EUROPEAN ACADEMIC RESEARCH
Vol. VII, Issue 8/ November 2019

Impact Factor: 3.4546 (UIF)
DRJI Value: 5.9 (B+)

ISSN 2286-4822
www.euacademic.org

Determination of honey quality of the south region of Albania based on physico-chemical parameters

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Abstract:

Honey, a natural product, is well known for its beneficial effects on human health due to its complex composition which depends mainly on the type of flowers used by bees for the honey production as well as on climatic conditions. The determination of honey quality control is a very important step to check its suitability for processing and meeting the demand of the market. The aim of this study was to evaluate the quality of honey collected in fifteen different beekeeping farms in the south region of Albania (five for each district). Honey samples were collected in this area due to its rich biodiversity and its Mediterranean climate. The physico-chemical parameters of honey such as: moisture (water content), ashes, pH, electrical conductivity, free, total and lactonic acidity, hydroxymethylfurfural (HMF), DDPH and total polyphenoles were determined.

The results obtained in this study for the Physico-chemical parameters indicate that honeys produced in South Region of Albania are of very good quality according to International Regulatory Standards.

Keywords: Honey, South Region of Albania, Physico-chemical Parameters, Quality Control, International Standards

AIMS AND BACKGROUND

Honey is a natural substance produced by bees, mainly Apis mellifera L., and is a nutritious food of economic importance worldwide (Aloisi, 2010). It is a very important energy food and is used as an ingredient in hundreds of manufactured foods and contains approximately 80% carbohydrates (35% glucose, 40% fructose, and 5% sucrose) and 20% water, serving as an excellent source of energy. Also, it contains more than 180 substances including amino acids, vitamins, minerals, enzymes, organic acids phenol compounds (A. Abselami, 2018) (Graciela Ojeda de Rodrıguez, 2004). Quality control of honey is important to determine its suitability for processing and meeting the demand of the market. The honey composition depends mainly on the type of flowers used by bees for the honey production as well as on geographical and climatic conditions (M.A. Al-Doghairi, 2007). The South Region of Albania is characterized by a rich and varied biodiversity. It has an extensive access to the warm Ionian Sea. This geographical position makes it suitable to have pronounced features of Mediterranean climate (https://www.britannica.com/place/Albania/Climate). This makes it suitable for the growth of many types of fruit and other crops such as olives, citrus, grapes, figs, and cherries. In the table 1 general characteristic regarding the situation of the beekeeping farms and hives according to each district in the studied area are given.

Table 1: General characteristics about the beekeeping farms in the South Region of Albania

District	Surface km²	Position on the map	Number of beekeeping farms	Number of bee hives/farm
Fier	1,890 km²		1,605	20,256

Gjirokastër	2,884 km²		1,535	23,180
Vlorë	2,706 km²		1.993	30,502

The aim of this study was to evaluate the quality of honey from South region of Albania. For this purpose, physico-chemical properties in 15 honey samples collected in this area were determined and were compared to international Regulatory Standards (Bogdanov *et al.*, 1999).

EXPERIMENTAL CONDITION

Honey samples were collected randomly in 2017 in fifteen different beekeeping farms in the south region of Albania as following: five samples in Vlora District, five samples in Fieri District and five other ones in Gjirokastra District. Honey samples were collected in this area due to the rich biodiversity and its Mediterranean climate.

The physico-chemical parameters of honey were determined immediately after the samples were taken to the laboratory according to "Harmonised methods of international honey commission" (Bogdanov & Lullman, 1997). Two sub-samples of each sample were analyzed in order to check the quality of the results.

The physico-chemical parameters determined included: moisture (water content), ashes, pH, electrical conductivity, free, total and lactonic acidity, hydroxyl methylfurfural (HMF), DDPH and total polyphenoles. All the measurements except hydroxy methylfurfural (HMF) were performed in Innovative Centre, Faculty of Chemistry L.t.d, Serbia.

The pH of each sample was measured using a Mettler Toledo pH-meter, from a solution containing 10 g of honey in 75 mL of CO2

free distilled water (Helrich, 1990). After the pH determination the samples were used for determination of acidity by titrimetric methods (The samples were titrated using sodium hydroxide to obtain the free acidity. Excess of sodium hydroxide (0.05 N) was added to hydrolyzed any lactose present and send immediately back to titration with HCl (0.05 N), hydrochloric acid. The total acidity was then calculated as the sum of free acidity and lactone acidity)

The moisture of honey samples was determined based on the refractometric method using a Abbe refractometer at 20° C after the homogenization and equilibrium. The determination of ash was performed in an electric furnace at 550°C temperatures putting five grams of each sample in a platinum ash dish. For the determination of electrical conductivity 20 gram of honey were accurately weighted and diluted with 100 ml of CO2- free distilled water. The determination of HMF for 6 samples (2 for each district) was performed in the Innovative Centre, Faculty of Chemistry in Serbia, using HPLC with UV detection (wavelength 285nm). Ash percentage was calculated.

Total phenolic content (TPC) was determined with Folin-Ciocalteu according to (Singleton, 1965) with minor modification. Briefly, 0.3 ml of the sample extract and 6 ml deionized water were mixed with 0.5 ml of 10% Folin- Ciocalteu reagent and the solution was incubating 6 min at room temperature. Then, 3 ml of 7.5% sodium carbonate were added. After 30 min at 40°C, absorbance was measured at 765 nm. As a standard was used gallic acid, concentration 50-250 μl/ml. Blank was prepared by mixing water and reagent. Results were expressed as mg gallic acid per kilogram honey.

DPPH (1, 1-diphenyl-2- picrylhydrazyl) determination was estimated according to (Nihal Turkmen, 2005) with some modification. 2 g of honey sample was dissolved in 10 ml of distilled water, centrifuge and filtered. After that, 0.75 ml of the solution were mixed with 2.25 ml of 0.1 mmol/L methanol of 1,1-diphenyl-2-picrylhydrazyl. A control test was prepared containing only with distilled water. The mixture was mixed by vortexing and incubated for 60 min at room temperature in the dark. The absorbance was measured against methanol at λ=517, using an Agilent, UV-VIS spectrophotometer. Results were expressed as percent of inhibition of DPPH radical using equation:

$$AA(\%) = (Abs\ contr - Abs\ sample) / Abs\ contr \times 100$$

The results obtained for the Physico-chemical results were compared with International Regulatory Standards (Bogdanov et al., 1999).

RESULTS AND DISCUSSION

The physico-chemical parameters of honey samples collected in different beekeeping farms in the South Region of Albania are given in Table 1. The results are given as the mean value of the results obtained for the two sub-samples of each sample analyzed.

Table 2. Physico-chemical parameters of honey samples collected in the south region of Albania

District	Sample code	Moisture (%)	Ash (%)	Cond (ms/cm)	pH	Free Ac. (meq/kg)	Lact.ac. (mek/kg)	Total ac. (meq/kg)	HMF (mg/kg)	DDPH	Total polyphenoles
Vlore	M87	15.4	0.02	0.23	4.19	12.65	3.5	16.15	10.72	22.94	157.8
	M88	15.8	0.061	0.48	4.18	13	4	17	10.83	22.27	167.9
	M89	16.9	0.037	0.34	4.18	12.75	4.5	17.25		18.62	243.4
	M90	15.5	0.04	0.37	4.19	12.5	3.75	16.25		20.45	187.5
	M33	15.7	0.055	0.45	3.91	39.25	6.5	45.75		21.61	255.1
Gjirokaster	M9	14.5	0.039	0.34	3.92	35	9.5	44.5	12.11	41.54	595.1
	M10	14.6	0.026	0.28	3.89	22	11	33	20.25	45.03	287.1
	M14	15.2	0.041	0.37	4.05	20.25	13.25	33.5		40.04	345.7
	M15	15.2	0.035	0.32	3.85	21.2	10.5	31.7		42.38	432.3
	M16	14.2	0.042	0.41	3.8	20.85	13.22	34.07		44.10	256.6
Fier	M35	17.5	0.021	0.28	3.7	23.2	3.25	26.45	21.93	57.48	373.7
	M36	17.2	0.041	0.35	3.98	42	3.25	45.25		58.64	254.3
	M37	16.8	0.052	0.4	4.02	28.75	5	33.75		59.81	322.2
	M38	16.5	0.031	0.32	3.74	24.75	4	28.75		62.96	387.4
	M39	17	0.039	0.38	3.78	21	1.25	22.25	23.07	62.63	140.3

In the figure 1 the minimum, maximum and mean values of Ash, Electric conductivity, moisture and pH are given.

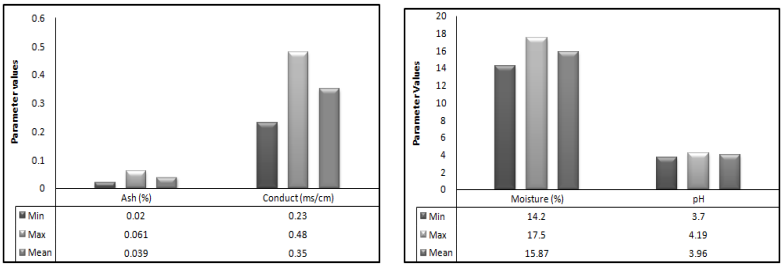

Figure 1. The minimum, maximum and mean values of Ash, Electric conductivity, moisture and pH

As we can see from the table 2 and from the graphic illustrated in figure 1, the ash content resulted 0.02- 0.061% with a mean value of 0.039%. As it can be seen, the honey samples from all the studied

districts showed mean ashes percentages below the allowable maximum given by the international regulatory standards for quality honey (Stefan Bogdanov, 1999).

The electrical conductivity in the honey samples analyzed varied from 0.23 ms/cm to 0.48 mS/cm with a mean value of 0.35 mS/cm. All of the samples analyzed presented electrical conductivity values characteristic of nectar honey (≤ 0.8mS cm-1) (Aloisi, 2010) (Stefan Bogdanov, 1999). The electrical conductivity in honey is related to ash content (mineral content) and acidity, revealing the presence of ions, organic acids and proteins (Yücel & Sultanoglu, 2013).

The moisture content in honey samples analyzed fluctuated between 14.2 to 17.5 %, in accordance with the recommended value, should not be higher than 20 % (2001/110/EC, 2001). The average moisture content in the honey of the South Region of Albania was low (15.67%) and indicated a proper degree of maturity (Aloisi, 2010).

In this study, the pH values in all honey samples analyzed resulted between 3.7 (M35, District of Fier) and 4.19 (M 87 and M 90 in Vlora District) with a mean value of 3.96, which are typical values in floral honey (< 4.5). The pH values in honey depend on the presence of organic acids that contribute to honey flavor and stability against microbial spoilage, Bogdanov et al (2008).

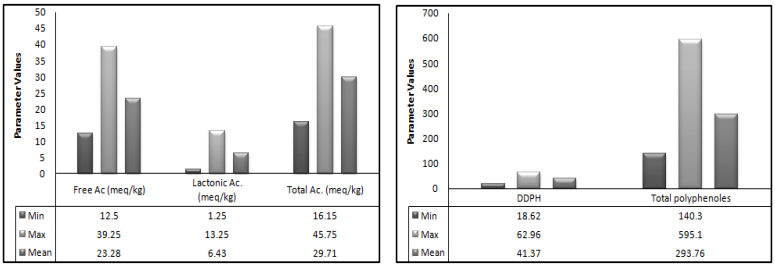

Figure 2. The minimum, maximum and mean values of Free, Lactonic & Total Acidity, DDPH and Total polyphenoles

In the figure 2, the minimum, maximum and mean values of Free, Lactonic & Total Acidity, DDPH and Total polyphenoles are given.

As it can be seen from the graphic, Free acidity determined in honey samples collected in the south region of Albania resulted between 12.5 meq/kg (M90) and 39.25 meq/kg (M33) with a mean value of 23.28 meq/kg, within the recommended value (the upper limit

for free acidity is 50 meq/kg) given in the Council Directive 2001/110/EC and the limit of 40 meq/kg established by the international regulations (Bogdanov et al., 1999).

Lactonic acidity ranged between 1.25 meq/kg (M39) and 13.25 meq/kg (M14) with a mean value of 6.43, total acidity ranged between 16.15 mg/kg (M87) and 45.75 mg/kg (M33), with a mean value of 29.71 mek/kg, (figure 2). The lowest and highest value of free and total acidity corresponds to samples taken in Vlora district, in the meantime low value of lactonic acidity corresponds to sample from Fieri district and the highest value correspond to sample from Gjirokastra district.

The HMF values fluctuated between 10.72 mg/kg (M87, Vlora District) to 23.07 mg/kg (M39, Fier District), and they are lower than 40 mg/kg-1, the maximum value established by the international regulations (Bogdanov et al., 1999). HMF parameter is usually absent in fresh honey (or it can be detected at low concentration) and usually is used for freshness evaluation of honey samples. This parameter tends to increase with time. Samples taking during this study showed HMF concentration lower than International Regulation value.

Total phenolic content varies from 140.3 mg/kg (M39 from Fieri district) to 595.1 mg/kg (M9 from Gjirokastra district). This high difference in total phenolic content may be because of floral source of the district were sample were taken (Khalil et al., 2011a). As it is known honey composition depend from various factors which include nectar source, season and storage condition (Kaskoniene and Venskutonis, 2010).

The radical scavenging activity of honey ranged from 18.62% to 62.96% in the DPPH reaction system. The highest value results in sample M38 from Fieri region and the lowest value results in M89 from Vlora region.

CONLUSIONS

In this study the quality control of honey collected in the South Region of Albania was performed in order check its and suitability for the market demand. For this purpose, some physico-chemical parameters such as moisture, ash, pH, electrical conductivity, free, total and lactonic acidity, hydroxymethylfurfural (HMF), DDPH and total polyphenoles in 15 honey samples were determined. In general,

the physico-chemical parameters in honey resulted in normal levels compared to International Regulatory Standards. Three samples resulted with a value of total acidity very closed to the value establish in Council Directive (50 mek/kg). Since acidity is related to the origin of the product such as flowering, climate and region we can say that these samples are not losing quality as long as this parameter is not accompanied by signs of fermentation.

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