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DETERMINATION OF PHYSICAL PROPERTIES OF SOME EGYPTIAN HONEY

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ABSTRACT

A determination of physical properties of some Egyptian honey collected from different locations of Egypt. Was don using many techniques. The moisture content ranged between 20.14in clover honey and 21.875 in cotton honey% , specific gravity recorded no clear change between all samples while the viscosity ranged between 15.3 in cotton honey and 25.64 in clover honey whereas the granulation ranged between 0.802 in clover honey and 1.2925 in cotton honey ,The electrical conductivity(E.C) ranged between 0.013 in citrus honey and 0.1425 in cotton honey whereas total soluble solids (T.S.S) ranged between 78.8 in citrus honey and 79.9 in clover honey while the color ranged between 0.2045 in citrus honey and 0.551 in cotton honey.

INTRODUCTION

Honey is a nectar collected from many plants and processed by honey bees (*Apis mellifera*). The composition of honey is variable, owing to deferencs in plant type, climate, environmental conditions, and contribution of the beekeepers (Azeredo, *et al* 2003). The quality of honey is mainly determined by its sensorial, chemical, physical and microbiological characteristics. Internationally, honey quality criteria are specified in Regulatory Standards, compiled in a Codex Alimentarius Standard which at present is under revision (Bogdanov, *et al* 1998). The Badie and shawer(1990) reported that heating of clover honey reduces water content, protein, ash, non-reducing sugars and ascorbic acid. They added that dark coloration develops as the temperature increases. Kaushik et al (1993) assessed the total soluble solids average in fresh honey sample is 81.5. Soria et al(2004) reported that color, electrical conductivity, acidity, ash content and pH were the physiochemical parameters with higher discrimination power in the differentiation of nectar and honeydew honeys from central Spain. Gonzales- Martin et al (1998) estimated 15% of Spanish honey samples to be adulterated with beet sugar and 4% with cane sugar.

The present study was directed to investigate the different types of Egyptian honeys collected from different locations from Egypt. The physical properties; moisture content, specific gravity, viscosity, granulation, Ec, total soluble solid and color of cotton, clover and citrus honey were assessed.

MATERIALS AND METHODS

This study was carried out at Economic Entomology Dept., Faculty of Agric., Kafr-Elshikh univ., during the period from 2002 to2004 to determine physical properties of cotton, clover and citrus honey collected from different locations of Egypt.

Samples of tested honey

Seventeen Egyptian honey samples were collected from different locations in Egypt, representing the following plant sources: citrus (6 samples), clover (7 samples) and cotton (4 samples). The samples were kept in plastic containers, and preserved at-10 °c till analysis procedures. All the samples were analyzed for the following properties:

1- Water content (%)

Water content of tested honey samples was carried out according to the method of; A.O.A.C(1995) The moisture content (%) of honey samples was carried out by measuring of refractive index value using Abbe refractometer at 20 °C. In case of non granulated samples, the honey was mixed thoroughly by stirring or shaking. In granulated samples, the container having the honey was put in an oven or water bath and heated at 50°C until liquefaction. The honey was mixed thoroughly as soon as the sample liquefies.

The refractive index of the test honey sample was determined using the refractometer at a constant temperature of 20°C. The reading of moisture (%m/m) was converted using the Table(1) given below, If the determination is made at a temperature other than 20°C, convert the reading to stander temperature of 20°C according to the temperature corrections quoted White *et al* (1962).

Table (1) refractive index and moisture content of honey

$_{20}N_D$	Moisture percent	$_{20}N_D$	Moisture percent	$_{20}N_D$	Moisture percent
1.5041	13.0	1.4955	16.4	1.4871	19.8
35	.2	50	.6	66	20.0
30	.4	45	.8	62	.2
25	.6	40	17.0	58	.4
20	.8	35	.2	53	.6
15	14.0	1.4930	.4	49	.8
10	.2	25	.6	1.4844	21.0
05	.4	20	.8	28	21.5
1.5000	.6	15	18.0	15	22.0
1.4995	.8	10	.2	02	22.5
90	15.0	05	.4	1.4789	23.0
85	.2	1.4900	.6	77	23.5
80	.4	1.4895	.8	64	24.0
75	.6	90	19.0	52	24.5
70	.8	85	.2	39	25.0
65	16.0	80	.4	26	25.5
60	.2	76	.6	1.4714	26.0

Taken from White *et al* (1962)

2-Specific gravity:

The specific gravity of tested samples was measured according to Wedmor (1955), and therefore tabulated water content % was calculated and honey grades were determined, according to White (1967). Top grade honeys (A&B) contains not more than 18.6% water, grade C contains water % to 20%, and grade D contains more than 20% water

3- Viscosity:

The viscosity of honey samples was measured by using viscometer at 29°C, according to Munro (1943).

4-. Color (as optical density)

The optical density of all samples was determined and the color was measured by using the relation between optical density and USDA color standards as indicated by White (1978). The method used for optical density determination was as follows: one gram of honey sample was dissolved in 10 ml distilled water in 20 ml beaker, and then the optical density of this solution was determined at 400 nm using spectrophotometer.

5-Electric conductivity.

Based on the method of Vorwohl (1964), the electric conductivity was measured using special apparatus model WTW "LF 530" at a constant temperature of 20 °C. Honey solution 20%, based on the dry substance was used.

To determine the electrical conductivity for honey samples, the electrode of the apparatus at 20°C was used. If the determination is made at temperature other than 20°C, the readings to standard temperature are converted according to the following formula:

$$K20 = \frac{kt}{1+\mu\,(t2-20)}$$

K20 =correct reading for electrical conductivity at 20°C.
Kt = the reading of electrical conductivity at temperature t2.
(Above or below 20°C).
μ = constant factor of 0.0261.
The results are expressed as: 10^{-4} s/cm.

6- Granulation:

The granulation of different types of examined honey was measured according to White *et al.* (1962) as the percentage between glucose and fructose (D/L).

RESULTS AND DISCUSSION

1.Cotton honey

The results in Table (2) show the physical properties of the cotton honey samples. The moisture content ranged between 20 and 23.5% with a mean value of 21.875%, specific gravity ranged between 1.359 and 1.400 with a mean value of 1.3962.The viscosity ranged between 13.6 and 20.4 with a mean value of 15.3.While the estimated granulation value (D/L) ranged between 1.056 and 1.333 with a mean value of 1.29. Concerning the electrical conductivity (E.C), the value ranged between 0.046 and 0.46 with a mean value of 0.1425 whereas total soluble solids (T.S.S) ranged between 76.5 and 80% with a mean value of 78.13%. The color measured as optical density ranged from 0.458 to 0. 712 with a mean value of 0.551.

2.Clover honey

Data in Table (3) show that clover honey moisture content ranged between 19 and 21.5% with a mean value of 20.14%, specific gravity ranged between 1.4101-1.395 with a mean value of1.397.The viscosity of the clover honey samples ranged between 13.6 and 34.9 with a mean value of 25.64.While the estimated granulation value(D/L) ranged between 0.767 and

0.833 with a mean value of 0.802 .Concerning the electrical conductivity (E.C)the clover honey show ranged between 0.011 and 0.46019 with a mean value of 0.016 whereas total soluble solids (T.S.S) ranged between 79.5 and 81% with a mean value of 79.9%. The color measured as optical density ranged from 0.221 to 0.390 with a mean value of 0.303 .

3.Citrus honey

Data in Table (4) show that citrus honey moisture content ranged between 19.5 and 23% with a mean value of 21.26%, specific gravity ranged between 1.39 and 1.4072 with a mean value of 1.3982.The viscosity of the citrus honey samples ranged between 13.6 and 34.9 with a mean value of 19.42.While the estimated granulation value (D/L) ranged between 0.725 and 0.842 with a mean value of 0.763 .Concerning the electrical conductivity (E.C) it ranged between 0.017 and 0.008 with a mean value of 0.013, whereas total soluble solids (T.S.S) ranged between 77.5% and 80.5% with a mean value of 78.8%.The color measured as optical density ranged from 0.162 to 0.306 with a mean value of 0.2045.

From the obtained results, it could be suggested that cotton and citrus honeys recorded high values of moisture content. However, moisture content in clover honey samples showed the least values. The higher value of moisture content (cotton and citrus honey)may be due to the abnormal beekeepers practices towards bee colonies by intensive feeding the honey bee colonies with sugar syrup during the honey flow as well as collecting the honey from the colonies before complete ripening. Concerning cotton samples collected from North part of Egypt, the ecological factors particularly high relative humidity may increase the moisture content in these samples. The T.S.S values were low in cotton and citrus honey samples while the clover honey recorded high values. These results may be affected by the moisture content of the tested samples. The T.S.S values may be related to the different factors affecting moisture content. While the highest mean value of viscosity was recorded in clover honey samples whereas the lowest mean value of viscosity was recorded in cotton followed by citrus honey samples. The estimated granulation value was high in cotton honey, while the lowest value was recorded in citrus honey samples. Concerning the E.C value the mean highest value was recorded in cotton honey and lowest mean value was indicated in citrus and clover honey samples. The higher values of color of tested honey samples as optical density was recorded in cotton honey while the mean lowest value was in citrus and clover honeys and. The differences in the estimated color among the tested samples may be due to higher contents of sediments in cotton honey followed by clover honey samples, while lower content of pollen in citrus honey may affect in this parameter. The beekeepers practices may be also affect the color of honey samples such as using old wax combs as well as the intensive feeding process with sugar syrup (particularly sucrose produced from sugar beet, *Beta vulgaris*).

Table (2): Physical properties of Egyptian cotton honey collected from different locations.

Year of production	Location	Moisture	Specific gravity	Viscosity	Granulation	Electrical conductivity(EC)	Total soluble solids (T.S.S)	Color
2002	Fac.of.Agric, Kafr- El-Sheikh	23.500	1.395	13.600	1.281	0.460	76.500	0.712
2003	Fac.of.Agric, Kafr- El-Sheikh	22.000	1.395	13.600	1.500	0.051	78.000	0.525
2004	EL-Garaida, Kafr El-Sheikh	20.000	1.400	20.400	1.333	0.013	80.000	0.509
2004	Abou-ELmatamir, Beheira	22.000	1.395	13.600	1.056	0.046	78.000	0.458
MEAN		23.5 -20.0 21.875	1.400-1.395 1.396	13.60-20.40 15.300	1.056-1.333 1.293	0.046-0.46 0.1425	76.500 -80.000 78.130	0. 458-0.712 0.551

Moisture content as %& Viscosity as poise & Granulation as glucose/fructose (D/L) & Electrical conductivity (EC) as % &Total soluble solids (T.S.S as%) & Color as optical density

Table (3): Physical properties of Egyptian clover honey collected from different locations.

Year of production	Location	Moisture content	Specific gravity	Viscosty	Granulation	Electrical conductivity(EC)	Total soluble solids (T.S.S)	Color
2002	Fac.of.Agric, Kafr- El-Sheikh	21.500	1.395	13.600	0.833	0.017	78.500	0.290
2003	Fac.of.Agric, Kafr- El-Sheikh	19.000	1.410	34.900	0.775	0.017	81.000	0.311
2004	Fac.of.Agric, Kafr- El-Sheikh	19.500	1.407	34.900	0.797	0.014	80.500	0.307
2004	Motobes, Kafr El-Sheikh	20.000	1.400	20.400	0.816	0.016	80.000	0.244
2004	Abou-ELMatamir, Beheira	21.000	1.395	20.400	0.767	0.011	79.000	0.358
2004	Basion, Gharbia	20.500	1.400	20.400	0.821	0.019	79.500	0.390
2004	Teira, Dakahlia	19.500	1.407	34.900	0.802	0.018	80.500	0.221
MEAN		19.000 - 21.500 20.140	1.410 - 1.395 1.397	13.600-34.900 25.640	0.767-0.833 0.802	0.011-0.019 0.016	79.500-81.000 79.900	0.221-0.390 0.303

Moisture content as %& Viscosity as poise & Granulation as glucose/fructose (D/L) & Electrical conductivity (EC) as % &Total soluble solids (T.S.S as%) & Color as optical density

Table (4): Physical properties of Egyptian citrus honeys collected from different locations.

Year of production	Location	Moisture content	Specific gravity	Viscosity	Granulation	Electrical conductivity(EC)	Total soluble solids (T.S.S)	Color
2002	Rasheed, Beheira	22.000	1.395	13.600	0.725	0.015	78.00	0.281
2003	Rasheed, Beheira	22.550	1.395	13.600	0.842	0.017	77.500	0.306
2004	Rasheed, Beheira	20.500	1.400	20.400	0.772	0.008	79.500	0.197
2004	Moshtohor,Qlubia	23.000	1.390	13.600	0.738	0.017	77.000	0.170
2004	Motobes, Kafr El-Sheikh	20.000	1.407	34.900	0.775	0.013	80.500	0.162
2004	Abou-ELMatamir, Beheira	19.500	1.403	20.400	0.727	0.010	80.000	0.211
MEAN		19.500-23.000 21.260	1.390-1.407 1.398	13.600-34.900 19.420	0.725-0.842 0.763	0.008-0.017 0.013	77.500 - 80.500 78.800	0.162 - 0.306 0.2045

Moisture content as %& Viscosity as poise & Granulation as glucose/fructose (D/L) & Electrical conductivity (EC) as % &Total soluble solids (T.S.S as%) & Color as optical density

Concerning the electrical conductivity (EC), clear differences among the tested samples were recorded. Cotton honey samples recorded the highest value of E.C. while clover samples followed by citrus samples showed the lowest valus. The higher value of E.C in cotton honey may be due to the higher content of minerals and other components collected from the extra floral nectar by honey bee while lower values in the other tested samples may be due to the lower content of minerals and the intensive feeding processes by sugar syrup towards the colonies .

The estimated granulation values between glucose and fructose (D/L) is considered one of the important factors affecting the granulation process in honey samples. D/L in cotton honey showed higher values among the tested samples, and thus results in a rapid granulation, while low values result in slow granulation.

The viscosity values of honey samples indicated lower values in cotton honey samples followed by citrus one , whereas clover honey recorded the highest value. It could be suggested that the relation between moisture content and viscosity values apparently affected the low values in viscosity in cotton and citrus honeys. In contrast, the clover and unusual honey samples recorded the highest value of viscosity. On the other hand, there were no differences in the specific gravity values among the tested samples. Generally, the physical properties of the most honey samples were not in the range values as mentioned by the specification of the Egyptian Honey standard 2003.This may be due to the abnormal practices occurred by the beekeepers towards their honey bee colonies during the honey flow, or gathering the honey from these colonies before complete ripening. Many authors discussed the physical properties of the honey. Abu-Jdayil *et al.* (2002) found that color intensity values (O.D) ranged from 0.16 to 0.46. Vorwohl *et al* (1989) reported that color of Egyptian honeys ranged from 0.225 to 2.610 (O.D. at 400 nm). Cotton honey attained a darker color than that of the citrus or clover honey (El-Sherbiny *et al.*, 1986): Fennel flower honey had the highest value of color, followed by marjoram honey, cotton honey and color honey. Color grade value ranged from 33 to 114 mm P fund grader.(Hassan and Abd El-Aal 1997).

While in Saudi Arabia, Abu Tarboush *et al.* (1992) pointed out that moisture was 13.4 to 18.12%.In Dhofar (Oman), tabulated moisture content as 15-23.7%, with an average of 18.735%; or about the same as Egyptian honeys (Hussein, 1989).

REFERENCES

Abu-Jdayil, B.; A. Ghzawi; Kl.M. Al-Malah and S. Zaitoun (2002): Heat effect on rheology of light- and dark-colored honey. Journal of Food Engineering, 51, 33-38.

A.O.A.C. (1995): Association of Official Analytical Chemists, 16th Ed., Washington, DC, USA.

Azeredo, L.C.; M.A. Azeredo; S.R. Souza and V.M. Dutra (2003): Protein contents and physicochemical properties in honey samples of *Apis mellifera* of different floral origins. Food Chemistry, 80, 249-254.

Badei, A.Z.M. and M.B. Shawer (1990): Retardation of honey granulation by

heat treatment. Egyptian Journal of Food Science, 18: (3) 221-231.
Bogdanov, and E. Baumann (1988): Determination of honey sugars with HPLC. Mitteilungen. Aus. Dem. Gebiete. Der. Lebens-Mitteluntersuchung. Undo Hygiene. 79: 198-206.
El-Sherbiny, G.; S. Rigk and M. El-Shiaty (1986): Adulteration of Egyptian honey. Agric. Res. Review, 64 (3): 503-518.
Gonzalez-Martin, I.; E. Marques-Macias; J. Sanchez-Sanchez and B. Gonzalez-Rivera (1998): Adulteration of Spanish honeys. Food Chemistry, 61(3):281-286 ..
Hassan, A.R. and H.A. Ahd El-Aal (1997): Physico-chemical analysis of some honey kinds in Egypt. Sugar and Sugar Substitutes. In Fd. Prod. And Nutr., Ismailia, 14-16 Oct. (1997), 128-140.
Kaushik, R.M.; V.K Joshi and J.K. Gupta (1993): Total soluble solids , acidity, pH and standard plate counts in the Indian honey as affected by different treatments and storage conditions. J. Food Sci. Technol., 6:442-443.
Munro, J.A.,(1943): The viscosity and thixotrophy of honey. J. Econ, Ent., 36 (5): 769-777.
Soria, A.C.; M. Gonzalez; C. de Lorenzo; I. Martinez-Castro and J. Sanz (2004): Characterization of artisanal honeys from Madrid (Central Spain) on the basis of their melissopalynological, physicochemical and volatile composition data. Food Chemistry, 85, 121-130.
Vorwohl, G. (1964): Relationships between the electrical conductivity of honeys and their floral origin. Ann. Abeille,7, 301-309.
Vorwohl, G.; M.S. Salem and M.E. Nour (1989): Chemical and physical properties of Egyptian honeys. Proc. 4th Int. Conf. Apic. Trop. Climates, Cairo: 240-244.
Wedmore, E.B. (1955): The accurate determination of the water content of honeys. 1- Introduction and results. Bee World, 36 (11): 197-202.
White, J.W.;MN.L. Riethof; M.H. Subers and I. Kushnir (1962): Composition of American honeys. U.S. Dept. Agr. Tech. Bull. 1261: 124 pp.
White, J.W. (1967): Measuring in honey quality a rational approach. Arm. Bee J. 107(10): 374-375.
White, J.W.; R.W. Meloy; J.L. Probst and W.F. Huser (1978): Sugars containing galactose occur in honey. J. Apic. Res. 25(3):182-185.

تقدير الصفات الطبيعية لبعض الأعسال المصرية المجموعة من مناطق مختلفة.

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وقد سجل عسل القطن متوسطا عاليا من الرطوبة (٢١,٨٧٥%)بينما أقل متوسط كان بعسل البرسيم (٢٠,١٤%)كما كانت أعلى نسبه للأملاح الذائبة الكلية في عسل البرسيم(٨١%) وأقل نسبة بعسل القطن (٧٦,٥%)وكان أعلى متوسط للزوجة بعسل البرسيم(٢٤,٦٤%)وأقل متوسط بعسل القطن(١٥,٣%).كما أوضحت النتائج أن أعلى متوسط للتحبب كان بعسل القطن(١,٢٩٢٥%) بينما كان أقل متوسط بعسل البرسيم(٠,٨٠٢%) أما التوصيل الكهربي فسجل أعلى متوسط في عسل القطن(٠,١٤٢٥) بينما كان أقل متوسط بعسل الموالح(٠,٠١٣%) وكانت درجة اللون أعلى في عسل القطن (٠,٥٥١) وأقل في عسل الموالح(٠,٢٠٤٥).