Percentage of Water in Acacia and Meadow Honey in the Period from 2019 to 2021

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Abstract

Honey is a naturally occurring material made by bees from the sweet, fragrant nectar of flowers. More than 200 substances have been identified in honey, the majority of which are sugars and water. Certain physical characteristics of honey, such as crystallization and viscosity, are substantially affected by moisture. The honey may be stored for a longer period of time because of the low water content, which shields it from microbial activity. Honey from around Pozarevac, the place in Serbia with the largest production of honey, was controlled. A refractometer from A. KRÜSS Optronic GmbH was used for this research. In the period from 2019 to 2021, 99 samples of acacia honey and 114 samples of meadow honey were analyzed. The average values of water percentage in the indicated period in both types of honey were between 16 % and 17 %. Based on this research, it can be concluded that the percentage of water in acacia and meadow honey was below the maximum allowed values according to national and European regulations. Below 17 % water content, honey fermentation is inhibited. Honey with a water percentage above 17 % is sensitive to fermentation, while honey with a water content above 19 % is extremely vulnerable.

Keywords: meadow honey, water, refractometry, acacia honey.

1. Introduction

Honey is a naturally occurring material made by bees (Apis mellifera) from the sweet, fragrant nectar of flowers. It has been utilized as food and medicinal ever since the beginning of time. Due to its many geographical and botanical origins, it is a complicated mix with highly brilliant differences in composition and features, with its primary characteristics dependent on the floral source or nectar being given to bees. The weather, the level of humidity in the hive, the condition of the nectar, and how the honey is handled during extraction and storage are all environmental elements that affect the composition and quality of honey throughout production [1,2]. With changes in bee diet, honey composition changes. More than 200 substances have been identified in honey, the majority of which are sugars and water. Other components include proteins (enzymes), organic acids, vitamins (particularly vitamin B6, thiamine, niacin, and pantothenic acid), minerals (including calcium, copper, iron, magnesium, manganese, phosphorus, potassium, sodium, and zinc), pigments, phenolic compounds, a wide range of volatile compounds, and solid particles derived from the honey harvesting process. Honey has a wide range of uses and practical applications in human and veterinary care, as well as in culinary, magical, and religious rites. Due to its sweetness, color, flavor, caramelization, pumpability, and viscosity, it is a highly significant source of energy and is utilized as an ingredient in hundreds of processed meals, mostly in goods made from grains. Mostly made of sugar, honey is a natural food that also contains additional nutrients such enzymes, amino acids, organic acids, carotenoids, vitamins, minerals, and aromatic compounds. It is abundant in flavonoids and phenolic acids, which exhibit a variety of biological activities and function naturally as antioxidants [2,3,4]. Additionally, honey is a food whose composition changes significantly while it is stored. These are

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the anticipated modifications that are typically brought about by a variety of chemical processes, including as fermentation, oxidation, and heat treatment, which are influenced by the components of honey. Due to the scarcity of honey and its high price, adulterated versions have become more popular. It is thought that the identification and quality characteristics of honey are helpful for spotting these potential adulterations as well as for validating the sanitary conditions for handling and storing honey.

People all throughout the world eat and appreciate honey, a viscous, flavorful, and sweet meal. In order for people to eat honey safely, for it to circulate unrestrictedly on the domestic market, and for it to have access to international markets, specific criteria and rules that ensure its identity and quality are necessary. The addition of inexpensive sweeteners (such as cane sugar or refined beet sugar, corn syrup, high fructose or maltose syrup), as well as feeding bees sucrose, are the two most frequent methods of churning honey. Certain physical characteristics of honey, such as crystallization and viscosity, are substantially impacted by moisture. Other aspects of honey, including its appearance, color, aroma, and taste as well as its specific gravity, solubility, and ability to be preserved, are also crucial. High honey humidity is another sign that the honey has been tampered with. For honey to resist fermentation and granulation, water in the honey is crucial. The honey may be stored for a longer period of time because to the low water content, which shields it from microbial activity [3]. The likelihood that osmotolerant yeasts may ferment honey after storage increases with humidity. Below 17.1 % water content, honey fermentation is inhibited. Additionally, for moisture contents between 17.1 % and 20 %, the microbiological load affects honey stability, and at moisture contents above 20 %, osmophilic yeast can grow. Honey with a water percentage above 17 % is sensitive to fermentation, while honey with a water content over 19 % is extremely sensitive, claim Snowdon and Cliver (1996) [4]. Honey is gaining popularity as an antioxidant source due to the rising need for anti-oxidants in diet [5, 6].

The aim of this paper is to give an overview of the results of the tested honeys on the territory of the Republic of Serbia, from the area around the municipality of Požarevac. During a period of three years, the amount of water present in two types of honey was monitored. The amount of water in acacia and meadow honey was monitored. Water was chosen as one of the main parameters during the control and sale of honey, which has a significant impact on the price. The assessment of the water content in acacia and meadow honey served as the foundation for this research, which was carried out in Serbia between 2019 and 2021.

2. Materials and methods

Ninety-nine acacia and one hundred and fourteen meadow honeys from the Požarevac district in Serbia were used in the work. The samples were stored in transparent glass containers in the amount of 500 g, at room temperature, on shelves exposed to light. These conditions were chosen to confirm the botanical origin of the honeys, as they correspond very well to the average conditions and duration of honey storage in households. After delivery, the samples were analyzed on the same day. The reference material (CRM Fapas) for control quality Parameters in honey was used.

Acacia honey comes from the acacia flower. The color varies from golden yellow to light green. It is extremely bright, almost transparent. Acacia honey has a mild taste and smell and crystallizes very slowly into small crystals and then acquires a milky white color. It is rich in vitamin C and its composition works to relax the body. Unlike meadow honey, it contains a smaller amount of pollen, so it is more suitable for use by people allergic to certain types of pollen. With its energetic composition, it increases the general strength of the organism, awakens a cheerful mood and quickly recovers the body after physical and mental efforts. It is crucial for athletes, pregnant women, and other people. In traditional medicine, it is also used for respiratory infections, liver ailments, and stomach and intestinal illnesses. Acacia honey contains modest antibacterial and anti-inflammatory effects, same like other types of honey. It works great as an antiseptic and may be used to treat wounds and scrapes. Acacia honey eating takes away pounds with modest exercise. Honey helps fatigued muscles to recuperate by using body fats. It is also used in traditional medicines to improve digestion and appetite, treat respiratory infections, persistent coughs, and bronchitis, help the body recover from stressful situations, improve sleep, improve

bowel and liver function, boost immunity, and act as an antioxidant owing to tiredness, the body is detoxifying and recovering. However, diabetics should ask their doctor about the daily quantities they can use before using honey as a substitute for other sweets [7].

Meadow honey is polyfloral, meaning it comes from a variety of plants, each with a unique chemical make-up. As a result, the honey includes additional vitamins, minerals, or essential oils. Whether I like it or not, it is created at the end of August from spring-blooming plants like dandelion, white rada, sage, violet, thyme, and St. John's wort, as well as from the blossoms of apple, plum, and cherry trees. It is frequently referred to as flower honey since it is made from meadow flowers. Depending on which plant species predominate in the honey, it has a different flavor and perfume. When compared to acacia honey and forest honey, meadow honey has a greater aroma and flavor that ranges from yellowish to dark red. Meadow honey, like all other varieties of honey, includes nutrients from the nectar, notably ferments and organic acids, as well as vitamins and minerals the bee added to the nectar. Meadow honey has uses in traditional medicine because it is made from the nectar of many different plant species and contains a number of physiologically active ingredients. Meadow honey is mostly used to boost defense mechanisms. Because meadow honey is created from a variety of plant pollen, which is the source of all those allergies, it should be removed from our environment, especially if we struggle with allergic reactions to pollen. Consumption is advised all year because to its unique makeup, but especially in the fall and spring when colds are most prevalent. It is advantageous for an organism's recuperation, the health of the elderly, and the growth of young children. Patients with respiratory and cardiovascular conditions are advised to take it. It contains anti-fungal, antibacterial, and antiseptic properties due to the abundance of minerals, organic acids, and different enzymes, and is typically used as a preventative step [8].

Determination procedure

The sample is prepared in accordance with the instructions in Fig. Sheet SFRJ 4/85, Procedure 4, for the method of sample preparation for analysis. Before beginning the analysis, if the honey is liquid, it is gently stirred with a stick or shaken. At a constant temperature of 20 ℃, the refractive index of the sample is then calculated using a refractometer. The quantity of water (% m/m) is computed based on the refractive index [9]. A temperature correction is applied and the findings are decreased to a temperature of 20 ℃ if the index determination was not done at that temperature. The assessment of measurement uncertainty was done according to the instruction AC-PA06 "Assessment of measurement uncertainty" and EURACHEM / CITAC Guide CG 4, Quantifying Uncertainty in Analytical Measurement, Third Edition.

The identification of the source of measurement uncertainty depends on the assessment of the intra-laboratory reproducibility of the unstable control sample and the measurement uncertainty of the system components and is expressed by the formula:

$$\mathbf{u_C} = \sqrt{\mathbf{u_A^2} + \mathbf{u_B^2}}$$

$\mathbf{u_A}$ represents the intra-laboratory reproducibility estimate of the unstable control sample (r %) divided by 1.128,

$\mathbf{u_B}$ represents the measurement uncertainty of system components (refractometer, thermometer).

The result is expressed as follows:

$$\text{result} = \text{value} \pm \text{uncertainty}$$
$$(\text{result}) = (X \pm U \cdot X/100)\ (\text{unit})$$

The measurement uncertainty for testing acacia and meadow honey is 4.1 %.

A refractometer from A. KRÜSS Optronic GmbH, Hamburg, Germany was used for this research.

Leading producer of high-precision measuring tools and analytical equipment, A. KRUSS Optronic provides a variety of products and tailored solutions for quality assurance in the chemical, petrochemical, food and beverage, pharmaceutical, and research and scientific industries. One of the earliest laboratory tools for detecting the refractive index of liquids was the Abbe refractometer, which Ernst Abbe created about 1869. It uses entire reflection as the foundation for measuring. measures sugar concentration (%Brix) and refractive index (nD) in solid, viscous, and liquid materials. The devices have thermostat connectors that enable temperature control using an external thermostat

on both sides of the top and lower prism holders. The Abbe refractometer AR4 measures sugar content in the range of 0–95% Brik and determines the refractive index between nD 1.3000–1.7200. The drive button may be used to manually adjust the scales. After that, the measured value is read using the eyepiece. To keep the temperature at 20°C or 25°C, the refractometer can be linked to a circulation thermostat (PT31) with a Peltier element. The embedded digital thermometer will measure the temperature and show it on the LCD screen.

3. Results and discussion

During 2019 and 2021, a total of 213 honey samples were examined, of which 99 were acacia honey and 114 were meadow honey. Table 1 provides a summary of the average water content measurements in this study for meadow honey and acacia honey. The results of other authors from Serbia and other nations were compared with the values found in the Rulebook on the quality of honey in the Republic of Serbia (Official Gazette, 101/2015), as well as the values determined by the obtained values. All tested samples of honey produced in the period from 2019 to 2021 had a water content below 20 %, which is the upper limit allowed by local regulations on honey (Official Gazette No. 101/2015). Mean value results for the certificate reference material was 18.2 %. The range of the reference material (Fapas) was from 17.2 to 18.5 %, which confirms that the measurement is satisfactory.

Within the group of tested acacia honey in 2019, 34 samples were tested, none of which exceeded 20 %. In 2020, 38 samples were tested, none of which exceeded 20 %, while in 2021, 27 samples were tested, none of which exceeded 20 %, which is shown in Figure 1.

Table 1. Water content in acacia honey and meadow honey

Type of honey	Water content (%)								
	2019			2020			2021		
	No. of samples	Average value	Standard deviation	No. of samples	Average value	Standard deviation	No. of samples	Average value	Standard deviation
Acacia	34	16.2	1.02	38	16.4	1.08	27	16.3	1.16
Meadow	30	16.3	1.23	29	16.4	1.41	55	16.5	1.36

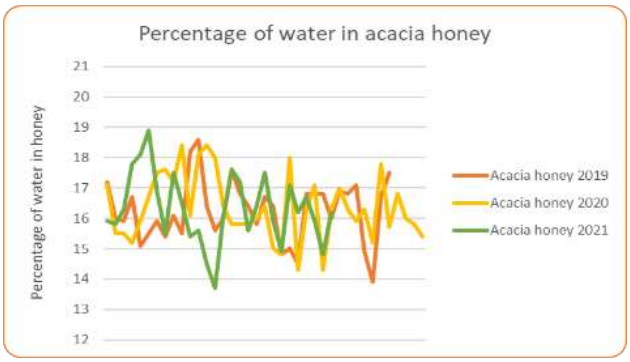

Figure 1. Percentage of water in acacia honey, 2019-2021

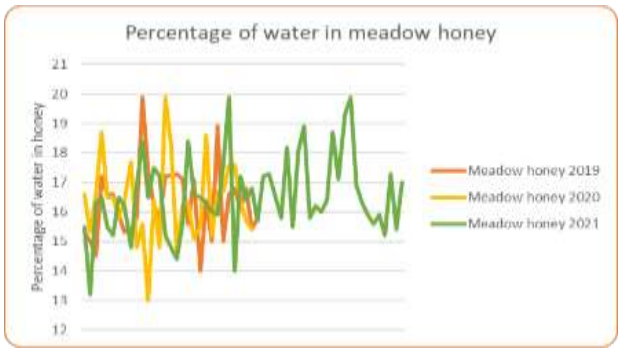

Figure 2. Percentage of water in meadow honey, 2019-2021

Within the group of meadow honey tested in 2019, 30 samples, none of which exceeds 20 %, but one sample is at the upper limit of the maximum allowed amount of water and is 19.9%. In 2020, 29 samples were tested, none of which exceed 20 %, but one sample is at the upper limit of the maximum allowed amount of water and is 19.9 %, while in 2021, out of the 55 samples tested, two samples are at the upper limit limits of the

maximum allowed amount of water and amount to 19.9 %, which is shown in Figure 2.

4. Conclusions

The research showed that the water content in the examined honey samples depends on the origin of the honey. In 2019, a total of 64 honey samples were tested, the water content in the tested samples was below the maximum allowed value, and only one sample had a water content close to the maximum allowed value (19.9%). Out of a total of 67 samples tested in 2020, one sample had a water content close to the maximum allowed value, while the water content in the other samples was below the maximum allowed value. In 2021, 82 samples were tested, two of which had a water content close to the maximum allowed value, while the other samples had a water content below the maximum allowed value. It was found that the meadow honey samples had a water content close to the maximum allowed value, while the acacia honey samples did not. The information from water supply content analysis can be used to compare our research with similar research from other regions and can provide data valuable for predicting honey's microbiological quality, viscosity, crystallization, and rheological behavior.

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