey and other bee products, and there is a statistically significant difference between the arithmetic means for both types of honey by area (floral honey t = 4.118, p <0.05; acacia honey t = 6.150, p <0.05). Observing all the results, the content of free acid is higher in relation to acacia honey, which is in accordance with the research of other authors [3, 28, 29]. Some authors state that electrical conductivity is related to ash and acidity measurements [30].

By analyzing the Pearson correlation coefficient, in both types of honey there was a very high negative correlation between dry matter content and water content (r = -0.956; p <0.01) and a high positive correlation between electrical conductivity and mineral content (ash) (r = 0.815; p <0.01). Ash and electrical conductivity values depend on the mineral content of the honey: ash gives a direct measure of inorganic residue after carbonisation, while electric conductivity measures all ionisable organic and inorganic substances [31]. The relationship between these two parameters and positive correlation has been demonstrated by several researchers [32, 33, 34, 35, 36].

Stolzenbach et al. [15] found in their study that honey has different and unique flavors associated with the origin of the place - local sensory uniqueness.

Acording the results (Table 2), floral honey from the municipality of Milići were better evaluated than from the municipality of Srebrenica. They had a better ratings for the clarity, smell, taste and aroma, but T test showed a statistically significant difference in arithmetic means only for the sensory property of smell (t = 2.638; p <0.05) and the characteristics of the type of honey (t = 2.734; p = 0.026 <0.05). This may be associated with smaller acidity values for honey samples from Milići area. Acacia honey from the municipality of Zvornik were better evaluated than honey from the municipality of

Bratunac. Accordingg the results (table 2), samples from Zvornik had a better ratings for the purity, smell, taste i aroma and T test showed a statistically significant difference in arithmetic means for all this sensory properties: purity (t = 3.685; p <0.05), smell (t = 8.383; p <0.05), taste (t=4,356, p <0.05) characteristics of honey type (t = 8.478, p < 0.05) and the presence of aroma (t = 5.017, p<0.05).

Table 2. Sensory analysis of honey samples from four municipalities in the Middle Podrinje area

Municipality	Appearance					Aroma	
	Color (1-3)	Purity (1-4)	Clarity (1-3)	Smell (1-5)	Taste (1-5)	Characteristic of honey type (1-6)	Presence (strength) of aroma (1-4)
Srebrenica	2.8	3.6	2.6	3.4	3.1	3.4	2.7
	3.0	3.2	2.6	4.3	4.4	4.8	3.4
	2.7	4.0	2.4	4.2	4.4	4.8	3.8
	2.9	4.0	2.6	3.2	3.0	3.2	2.3
	3.0	4.0	2.8	3.8	4.5	5.2	3.9
	2.2	3.6	2.3	3.4	3.8	4.4	3.6
Milići	3.0	3.0	3.8	4.4	4.6	5.0	3.8
	3.0	3.0	3.6	4.6	4.4	5.6	3.4
	2.4	2.4	3.6	4.6	4.0	5.8	3.6
	2.6	3.0	3.0	4.0	4.0	5.6	3.8
Zvornik	3.0	3.8	2.8	4.8	5.0	6.0	4.0
	3.0	4.0	3.0	4.6	4.8	6.0	3.6
	3.0	4.0	3.0	5.0	5.0	6.0	4.0
	3.0	4.0	3.0	5.0	5.0	6.0	4.0
	3.0	4.0	3.0	4.6	5.0	5.8	3.8
	2.6	3.8	2.8	4.8	4.6	6.0	3.6
Bratunac	3.0	3.0	3.0	2.0	2.4	3.4	2.0
	3.0	3.6	3.0	2.8	3.8	4.0	2.4
	3.0	3.6	3.0	3.2	4.0	4.6	3.2

IV. CONCLUSION

Based on the conducted analyzes, two samples floral honey from the municipality of Milići does not correspond to the quality parameters prescribed by the Regulation on honey and other bee products. They had a inappropriate electrical conductivity and content of water.

Honey from similar places are differ in sensory profile and depends on climatic conditions, bee varieties, humidity and air temperature in the hive, processing and storage conditions. There are differences in the quality of honey concerning the area, and they are statistically significant for certain quality parameters and sensory properties of honey. Floral honey from the municipality of Milići and acacia honey from Zvornik area were better evaluated than floral honey from the municipalities of Srebrenica and acacia honey grom Bratunac area.

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