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Detection of the Electrical Conductivity and Acidity of Honey from Different Areas of Tepi

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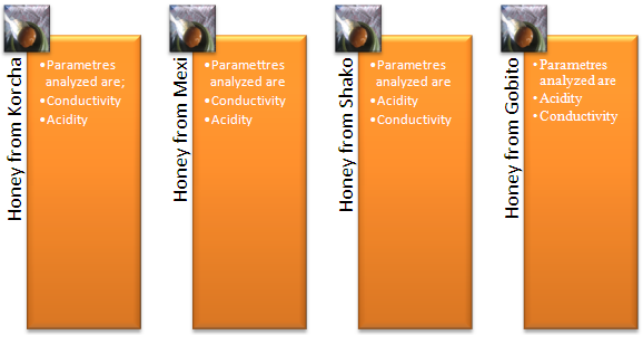
Abstract Honey is the ingredient of most industrial products for sweetening and improving its food composition. The study is therefore based on the determination of physical parameters such as electrical conductivity and acidity. The instrumentation and apparatuses used in the work are conductometry and titration apparatuses. Honey samples obtained from different areas with respect to Tepi town have been analyzed and the result obtained is on the basis of conductometry and acidity measurement. Hence 20g of each anhydrous honey sample was weighed and dissolved in 100mL of deionized water in order to prepare 20 %(w/v) solution to measure conductivity. The acidity is detected after 10g of each honey sample is dissolved in 75mL of deionized water. The conductivity in summer honey determined to be 0.097mS/cm, 0.153mS/cm 0.117mS/cm and 0.337mS/cm in Korcha, Mexi, Sheko and Gobito respectively. Acidity is found to be 17, 28.67, 29 and 25miliequi/Kg. The conductivity in winter honey is detected to be 0.123, 0.186, 0.103 and 0.246mS/cm. The acidity in winter honey is 3.36-4.26 and 18.3-25.3meq/Kg from pH meter and titration respectively. The conductivity of darker honey is slightly greater than lighter honey, which indicated that the darker honey has more mineral content; and acidity of three honey samples is almost similar. The honey products are safe and fit the international honey commission standard and probably both darker and lighter honey are nutritionally important.

Keywords Acidity, Color, Conductivity, Honey, Nectar

Abstract for the work is summarized as follows



1. Introduction

Honey is one of the complex food stuffs produced by nature, and certainly the only sweetening agent that can be used by humans without processing. Both Predisposition and the commercialization probabilities depend on sensory properties (color, flavour and texture). These properties are a complex function of physicochemical parameters, which are over time, determined by the botanic and geographic origins. Therefore, the characterization of honeys is a hard task in response to consumer's demands. The International honey standards allow specific denominations for honey produced from particular nectar [1]. One of the way of handling scientific analyses of various honeys must have three aims: quality control, purity control, and identification of adulterations. Honey quality test is important task to be done in order to measure and evaluate the product manufactured locally as well as commercially. Hence the study makes its attention on the determination of conductivity and acidity of honey collected from products manufactured locally [1, 2].

The conductivity is a good criterion of the botanical origin of honey and thus is very often used in routine honey quality control and purity. Honey contains organic acids and mineral salts, compounds which chemically are called "ionizable" that is when in solution, they have the property to conduct electric current. The electrical conductivity of honey is defined as that of a 20% (w/v) weight in solution at $20^0C \pm 0.5$, where the 20% refers to anhydrous honey and express in mill Siemens per centimeter ($mS.cm^{-1}$)[2,3].

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. The acidity of honey can be measured by titration against sodium hydroxide equivalents or direct measurement of pH. The commercial high-quality honey should have the free acidity up to 50mili equivalents/Kg of honey. Natural acidity of honeys may increase when they grow older, when it is extracted from combs with propolis, and especially when it deteriorates due to fermentation. Moreover, 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. According to the National Honey Board, the acidity of honey

ranges from a pH of about 3.4 to about 6.1, with an average of 3.9 [4].

The acidity of any honey is directly related to the floral sources that created it. Honey contains a number of different acids, including about 18 amino acids, many different organic acids, as well as aliphatic and aromatic acids. The aromatic acids greatly contribute to the flavor of honey [5].

International honey commission established standards to evaluate the quality of honey based on the color. Evaluating the quality of honey in terms of the conductivity and acidity has got special attention in this study because acidity and conductivity can affect the importance of honey and to classify honey and its products.

The objective of the study is to determine physical parameters such as electrical conductivity and acidity.

The study is expected to be significant to classify honey on the color variation which is one way of indicating quality and emitted the first kind of scientific research for the area. Hence it benefited the producer and consumer in providing awareness how easily the quality of honey can be governed by testing the color [6].

2. Materials and Methods

Instrumentation and chemicals

Apparatuses and instrumentation used for the study are plastic bottles, thermometer, conductometry, pH meter, volumetric flasks, beakers, stirrer, graduated cylinder, temperature compensator immersed in solution. Reagents and chemicals used for preparation of sample are deionized water, Analytical Reagent grade Potassium chloride (KCl) dried at 105℃, Analytical Reagent grade 0.1MNaOH, and phenolphthalein indicator (1g of phenolphthalein dissolved in 95% ethanol solution) [6,7]

Sampling and sample collection

The first category of honey samples were obtained from four different locations (Korcha, Mexi, Gobito and Shako) with respect to Tepi town and three replicate samples in each case were collected randomly using plastic bottles during summer season. The second phase of sample was obtained from the same area during winter season. The collected samples were preserved in ice bag and transported to the laboratory for investigation.

Sample preparation and analysis

Sample preparation involves identification and grouping with respect to color, season and place of collection. The honey samples collected are classified as lighter and darker because conductivity and acidity can significantly be affected by color.

20g of each anhydrous honey samples dissolved in 100mL of deionized water to prepare 20 %(w/v) solution for measurement of conductivity. Secondly 10g of each sample has been dissolved in 75mL of deionized water for the determination of acidity.

Preparation of reagents taken place by dissolving 0.7456g of standard potassium chloride in 100mL used to calibrate the conductometry and further to measure cell constant. Standardized sodium hydroxide; 0.1M of NaOH solution was determined by titrating with known sulfuric acid and 4g of the reagent dissolved in 100mL deionized water.

Preparation of reagents to determine conductivity

40mL of 0.1M potassium chloride solution was added to a beaker and the cell immersed in the solution together with a thermometer. The electrical conductance (G) of this solution has been detected in mS after the temperature has been equilibrated to 20^0C. Conductivity (mS/cm) = [cell constant (cm^{-1})]*[conductance from the conductometry (mS)]

Preparation of reagents to determine acidity

The acidity of the sample was analyzed and detected by titration; i.e. titratable acids such as tartaric acids, acetic acids and other organic acids are determined by fixing the pH at about 8.3 which was done to prevent the hydrolysis problem of lactose which can influence the result of the measurement. Acidity of honey from titration expresses in mili equivalents per Kg of honey samples and calculated as

$$acidity(\frac{meq}{kg}) = \frac{volume\ of\ 0.1MNaOHconsumed * 10}{Kg\ of\ honey\ sample}$$

Where 10 indicates the dilution factor of honey sample during analysis; the acidity was further determined from pH measurement which accompanied the calibration of pH meter at 3, 7and 9.

Table 1. The results obtained from different honey samples for acidity and conductivity

Sample	Conductivity (mS/cm)	Acidity from pH measurement	Acidity (mili eqKg^{-1})
HG	Summer 0.0966±0.0057	Summer 4.17±0.13	Summer 17±2.64
	Winter 0.123±0.015	Winter 3.36±0.32	Winter 18.3±0.57
HM	Summer 0.153±0.0057	Summer 3.96±0.01	Summer 28.67±1.53
	Winter 0.186±0.02	Winter 4.1±0.095	Winter 22.3±1.52
HS	Summer 0.117±0.0152	Summer 3.96±0.01	Summer 29±1
	Winter 0.103±0.025	Winter 4.26±0.25	Winter 25.3±2.51
HK	Summer 0.337±0.0152	Summer 4.00±0.01	Summer 25±1
	Winter 0.246±0.011	Winter 3.73±0.15	Winter 21.3±1.52

HG- Honey Gbito, HM- Honey Mexi, HS- Honey Shako, HK- Honey Korcha

3. Results and Discussion

Electrical conductivity (EC) was measured according to the harmonized methods of the European honey commission and expressed in mS/cm. EC was measured at 20.^{0}C using microcomputer conductivity meter. All measurements were performed in triplicate.

Conductivity

Conductivity is the indication of ionizable acids and compounds in aqueous solution. The conductivity measurement collected from analysis of 40mL of different honey samples solution at 20^{0}C±0.5, from different location with respect to Tepi; is in the range of 0.09-0.1, 0.15-0.16, 0.1-0.13 and 0.32-0.35mS/cm in case of Korcha, Mexi, Shako and Gobito respectively in summer. In winter season 0.11-0.14, 0.17-0.21, 0.08-0.13 and 0.24-0.26mS/cm in Korcha, Mexi, Shako and Gobito have been determined. The conductivity value from Gobito is greater than in three cases. According to the study conducted the conductivity was found to be less than 1. The current work compared with the literature conducted before; for instance 0.39–0.89 mS/cm for willow honey samples, 0.52–0.63 mS/cm for winter rape and 0.52–0.85 mS/cm for floral honey samples have been reported [10].

Acidity

The acidity of honey determined by titration against 0.1M of NaOH was reported after conversion of the volume of base consumed by the formula, $acidity(\frac{meq}{Kg}) = \frac{mL\ of\ base * 10}{Kg\ of\ honey}$, According to the result in summer honey an average of 17miliequivalent/Kg in Korcha, 28.66 miliequivalent/Kg in Mexi, 29 miliequivalent/Kg in Shako and 25miliequivalent in Gobito have been detected. The acidity is also further tested with pH meter and the results are all less than 7; i.e.; 3.95 to 4.30. In Korcha sample 4.18, in Mexi sample 3.96, in Shako sample 3.96 and in Gobito sample 4.00. In winter honey 3.36, 4.1, 4.26 and 3.37 and further 18-28meq/Kg have been detected.

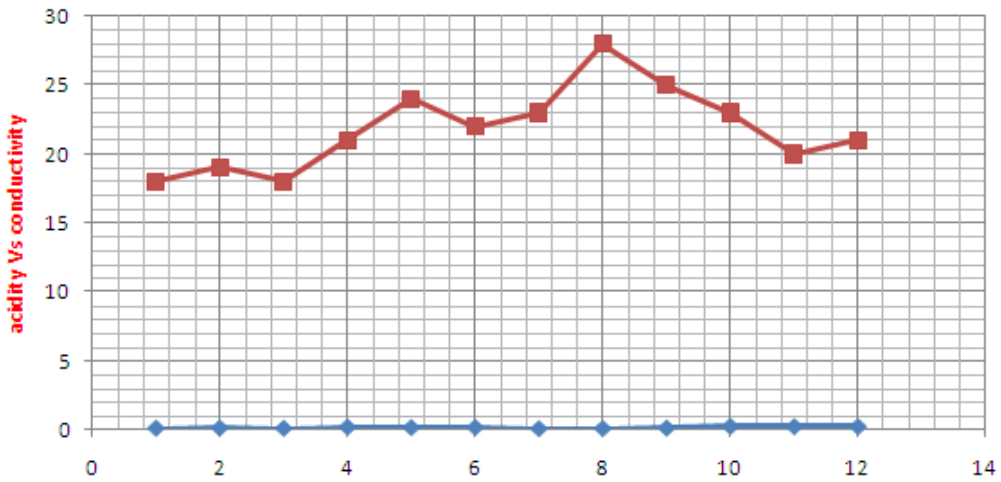


Figure 1. conductivity versus acidity of summer honey

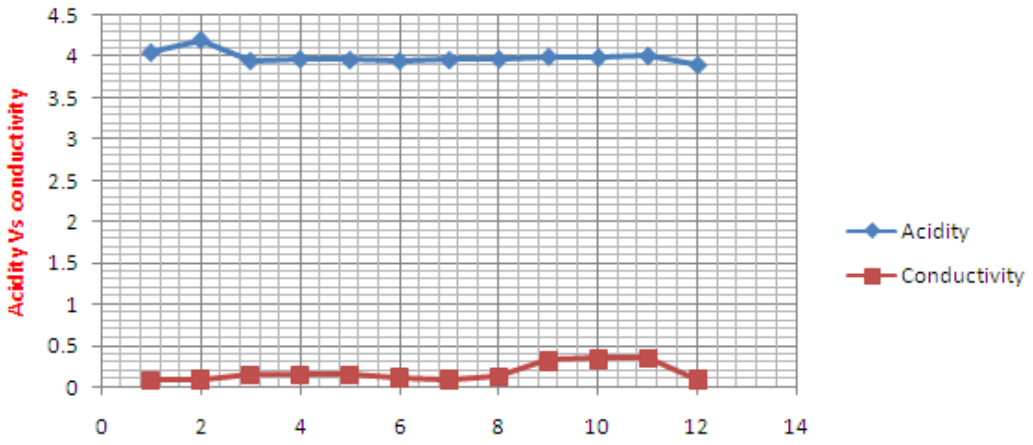


Figure 2. Conductivty(mS/cm) versus acidity(pH)

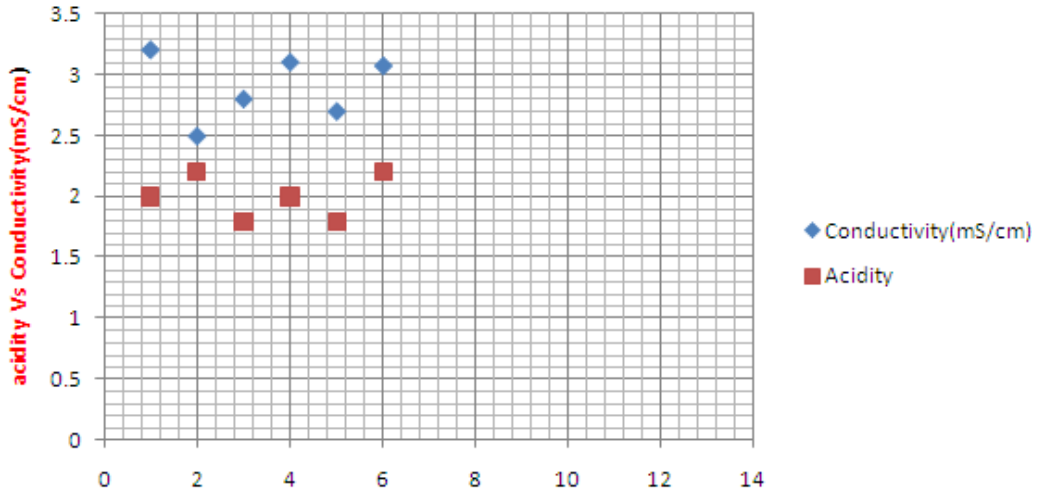


Figure 3. conductivity versus acidity in winter honey

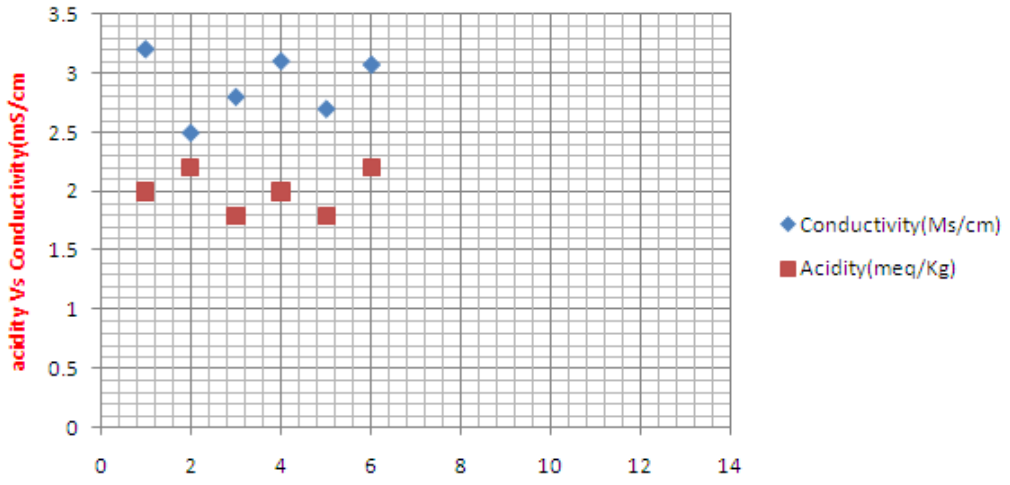


Figure 4. conductivity versus acidity of winter honey

4. Conclusions

The conductivity of honey samples collected from different sites of the same district during summer season has been analyzed at $20^0C \pm 0.5$. According to the work the conductivity of darker honey detected to be greater than the lighter honey. The conductivity in summer season is compared with winter season and the results become almost fall in similar range since the honey product detected was floral and no more components is significantly added with season change. Furthermore the conductivity detected is fair and fit with international honey commission standards. The

acidity of honey samples has been determined and almost darker honey exhibited slightly high acidity.

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REFERENCES

[1] Urska Kropf, Mojca Jamnik, Jasna Bertoncelj and Terezija Golob (2007). Linear Regression Model of the Ash Mass Fraction and Electrical Conductivity for Slovenian Honey, Slovenia

[2] Carolina Acquarone, Pilar Buera, Beatriz Elizalde (2002). Pattern of pH and electrical conductivity upon honey dilution as a complementary tool for discriminating geographical origin of honeys. Argentina

[3] http://www.bee-hexagon.net/en/network.htm (2001) Harmonized methods of the international honey commission. Athens

[4] Pridal1, l. Vorlova. 2002(10). Honey and its physical parameters Czech J. Anim. Sci., 47, 439–444 Czech Republic.

[5] Mojca Jamnik, Jasna Bertoncelj and Terezija Golob (2008). Linear Regression Model of the Ash Mass Fraction and Electrical Conductivity for Slovenian Honey Food Technol. Biotechnology. (3) 335–340, Slovenia.

[6] Pourtallier, Y, Taliercio (1972). Honey control analyses Apiacta 1, France.

[7] Stefan Bogdanov (2001). Harmonized methods of the international honey commission World network of honey science, Greece

[8] Assoc. Public Analysts (1992). / MAFF validated method for acidity in honey (4) 171-175.

[9] Stefan Bogdanov (2000): Review of the work of international honey commission

[10] W.R., Junk and H.M., Pancoast - Handbook of sugars. Avi Publ. Co. Inc., Westport, Connecticut, USA: (1973); pp.295-296;

[11] M. Battaglini and G.Bosi - Caratterizzazione chimicofisica dei mieli monoflora sulla base dell spettro glucidicoe del potere rotatorio specifico. - Scienzae tecnologia degli Alimenti, (4): (217- 221) (1973).

[12] Codex Alimentarius standard for honey, Ref.Nr.CL 1993/14SH- FAO and WHO, Rome 1993

[13] Bogdanov S., Martin P. and Lullmann C. Harmonized methods of European honey commission, Apidologie(extra issue) (1997) pp1-59.