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Determination of HMF and Acidity of Honey Originated from Albania

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Abstract
The main purpose of this study was to evaluate of the quality and chemical parameters such as: acidity and 5-hydroxymethylfurfuraldehyde content (HMF), in 10 honey samples, produced in Albania in 2018. HMF measurement is used to evaluate the quality of honey, based on the storage condition and the possible adulteration with other sugars or syrups. The current European legislation regulates the concentration of HMF, which must not exceed 40 mg/kg (for general types of honey). The obtained data for this study showed that the acidity in the analysed honey samples ranges from 3.85 to 4.18 and 7.88 meq/kg to 27.46 meq /kg, according to pH measurement and titration analyses, respectively. In this work, HMF was determined by the method according to White UV – VIS spectrophotometer.

Keywords: honey, acidity, hydroxymethylfurfuraldehyde (HMF), quality parameters

INTRODUCTION

Honey is a natural substance of honey bee products which have a potential role in contributing to human health. Honey is a concentrated aqueous solution of inverted sugar, but it also contains several classes of phenol acids, flavonoides, enzymes, Maillard reaction products, pigment, aroma and minerals [1, 2]. The composition and the quality of honey differ from one country to another, due to the influence of plants, climatic and environmental condition, production methods, processing and storage condition [3,4]. Hydroxymethylfurfural (HMF) or 5-hydroxymethyl-2-furaldehyde, is a water – soluble heterocyclic organic compound derived from sugar. It is a derivated of furan and has both aldehyde and alcohol function groups. This cyclic aldehyde is formed through the dehydration of the hexoses and hexuloses in an acidic environment, or as the result of the Maillard reaction and caramelization [5]. HMF is naturally present in honey, but its content in the fresh honey is very small and it's below 1 mg/kg [6]. Codex Alimentarius [7] estabilished that the HMF content of honey after processing and/or blending must not be higher than 80 mg/kg. The acidity in honey is caused by the organic acid usually existing in all honeys (tartaric, citric, oxalic, acetic, etc.) either from nectar or bees' secretions [8]. According to the National Honey Board, the acidity of honey ranges from a pH of about 3.4 to about 6.1, with average 3.9. The aim of this work was to analyze the quality parameters and to provide information regarding honey produced in Albania.

MATERIALS AND METHODS

Honey Samples

The present study was carried out in ten honey samples: samples H4 to H10 were collected in 2018 directly from beekeepers in different geographic regions of Albania. Samples H1, H2 and H3 were purchased from a local market in the same year. The samples were stored in glass bottles.

Chemical Analyses

The chemical analyses conducted, including pH, free acidity and hydroxymethylfurfural (HMF). Free acidity was determined by titrimetic method. The addition of 0.10N sodium hydroxide (NaOH) was stopped at pH 8.3 [9]. Acidity of honey from titration expressed in mili equivalents per kg of honey samples (meq/kg). The pH was measured on a pH-meter (pH – Meter 765, Calimatic), from a solution containing 10 g honey in 75 ml of CO_2 free distilled water [9]. HMF was determined after clarifying samples with potassium hexacyanoferrate (Carrez I) and zinc sulphate – 7 hydrate (Carrez II) and the addition of sodium bisulphate. Absorbance was determined at 284 nm and 336 nm in a spectrophotometer (UV – 1202, Shimadzu).

Statistical Analyses

The statistical analysis of the data was carried out using StatSoft Statistica 10.0® software. All measurements were performed with three repetitions, and the descriptive statistical analyses of obtained results were reported as the mean ± standard deviation (SD) and ANOVA is conducted for the comparison of means.

RESULTS AND DISCUSSION

Summary of descriptive statistics for chemical analyses of honey samples is presented in table 1. Honey is naturally highly acidic.

Table 1. Chemical characteristics of the honey samples

	Sample	HMF (mg/kg)	Acidity (meq/kg)	pH
Honey from supermarket	H1	34.60±0.11^{d}	27.45±0.02^{g}	3.84±0.02^{a}
	H2	2.48±0.06^{ab}	31.06±1.50^{h}	3.83±0.07^{a}
	H3	138.96±2.40^{e}	7.79±0.13^{a}	4.18±0.01^{b}
Self product honey	H4	5.48±0.06^{b}	20.72±0.45^{de}	4.17±0.01^{b}
	H5	2.34±0.05^{a}	12.80±0.02^{b}	3.82±0.01^{a}
	H6	15.75±0.05^{c}	11.15±0.04^{b}	4.60±0.04^{c}
	H7	17.08±0.05^{c}	17.31±0.01^{c}	3.87±0.01^{a}
	H8	3.51±0.05^{ab}	22.55±0.05^{ef}	3.81±0.04^{a}
	H9	1.69±0.03^{a}	18.74±0.03^{cd}	4.62±0.01^{c}
	H10	1.05±0.10^{a}	23.64±0.08^{f}	4.86±0.03^{d}

The results are expressed as mean ± SD values, followed by different letters in the same column are significantly different ($p < 0.05$), according to Tukey's HSD test

Its pH is extremely low, it ranges between 3 and 4.5, which inhibits the growth of bacteria and other spoil – ready organisms [10]. pH is a very important parameter during storage of honey, as it influences the texture, stability and shelf – life of honey [11]. In analysed samples, values of pH ranged from 3.81 (H8) to 4.86 (H10), indicating that the honeys tested were most likely of floral origin since the honey adulterated with sugar syrup has a very low acidity (less than 1) while that adulterated with inverted sugar has a clearly higher acidity [12]. Total acidity varied from7.79 meq/kg (H3) to 31.06 meq/kg (H2). Total acidity was within in all the honey samples (below 50 meq/ kg of honey), indicating absence of undesirable fermentation.

The heat treatment of honey is used to facilitate loading and retention of the crystalization process. Since the temperature is a major factor that exerts its influence on the quality and chemical composition of honey, HMF meauserment is used to evaluate the quality of honey; generally not present in fresh honey. Its content increases during conditioning and storage. In samples (H1, H2, H4, H5, H6, H7, H8, H9, H10) the content of HMF ranged from 2.34 mg/kg (H5) to 34.60 mg/kg (H1).

These values were lower than the allowed maximum limit of 40 mg/kg as recommended by the Codex Alimentarius [13] suggesting freshness and good practices by beekeepers [14]. However, the commercial sample H3 has the highest HMF level (138.96 mg/kg), which confirm the heating of this honey or not good storage conditions.

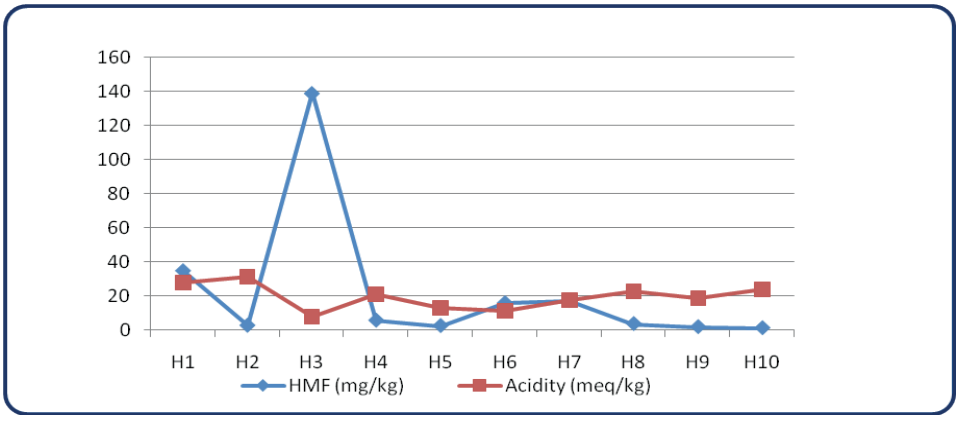

Figure 1. HMF (mg/kg) versus acidity (meq/kg) of the honey samples

CONCLUSION

The analytical result indicated that the honeys investigated in this study are of acceptable quality standards as most of the quality parameters fall within the international standards. Total acidity and pH indicate that the honey samples were most likely of floral origin. Concerning the freshness of the samples, the high level of HMF in sample H3, indicates that it has probably been heated. Storage temperature of honey (below than 35 °C), plays an important role to preserve its chemical and sensory quality.

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