

## THE PHYSICAL AND CHEMICAL PROPERTIES OF SOME EGYPTIAN HONEYS IN ASWAN GOVERNORATE

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**ABSTRACT:** *Five samples of multi-floral honeys were collected from five localities at upper Egypt . The five locality samples were (Idefo, Abo-Simbel 1, Abo-Simbel 2, Abo-Simbel 3, and Aswan).Four physical parameters were measured including viscosity, specific gravity, granulation, and electrical conductivity. Also , eleven chemical properties were determined including moisture, total soluble solids , pH, free acidity , lactone , total acidity , fructose , glucose , sucrose , and maltose , in addition to the phenols, and flavonoids. The results of physical properties showed that there were significant differences in the viscosity of tested honeys and ranged between 14-69 Poise ,the specific gravity was parallel and ranged between (1.39 - 1.42). the granulation ranged from 1.04 - 1.89 , the electrical conductivity (EC) ranged between 0.008 – 0.026 % . The results of chemical composition showed that the total soluble solids parallel and ranged from (77-88.5%), the moisture ranged from 17.5-23.0% , pH ranged between 3.8-4.4 , while the total acidity ranged between 34.5-76.5 millieq/kg. The honeys content of fructose ranged from 38 - 40 % , the glucose content ranged from 24 -33.2% , the sucrose content ranged from 0.93-3.6% , and the maltose content ranged from 2.85 – 10.2% . As for the honeys content of phenol and flavonoid compounds , results indicated that the honey of Abo- symbol 2 has the highest numbers and quantities of these compounds , while the least one was registered with the honey of Aswan and Idefo counties the rest samples occupied intermediate status . This research was aimed to be the first step to put a data base of Egyptian honeybee analysis especially in modern hives in Aswan Governorate.*

**Key words:** *Egyptian honeys ,honey bee, honey analysis,flavonoids, phenols.*

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### INTRODUCTION

Honey is one of the most important products appreciated since thousands of years, which prepared by bees mainly from nectar of flowers or honeydew (Dustmann, 1993).

The characteristics of texture, appearance, flavor and sweetness of honey, as well as its medicinal properties, have attracted thousands of consumers (Zunlai & Lulat, 1989 and Dustmann, 1993). Furthermore, a great number of consumers are aware that refined sugars are associated with

empty energy and thus they are looking for other more nutrition foods. So, it is anticipated that the world trade of honey will grow consistently in the future.

The chemical composition of honey is complex and its contents of individual constituents are very considerably (Hassan ,1985). Surveys of floral honey composition have established that the three major components are fructose, glucose and water, averaging 38.2%, 31.3% and 17.2%, respectively (Doner, 1977). In addition to di- and tri-saccharides and some higher sugars.

Honey, is also known to contain a large numbers of polyphenols, flavonoides and antioxidants (Blasa *et al.*, 2006)who evaluated the polyphenols, flavonoides and antioxidants of raw honey samples and found that phenolic content as caffeic acid ranged between 12.5-17.5 mg/100g while, the total flavonoides were ranged as 0.45-1.01 mg/100g .

From these points of view this research was conducted to know and determine the characters of some multi-floral honeys collected from five localities at Aswan Governorate, Egypt.

## **MATERIALS AND METHODS**

Multi-floral honey samples of Aswan governorate cited in the south of Egypt were collected from five localities (3 samples /each locality): Idfo, Abo-Simbel 1 (El Salam village) , Abo Simbel 2 (El Mostakbal village), Abo Simbel 3 (Abo Simbel county),and Aswan) during the period from June to October 2008. All samples (250 g each) were analyzed at the Chemical Analysis Laboratory of Honeybee Products, at Beekeeping Research Department, Plant Protection Research Institute, ARC , Giza , Egypt for the following properties:

### **1-Physical properties:**

Viscosity was measured according to (Munro,1943) ,the specific gravity was measured according to (Wedmore, 1955) , the granulation was measured according to (White , *et al.*,1962) , the electrical conductivity (EC%) was measured according to (Vorwohl , 1964).

### **2-Chemical properties:**

The moisture (%) was measured according to (AOAC, 1990a), the total soluble solids (%) was measured according to (AOAC, 1990b). Also, pH , free acidity , lactone , total acidity , and carbohydrates were measured according to (White,1979); different sugars, phenols and flavonoids were determined using High Performance Liquid Chromatography (HPLC) by measuring the concentration of fructose, glucose, sucrose and maltose (%) according to (Bogdanov and Baumann, 1988). The concentrations and values of different polyphenols, and flavonoids, were measured according to (AOAC, 1990c). Results were subjected to ANOVA test using the computer program Costat 22 (1998).

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### RESULTS AND DISCUSSION

#### 1-The physical properties of honey:

Results in Table (1) show some physical properties of honeys under investigation. The viscosity of collected honeys were ranged between 14- 69, there were significant differences among collected honeys, while no difference was recorded between the honeys of Aswan and Idfo. The specific gravity in all collected honeys were nearly equal 1.40 with no significant differences. The granulation ranged between 1.04 - 1.89 with significant differences between the honey of Abo-Simbel 3 and all other collected honeys. The electrical conductivity (EC) percentage ranged between 0.008 - 0.026 % with no significant differences among collected samples.

From the previous results it could be observed that the viscosity value of Abo-Simbel 3 was equal to the minimum range in comparison with the normal values , while the other localities recorded high values more than normal one , this may be due to the dried and hot atmosphere at these sites where the high temperature degrees increase the values of this property .

Table (1) Some physical properties of different honeys of bees at five localities of Aswan governorate.

Properties	Localities						Normal range
	Idefo	Abo-Simbel 1	Abo-Simbel 2	Abo-Simbel 3	Aswan	LSDat 5%	
Viscosity (Poise)	69.0 a	34.9 c	48.0 b	14.0 d	69.0 a	9.8	13.6-42
Specific gravity	1.42 a	1.40 a	1.40 a	1.39 a	1.42 a	0.36	1.39-1.44
Granulation	1.62 a	1.60 a	1.64 a	1.04 b	1.89 a	0.36	1.58-2.24
E. C. %	0.008a	0.018a	0.011a	0.009a	0.026a	0.011	0.002- 0.6

Values followed by the same letter within each row are not significantly different at 5% level according to Duncan's multiple range test.

Regarding to specific gravity values at all tested honeys Table (1) , it was noticed that , these values were in agreement with the normal degrees and ranged between 1.39-1.42, these values fall within those found by White, 1975; ranging between 1.421 - 1.423. Al-Arif (1998) found that specific gravity of Saudi honeys ranged from 1.42-1.44 with mean value of 1.432.

As for the granulation property , the obtained results are in agreement with normal values except the honey of Abo-Simbel 3 which gave a value of 1.04 less than the normal one .

The lower the water and the higher the glucose content, the faster the granulation. Temperature is important, since above 25°C and below 5 °C virtually no crystallization occur. The optimum temperature for fast crystallization is 14°C, and sharply increased in the presence of solid particles. These results are reported by Assil *et al.*, (1991), Gomez *et al.*, (1993) ,and Pereze *et al.*, (1994).

As pointed out by (White, 1975) the variations in viscosity of honey types are due primarily to temperature and water content where the values were highly different recording: 2.6, 10.7, 21.4 63.4 189.6 and 600 poise. Thawley (1969) and Crane (1990) related high viscosity of honey bee content of water, and (Pierro, 1994) reported that the viscosity is reduced when the temperature raise to 30 °C. Moreover , Abd-El- Bary and Meshref (1993) found that the viscosity in clover and cotton honeys were 24.34 and 31.52 poise , respectively , where (Meshref *et al.*,1997) found that the viscosity of clover and cotton and sunflower honeys were 55.56, 63.48 and 116 poise ,respectively . Al-Arif (1998) found that viscosity of some Saudi Arabian honeys ranged between 103.86 - 367.71 CP with mean value of 229.88 CP at 40 °C .

Finally, as for electrical conductivity % it could be concluded that all tested honeys were in agreement with the ideal one. These results were less than Meshref *et al.*, (1997) who found that the electrical conductivity of Egyptian honeys were (0.45 , 0.72, 0.87%) for clover, cotton and sunflower, respectively. The high EC values are attributed to high minerals content (Nour, 1988) . Laurrino and Gelli (2002) found that electrical conductivity of citrus honey was 0.185% .

## **2-The chemical properties of honey:**

Data in Table (2) show the chemical composition of five multi-floral honeys including water content , reducing sugars (glucose, fructose and maltose) and non reducing sugar (sucrose) collected from Aswan governorates at Idfo, Abo Simbel 1 (El salam village) , Abo Simbel 2 (El Mostakbal village), Abo Simbel 3 (Abo Simbel county),and Aswan .

Data reveled that the moisture percentages ranged between 17.5 -- 23.0% , the lowest percentage (17.5 %) was found in honeys of Aswan locality ; while the highest percentage (23.0 %) was found in honey of Abo-Simbel 3. Water is quantitatively the second prevalent component of honey. Its content is critical since it affects the storage of honey. The final water content depends not only on a number of environmental factors during production, such as weather and humidity inside the hive, but also on nectar conditions and treatment of honey during extraction and storage (Krell, 1996).

These results are in symmetry with the values obtained by Sancho *et al.*, (1991) mentioned that the moisture content ranges from 12.4 to 20.3 %,

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Foldhazi (1994) reported a range of 16.46 - 17.70 %, while Ihtishamulhaq et al., (1998) reported higher ranges of 17.6 - 21.83 % , finally , Al-Arif (1998) found that moisture of Saudi honey ranged from 14-16.9 % with mean value 15.26%.

The total soluble solids (T.S.S) percentages ranged between 77.0 and 88.5%. The highest values of TSS were recorded at all collected samples except the samples of Abo-Simbel 3 which gave only 77 %, in addition it could be noticed that all honey content of TSS located at the normal rate of honeys . The TSS, which should be 77% or more , is responsible for protecting honey from fermentation . In this respect , these results are in harmony with those obtained by Minh et al., (1971)who reported that 79.34 % TSS was recorded in honeys from Philippines, Hussein (1989) mentioned 76.83 % TSS in honey from Oman, and finally , Al-Arif (1998) found that the TSS of Saudi honey ranged from 81.73 - 84.33 % with mean value 83.26%

As for the values of pH, it could be concluded that all collected honeys recorded pH values ranged between 3.8-4.4 located within the normal values of honeys (3.42-6.1).

Regarding to the content of collected honeys of free acidity Millieq/kg , lactone Millieq/kg , and total acidity Millieq/kg , it could be concluded that , all collected honey gave satisfied values representing the normal values of honeys , except the sample of Abo-Simbel 2 which gave 76.5 total acidity which was very high in comparison with that of normal values (9.0-59.5).

The sugar (Fructose, glucose, sucrose, maltose)content of collected honey samples indicated that all tested samples contain ideal values representing normal values of honeys with one exception at the sample of Abo-Simbel 3 which gave only 24% glucose while the standard value ranged between (28.6-37.3%). In addition, it could be observed that all tested samples recording low percentages of fructose sugar where it was ranged between (38-40%) while the normal content is (42.5-55.8%). Regarding to sucrose values of all tested honeys , it was noticed that , these values were ranged between (0.93 -4.8%) , while the normal values of sucrose content is ranged between (0.2-5.0 %) it means that the honey content of sucrose is partially similar to normal ones . As for, maltose values of all tested honeys , it was noticed that , these values were ranged between (2.85-10.2%) , while the normal values of maltose content is ranged between (2.0-15.9 %) it means that the honey contents of maltose sugar is within the normal values .

**Table (2): Mean numbers of chemical composition of different honeys of bees at five localities of Aswan Governorate , Egypt.**

Properties	Localities						
	Idefo	Abo-Simbel 1	Abo-Simbel 2	Abo-Simbel 3	Aswan	LSD at 5%	Normal range
Moisture %	18.0 a	19.50a	19.0 a	23.0 a	17.5 a	5.6	13.4-23.9
T.S.S %	82.0 a	80.5 a	81.0 a	77.0 a	88.5 a	6.7	77-86.5
pH	3.8 a	4.2 a	3.9 a	4.1 a	4.4 a	0.8	3.42-6.1
Free acidity Millieq/kg	48.5 b	44.5 b	66.5 a	44.5 b	34.5 c	9.2	6.8-47.2
Lactone Millieq/kg	8.0 b	9.0 ab	10.0ab	13.0 a	0.0 c	4.6	0.0-18.7
Total acidity Millieq/kg	56.5 b	53.5 b	76.5 a	57.5 b	34.5 c	7.0	9.0-59.5
Fructose %	39.0 a	39.1 a	40.0 a	38.0 a	38.0 a	3.2	42.5-55.8
Glucose %	29.2 a	31.3 a	31.2 a	24.0 a	33.2 a	8.2	28.6-37.3
Sucrose %	4.8 a	0.93 b	2.44 a	2.85 a	3.6 a	2.7	0.2 -5.0
Maltose %	7.85 a	7.14 a	5.71 b	10.2 a	2.85 b	4.2	2.0-15.9

Values followed by the same letter within each row are not significantly different at 5% according to Duncan's multiple range test.

Comparable results are reported by White and Lands (1980) and Singh and Singh (1991) who reported that honey contains 78 % carbohydrate, 28.01% glucose and 35.8 % fructose. Also Assil *et al.*, (1991) reported that 30.9- 39.9% glucose, 35.3 - 41.7 % fructose. Perez *et al.*, (1994) reported 36.69% fructose, 31.12 % glucose. Al-Arif (1998) found that fructose of Saudi honey ranged from 29.4-42.83 % with mean of 36.47 %, glucose 24.83- 38.23% with mean value 30.6 and sucrose 0.028 - 6.23 % with mean value 1.8%.

As for the content of collected honey samples of polyphenol, and flavonoid compounds Table (3) it could be observed that all collected samples are free of Pyro gallic, Gallic , Quercetin , Chrysin, Galangin compounds .

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**Table (3) Chemical analysis of polyphenol and flavonoid compounds in different honeys of bees at five localities of Aswan Governorate.**

Compounds	Ave no. of compounds (mg/100g honey)				
	Idfo	Abo Simbel 1	Abo Simbel 2	Abo Simbel 3	Aswan
Pyro gallic	0.0	0.0	0.0	0.0	0.0
Gallic	0.0	0.0	0.0	0.0	0.0
Resolcenol	0.9390	0.0	0.0735	0.0	0.0730
Protocetchol	0.0	0.0	0.0	0.0	0.4700
P(oh)benzoic	0.0	0.0	0.0001	0.0017	0.0
Phenol	0.0	0.0695	0.0342	0.0	0.2115
Caffeic acid	0.0711	0.0005	0.0036	0.0060	0.0
Vanillin	0.0	0.0040	0.0069	0.0	0.0
Salicylic	0.0	1.7955	1.6823	1.5835	0.0
Ferulic	0.0237	0.0	0.0	0.5618	0.0
3,5 dimethoxybenzyl	0.7560	0.8726	0.0	2.2700	0.9419
Comaric	0.0	0.0166	0.0010	0.0	0.0
Cinnamic	0.0	0.0013	0.0020	0.0	0.8734
Quercetin	0.0	0.0	0.0	0.0	0.0
Phenol phenthline	0.0894	0.0	0.0040	0.0442	0.0
Euganol	0.0	0.0	0.0118	0.1352	0.0
Pinocebrine	0.0972	0.0	0.2090	0.3062	0.0
Chrysin	0.0	0.0	0.0	0.0	0.0
Galangin	0.0	0.0	0.0	0.0	0.0
Acocetin	0.0384	0.0	0.0	0.0	0.0
3,5 di (OH) iso flavone	0.0	0.0121	0.0100	0.0100	0.0
Pinostrobin	0.0	0.0721	0.0	0.0	0.0

Aswan honey samples contain the least values and numbers of polyphenol, flavonoid, and antioxidants compounds, while Abo Simbel samples contain the highest quantities and numbers of polyphenol, flavonoid, and antioxidants compounds.

These results are partially confirmed with those obtained by Bogdanov (1984) who found the presence of pinocembrin as a phenolic compound in the honey of dew , in addition , Yao *et al.*, (2004) who analyzed the flavonoids of nine Australian monofloral Eucalyptus honeys and found a common flavonoid profile comprising tricetin , quercetin, and luteolin. Moreover, (Blasa *et al.*,2006 ) evaluated the polyphenols, flavonoides and antioxidants of raw honey samples and found that phenolic content as caffeic acid ranged between 12.5-17.5 mg/100g while , the total flavonoides were ranged as 0.45-1.01 mg/100g . Recently, Farag ( 2007) found that no significant differences , in the physical properties , were recorded among the collected honeys from north and middle Egypt except pH and total acidity where it was varied.

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الخصائص الطبيعية والكيميائية لبعض الاعسال المصرية فى محافظة اسوان

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### الملخص العربى

أجرى هذا البحث لدراسة أهم الخصائص الطبيعية والكيميائية لخمسة أنواع من الاعسال جمعت من خمسة مناطق بمحافظة اسوان بجمهورية مصر العربية وهى ادفو وابو سمبل ١ (قرية السلام) وابو سمبل ٢ (قرية المستقبل) وابو سمبل ٣ (مدينة ابو سمبل) ومدينة اسوان فى الفترة من يونيو حتى أكتوبر ٢٠٠٨ وأجريت التحاليل المختلفة فى معمل تحليل منتجات النحل بقسم بحوث النحل - معهد بحوث وقاية النبات - مركز البحوث الزراعية .

وأظهرت النتائج وجود فروق معنوية فى خاصية اللزوجة للاعسال المختبرة وتراوحت بين ١٤ - ٦٩ . كما لم تسجل أية فروق معنوية فى خاصية الكثافة للاعسال المختبرة وتراوحت بين ١,٣٩-١,٤٢ . أما خاصية التحبب للاعسال الخمسة فقد وجد فرق معنوى بين عسل ابو سمبل ٣ وباقى الاعسال وتراوحت بين ١,٠٤-١,٨٩ . اما عن درجة التوصيل الكهربى فلم تسجل فروق معنوية بين الاعسال المختبرة وتراوحت بين ٠,٠٠٨ - ٠,٠٢٦ % .

كما أظهرت النتائج أن محتوى الأعسال من الرطوبة تراوحت بين ١٧,٥-٢٣% ومحتوى المواد الصلبة الكلية الذائبة تراوح بين ٧٧-٨٨,٥ % و pH بين ٣,٨-٤,٤ % والحموضة الكلية ٣٤,٥-٧٦,٥ ملليمكافى/ ١ كجم عسل .

وكان محتوى العينات من سكر الفركتوز من ٣٨-٤٠% ، بينما سجل سكر الجلوكوز نسب تراوحت بين ٢٤-٣٣,٢% والسكروز من ٠,٩٣-٤,٨% والمالتوز ٢,٨٥-١٠,٢% .

وسجلت المواد الفينولية ومكسبات الطعم والرائحة فى اعسال منطقة ابو سمبل ٢ اعلى الكميات من هذه المواد بينما كان اقل الكميات فى منطقة أسوان وادفو وتقاربت كميات هذه المواد فى أعسال مناطق أبو سمبل ١ ، ٣ وقد يرجع ذلك لاختلاف مصادر المرعى ومساحتها .