

The physico-chemical properties and composition of Saudi Arabia honeys of different botanical origin.

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ABSTRACT

Eight multi-floral of Saudi honeys of different botanical origin collected from eight regions were studied . The eight region samples of Saudi honeys were (Fakhera, Rabie Fayad, El. Bashaier, Rabie Kobba, El-Saiel Al Kabeer, El-Nokhba, Tabba and Om Azoaba).16 physicochemical parameters were measured including specific gravity , viscosity , color, electrical conductivity , total soluble solids , moisture , carbohydrate , fructose , glucose , sucrose , maltose , HMF. The results of physical properties showed that the specific gravity was parallel and ranged from (1.42 – 1.43). The viscosity ranged from 87.5-183.0 Poise, the color ranged from 0.25- 0.94 , the granulation ranged from 1.72-2.18 , the electrical conductivity (EC) ranged from 0.09-0.19 % , whereas the total soluble solids parallel and ranged from (83.5-84%). The results of chemical composition showed that the moisture ranged from 15.5-17.0% . The carbohydrate content is parallel and ranged from 82.2-83.1% , the fructose content ranged from 38.5-44.9 % , the glucose content ranged from 27.5-35.0% , the sucrose content ranged from 2.3-5.6% , and the maltose content ranged from 3.3-5.3% . The HMF content ranged from 0.48-21.12mg/kg in the different types of tested honeys.

INTRODUCTION

Honey, a viscous and aromatic product appreciated since ancient Grecian times, is 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 (Zumlai & Lulat , 1989 ; 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 anticepted that the world trade of honey which grow consistently in the future.

The chemical composition of honey is complex and the contents of individual constituents vary considerably (Zander & Kocii, 1975; White, 1978). 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). Beside them di- and tri-saccharides and some higher sugars.

Honey, is also known to contain a large number of enzymes (white, 1979) including α . and β . amylase (diastase, α . glycosidase (invertase), glucose oxidase, catalase and acid phosphates. Also, protease and esterase activity have been reported (Evanov, 1981).

Enzymes in honey are of interest as indicators of honey quality (FAO/WHO Codex Alimentarius Commission, 1970). The discovery of each new enzyme in honey leads to speculation on its origin (bee – added or other) and purpose.

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MATERIALS AND METHODS

Sample of Saudi honeys were collected from eight regions (Fakhera, Rabie Fayad, El Bashaier, Rabie Kobba, El-Saiel Al Kabeer, El-Nokhba, Tabba and Om Azoaba) in Saudi Arabia. All the samples were analyzed for the following properties:-

1- Physical properties which includes ; specific gravity, viscosity , color, electrical conductivity (%) and total soluble solids (%).Chemical properties which include; moisture (%), pH, free acidity (mq/kg) , lactone (mq/kg), total acidity (mq/kg) , carbohydrate (%) , fructose (%), glucose (%), sucrose (%), maltose (%)and Hydroxymethylfurfural (HMF) .

The physical properties:

The specific gravity was measured according to (Wedmore, 1955) , the viscosity was measured according to (Munro, 1943) , the color was measured according to (White , 1978) , the granulation was measured according to (White , *et al.* ,1962) , the electrical conductivity (%) was measured according to (Vorwohl , 1964).

The chemical composition:

The moisture (%) was measured according to (AOAC, 1990a), the total soluble solids (%) was measured according to (The AOAC, 1980). The carbohydrates were measured according to (Dubois,*et al.*,1956); quantitation of sugars by High Performance Liquid Chromatography (HPLC) measured the concentration of fructose, glucose, sucrose and maltose (%) according to (Bogdanov and Baumann, 1988), while the Hydroxymethylfurfural (HMF) was measured according to (Lee, *et al.* , 1986)

RESULTS

Table (1) shows the physical properties of Saudi Arabia honeys under study, the specific gravity in all types were nearly equal 1.43; except in Rabie Fayad and El Saiel Al Kabeer honeys (1.42). The viscosity ranged between 87.5 and 183.0 .The color ranged between 0.25 and 0.94. The granulation ranged between 1.72 and 2.18. The electrical conductivity (EC) percentage ranged between 0.09 and 0.1 %

Table (1): Physical Properties of Some Saudi Arabia Honeys.

Parameter	HoneyTypes							
	Fakhera	Rabie Fayad	El Bashaier	Rabie Kobba	El Saiel Al Kabeer	El Nokhbba	Tabba	Om Azoaba
Specific gravity	1.43	1.42	1.43	1.43	1.42	1.43	1.43	1.43
Viscosity(Poise)	138.0	87.5	138.0	87.5	87.5	183.0	87.5	183.0
Color	0.63	0.37	0.94	0.25	0.64	0.54	0.55	0.71
Granulation	1.92	1.93	2.18	1.75	1.72	2.03	2.04	1.77
EC (%)	0.06	0.07	0.09	0.01	0.09	0.01	0.01	0.03

Data in Table (2) shows the chemical composition of eight bee honey types from Saudi Arabia (Fakhera , Rabie Fayad , El Bashaier , Rabie Kobba , El Saiel Al Kabeer , El Nokhba , Tabba and Om Azoaba .Data reveled that the moisture percentage ranged between 15.5 – 17.0 % , the lowest percentage (15.5 %) was found in honeys of Fakhera and Om Azoaba ; while the highest percentage (17.0 %) was found in honey of El Saiel Al Kabeer .The total soluble solids (T.S.S) percentage ranged between 83.5 and 84.5%.

Table (2): Chemical composition of some Saudi Arabia honeys.

Parameter	Honey Types							
	Fakhera	Rabie Fayad	El Bashaier	Rabie Kobba	El Saiel AL Kabeer	El Nokhba	Tabba	Om Azoaba
Moisture (%)	15.5	16.5	16.0	16.5	17.0	16.0	16.5	15.5
T SS (%)	84.5	83.5	84.0	83.5	83.0	84.0	83.5	84.5
Carbohydrate (%)	82.8	82.5	83.1	82.2	82.2	83.1	82.5	82.8
Fructose (%)	44.0	39.69	40.0	42.0	42.0	38.5	39.7	44.9
Glucose (%)	29.7	32.0	35.0	29.0	29.4	32.6	33.8	27.5
Sucrose (%)	4.4	2.4	3.2	5.6	4.4	2.4	2.3	4.0
Maltose (%)	3.8	4.4	4.5	3.3	3.3	5.3	4.3	4.9
HMF (mg/kg)	15.3	0.48	1.92	7.68	15.36	7.68	7.68	21.12

The total carbohydrate content percentage of the different honey types ranged between 82.2 and 83.1 %; the lowest content of carbohydrate were found in El Bashaier and El Nokhba; while the highest content was found in Fakhera and El Saiel Al Kabeer. The fructose content were highest (44.9 , 44.0 and 42.0%) in honeys from Om Azoaba , Fakhera, Rabie Kobba and El Saiel Al Kabeer , respectively ; while the lowest fructose content (38.5 , 39.7 and 40.0 %) in honeys from El Nokhba, Rabie Fayad ,

Tabba and El Bashaier, respectively . The glucose content of different types of honey was highest in El Bashaier honey (35 %) ; while it was the lowest in Om Azoaba honey (27.5 %) . The sucrose content percentage was ranged between 2.3 and 5.6 %, the highest content percentage was found in Rabie Kobba honey; while the lowest value of sucrose content percentage was found in Tabba honey. The maltose content of different types of honey ranged between 3.3 and 5.3 %, the lowest content was found in El Bashaier and El Saiel Al Kabier honeys (3.3 %); while the highest content (5.3 %) was found in El Nokhba honey. The Hydroxymethylfurfural (HMF) content in different types of honey ranged between 0.48 and 21.12 mg/ kg.

DISCUSSION

1-The physical characteristics of honey :

Viscosity is an important technical parameter during honey processing, because it reduces honey flow during extraction, pumping, setting, filtration, mixing and bottling.

Results in Table (1) show that the tested honeys fall into three groups in relation to viscosity values arranged in descending order as follows:

- 1) El Nokhba and Om Azoaba honeys with (183.0) poise
- 2) Fakhera and El Bashaier honeys (138.0)
- 3) Rabie Fayad, Rabie Kobba, El Saiel Al Kabier and Tabba honeys

(87.5). As pointed out by (White, 1975) the variations in viscosity of honey are due primarily to temperature and water content where the viscosity values were; 2.6, 10.7, 21.4 68.4 189.6 and 600.0 poise.

(Crane, 1990) related high viscosity of honey to high sugar and low water content, and (Pierro, 1994) reported that the viscosity is reduced when the temperature raise to 30 °C. (Abd-El- Bary and Mishref ,1993) found that the viscosity in clover and cotton honeys were 24, 34 and 31.52 poise , respectively ,where (Mishref *et al* ,1999) found that the viscosity of clover , cotton and sunflower honeys were 55.56 , 63.48 , and 116.0 poise , respectively . Al-Arif (1998) found that viscosity of Saudi honey ranged from 103.86-367.71 C.P. with mean value 229.88 CP. at 40 °C.

Another physical characteristic of practical importance is density. Honey density, expressed as specific gravity, it depends on the water content of the honey. Because of the variation in density is sometimes possible to observe distinct stratification of honey in large storage tanks. The higher water content (less density) honey settles above the denser, drier honey. The densities of tested honeys (Table 1) could be ranged 1.42 – 143 , these densities fall within those found by White, 1975; ranging

between 1.421 – 1.423 .Al-Arif (1998) found that specific gravity of Saudi honey ranged from 1.42-1.44 with mean value 1.432.

Color (as an optical density) varies with botanical origin , age and storage condition , but transparency or clarity depends on the amount of suspended particles such as pollen .The color of the tested honeys falls into four groups in descending order as follows :

- 1) El Bashaier honey with 0.94
- 2) Rabie Kobba and Rabie Fayad (0.25 and 0.37, respectively).
- 3) El Nokhba and Tabba (0.54 and 0.55 , respectively)
- 4) Fakhera, El Saiel Al Kabeer and Om Azoaba (0.63, 0.64 and 0.71, respectively).

According to the color standard table (given by White, 1978)

Thawley (1969) explained that the dark color was partially attributed to condensation between amino acids and sugars in honey of the coloring materials are plant pigments. Hassan (1985) described the color of citrus, clover and cotton honeys to fall between water white and extra white. Nour (1988) reported that the range of color for clover honey was between 0.12 to 0.240 and for citrus honey between 0.112 to 0.240. The results of color by Abd- Elbarry and Mishref (1993) for clover and cotton honeys from Fayoum (0.15 and 0.25). Nour (1991) showed lower values of color of Egyptian honeys (0.125, 0.202 and 0.18, respectively). Mishref *et al.*, (1999) reported that color ranged (0.12 – 0.24).

Considerable differences in the electrical conductivity (E_c) values of the tested honeys fall into two groups in descending order as follows :

- 1) Fakhera, Rabie Fayad, El Bashaier and El Saiel Al Kabeer were 0.06, 0.07 0.09 and 0.09, respectively.
- 2) Rabie Kobba , El Nokhba and Tabba (0.01) and Om Azoaba (0.03)

These results were less than Mishref *et al.*, (1999) who found that the E_c of Egyptian honey were (0.45 , 0.72 , 0.87%) for clover, cotton and sunflower, respectively .The high E_c values are attributed to high minerals content (Nour , 1988) . Accorti *et al.* (1986) suggested that the measurement of E_c could replace that of ash content in official analytical methods. Laurino and Gelli (2000) found that E_c of citrus honey was 0.185 %.

The lower the water and the higher the glucose content, the faster the crystallization. Temperature is important, since above 25 and below 5 °C virtually no crystallization occur. Around 14°C is the optimum temperature for fast crystallization, but also the presence of solid particles. Granulation of Saudi Arabia honeys tested were similar, it was ranged between 1.75 – 2.04. Comparable results are reported by other authors (Gomez *et al.*,

1993) fructose / glucose ratio of 1.93; Assil *et al.*, (1991) reported that fructose / glucose ratio of 1.3. Perezze *et al.*, (1994) fructose / glucose ratio of 1.17.

2- Chemical composition of Honey

The chemical composition of the floral honeys including its contents of water, carbohydrate ,reducing sugars (glucose, fructose and maltose) and non reducing sugar (sucrose) and HMF.

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).

It is worthnoting that the percentages of moisture in honeys tested were approximately (18 – 19.5 %), (Table 1).These results are in agreement with the values obtained by other authors. Sancho *et al.* (1991) mentioned that the moisture content ranges from 12.4 - 20.3 %. Foldhazi (1994) reported a range of 16.46 - 17.70 %, while Ihtishamulhaq *et al.* (1998) reported higher a range of 17.6 – 21.83 %. Al-Arify (1998) found that moisture of Saudi honey ranged from 14-16.9 % with mean value 15.26%

The Total Soluble Solids (T.S.S.) values of honeys tested were approximately the same in all Saudi Arabia honeys (Table 1) , it was ranged from 83.5 – 84.5 % . The dry matter , which should be 78 % or more , is responsible for protecting honey from fermentation . In this respect , Minh *et al.*, (1971) reported 79.34 % T.S.S. in honey from Philippines and also , Hussein (1989) mentioned 76.83 % T.S.S.in honey from Oman . Al-Arify (1998) found that the T.S.S of Saudi honey ranged from 81.73-84.33 % with mean value 83.26%

By far, the largest portion of the dry matter in honey consists of sugars. This attributes to the characteristic physical properties of honey: high viscosity, high density, and immunity from some types of spoilage. Levulose (fructose) and dextrose (glucose) are the simple sugars making up most of the honey. Sucrose is also present in honey, and is one of the main sugars in nectar, along with levulose and dextrose. "Maltose" is actually a mixture of several complex sugars, which are analyzed collectively and reported as maltose (White and Doner, 1980)

Results in Table (2) show that the carbohydrate content in all honey types was parallel and ranges from 82.2-83.1 mg / 100 mg. The concentration of fructose is 38.5-44.9 mg /100 mg. As for glucose content, it ranges from 27.5 –33.8 mg / 100 mg.

In regard to the reducing disaccharide maltose a marked reduction was observed in its concentration in the tested honey (3.3-5.3 mg / 100 mg). On the contrary, a marked elevation in the sucrose content was recorded in the tested honeys (2.3- 5.6 mg / 100 mg). Comparable results are reported by other authors. Singh and Singh (1991) 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 and a fructose: glucose ratio of 1.3. Perez *et al.*, (1994) reported 36.69% fructose, 31.12 % glucose in ratio of 1.17. 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%. Fructose/glucose ratio ranged between 0.93 – 1.56 with mean value 1.2.

Hydroxymethylfurfural (HMF):

HMF, is a breakdown product of certain sugar solution particularly Fructose, when stored at high temperature or for a long time or honey adulteration with invert sugar prepared by acid hydrolysis at high temperature.

In this study the values of HMF of Saudi Arabia honey ranged between 0.48 – 21.12mg/kg. Comparable results are reported by other authors. Laurino and Gelli (2000) found that the values for HMF ranges between 2.0 – 26.0 mg/kg. Nour *et al* (1991) found that HMF values ranged between 1.27-19.13. in mg/kg freshness honeys. Gomez *et al* (1993) reported that a mean value of 3.6 mg/kg for HMF.

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المخلص العربي

الصفات الفيزيائية والمكونات الكيميائية لأعسال السعودية المختلفة المصادر النباتية

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جمعت عينات من الأعسال السعودية من ثمانى مناطق فى المملكة العربية السعودية وقد تم تحليل جميع هذه العينات لدراسة الصفات الطبيعية والتي تشمل : اللون- اللزوجة- الكثافة النوعية- درجة التوصيل الكهربى - التحيب - المواد الكلية الصلبة الذائبة . وكذلك دراسة المكونات الكيميائية والتي تشمل : الرطوبة- الكربوهيدرات الكلية - الفركتوز- الجلوكوز - السكروز- المالتوز- وكذلك مادة الهيدروكسى ميثيل فورفورال (HMF) . وقد أوضحت النتائج أن الكثافة النوعية للأعسال المختبرة كانت تقريبا متساوية بينما كانت اللزوجة ما بين (Poise 183,0-87,0) واللون ما بين 0,25-0,94. والتحيب 1,72-2,18 ودرجة التوصيل الكهربى 0,1-0,09 % فى حين كانت المواد الكلية الصلبة الكلية الذائبة ما بين 83,0-84,0 % . وقد أوضحت النتائج أيضا أن المكونات الكيميائية من حيث الرطوبة تراوحت بين 10,0 - 17,0 % والكربوهيدرات الكلية 82,2-83,1 % ومحتوى الفركتوز 38,0-44,9 % والجلوكوز 27,0-30,0 % والسكروز 3,2-5,6 % والمالتوز 3,3-5,3 % . فى حين كان الهيدروكسى ميثيل فورفورال 0,48 - 21,12 (ملجم /كجم) وذلك فى الاتواع المختبرة .