

QUALITY ASSESSMENT OF SOME EGYPTIAN AND SAUDI ARABIA HONEYS

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ABSTRACT: *The present study was conducted to evaluate the physicochemical properties of Egyptian cotton monofloral honey, and compare it with Saudi Arabia acacia (salam) honey. Cotton honey produced from cotton plants (*Jossypium barbadense*) by hybrid carniolan bees *Apis mellifera carnica*, while salam honey produced by *Apis mellifera jamanitica* bees. Three cotton honey samples were collected in (September 2014) from Sharkeia governorate, Egypt. In addition, three honey samples from salam plant (*Acacia ehneberingiana*) were collected during the blooming period (May, 2015) from Sabia district, the south region of Saudi Arabia. It could be concluded that salam honey had the highest viscosity values than the cotton honey presented 18000-16250 cps, respectively. The average results of water content were (22.2-17.2 %), pH (3.81-3.79), total acidity (38.5-42.0 meq/kg), HMF (11.65-246 mg/kg), total amino acids (1.5-3.57 g/100g), total minerals content (0.80-0.36%), for cotton and salam honeys, respectively. The average results of sugar composition for cotton and salam honeys were (42.66-34.3, 37.43-37.7 and 3.0-7.3%) for Glucose, Fructose and Sucrose, respectively. For minerals content, K, Ca, Na and Mg were superior of all tested minerals in both of cotton and salam honeys. It's cleared that B1 and B3 vitamins did not detected in cotton honey. Also, B12 vitamin did not detected in salam honey. Cotton honey was only superior of vitamin B6 giving 0.031 mg/100g. Meanwhile, Vitamins B3, B5 and B9 was in high values in salam honey presented (0.6, 0.2 and 0.1 mg/100g), respectively. Finally, it could be concluded that honeys must correctly classified according to its floral origin. In addition, further studies are needed in order to investigate other floral origins to provide a robust model to classify honey samples from these regions.*

Key words: *Honey analysis, physiochemical characters, geographical origin.*

INTRODUCTION

Determination of the standard criteria of food products is the most important process, since consumption, quality and validity of these products depend on it. Also, purity and contaminant-free food are other factors of great concern for consumer health. Honey is one of the most important global natural products. Honey comes in the first order of these products, since it has many benefits in foods, and medicine. (Serrano *et al.*, 2007). Since honey types differ from one country to another and in different regions in the same country due to floral origin, soil composition

and other factors consequently, quality criteria differ from one honey type to another, i.e. blossom honey is greatly different than the honeydew one. The reason for testing honey for quality control purposes is to verify the authenticity of the product and to reveal the possible presence of artificial components or adulterants, as well as to address processing and market needs (Krell, 1996). This requires not only determining the moisture and mineral content (ash), but also the levels of hydroxymethylfurfural (HMF), acidity, diastase activity, apparent sugars and water insoluble solids (Bogdanov *et al.*, 2002). The

quality factor that is used in the international honey trade, besides its organoleptic characteristics (flavour, consistency and colour), is its chemical composition mainly moisture and HMF content, the diastase index, pH, acidity as well as the content and proportion of the carbohydrates (sugars). The level of these indicators in a honey sample gives an indication of its quality (Muli *et al.*, 2007). Honey composition is tightly associated to its botanical origin, which is closely related to the geographical area in which it is originated, because soil and climate characteristics determine melliferous flora as well as the presence of different minerals arising from soil, dust, etc. (Nelly *et al.*, 2005). The floral origin of honey is an important characteristic in the evaluation of its quality (Baroni *et al.*, 2006). Products from one region may attain a surplus value than similar products from another area. However, labeling of regional honey must be supported by analysis that confirms its provenance (Woodcock *et al.*, 2007). In Egypt and Saudi Arabia, beekeeping is practiced in many areas, characterized by a remarkable richness of honey plants. In Saudi Arabia, the consumption of honey is increasing, since it is one of the principle ingredients in foods, as remedy and in natural mixtures (Alqarni, 2011). There are many types of honey (local and exotic) commonly consumed in Egypt and Saudi Arabia. Most of these honeys are traded without quality sign or reference to their origins and this may lead to honey adulteration and/or marketing non-standard honeys (Alqarni *et al.*, 2012). So, comparing these honeys with quality standards is greatly required. The quality and biochemical properties of honey were related to honey maturity, production methods, climatic conditions, processing and storage conditions as well as the nectar source of honey (Crane, 1979). In many honey countries, there is a considerable difference in the price of honey depending on the botanical and geographical origin.

The main goal of this work was to characterize cotton honey from the honeybee Carniolan hybrid collected from Sharkeia governorate, Egypt, establishing associations among chemical variables and the production zone in comparing with acacia honey produced in south region of Saudi Arabia, from local colonies, *Apis mellifera jemenitica*. Thus, several physical and chemical parameters were evaluated.

MATERIALS AND METHODS

The present investigation was carried out at Food Safety & Quality Control Lab, Faculty of Agriculture, Cairo University, Egypt during 2015, to study physical and chemical properties of the cotton and acacia (salam) honeys. Three cotton and acacia (Salam) honey combs represented three different local colonies were collected. For each parameter, the tests were replicated three times and the mean values were taken.

Collecting honey sample:

Cotton honey samples from cotton plants (*Jossypium barbadense*) cultivated in Sharkeia governorate, about 100 km. east Cairo city, were collected from three different carniolan hybrid colonies *Apis mellifera carnica*. On the other hand, Unprocessed (raw) Salam honey from acacia trees (*Acacia ehenbergiana*) in Sabia region (Fig, 1) about 1800 km. south-west Riyadh city, Saudi Arabia, collected by cutting a honey comb from three different traditional colonies of sub species *Apis mellifera jemenitica* and put in light plastic pages kept in freezing conditions until analyses. Each Salam honey comb was squeezed with mesh to collect three honey samples. Meanwhile, cotton honey was collected from honey bee colonies kept in modern hives and extracted by the extractor and sieved. Then, each sample was kept in tied glass bottles (200 gm/colony) and put directly in the refrigerator until the experimental analysis was done. All samples were analyzed for the following properties:

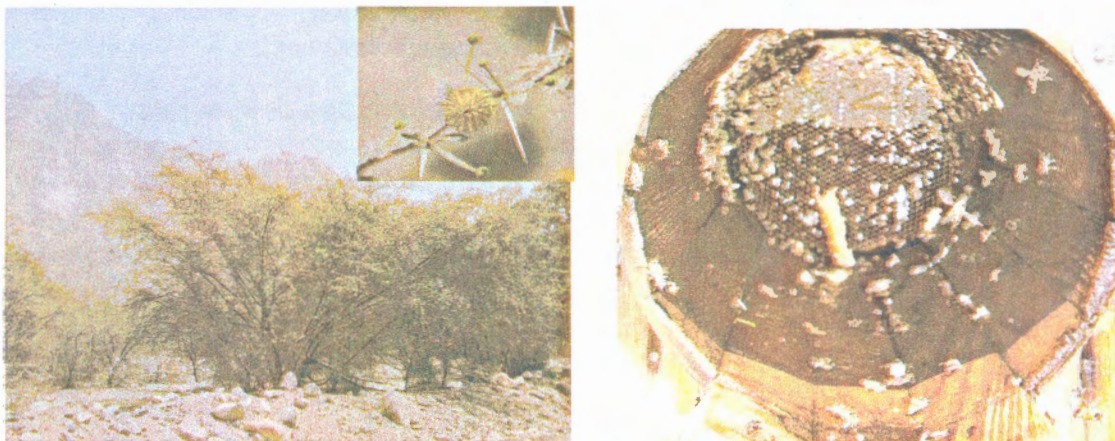


Fig (1). Comb honey in traditional hives and the flower of Salam tree in south region, KSA

Analytical procedures:

a. Determination of Water content

Determination of moisture content of honey was carried out by measurement its refractive index value (Abbe refractometer at 20 °C) (A.O.A.C, 1995).

b. Determination of pH, free acids and total acidity

Based on the method of White *et al.* (1962). Reagents. Sodium hydroxide 0.05 N. Hydrochloric acid 0.05 N. Phenolphthalein indicator 1% (m/v) in ethanol, neutralized. Distilled water made carbon dioxide free, by boiling and subsequent cooling. Apparatus, pH meter, recently calibrated at pH₄ and 8, 10-ml microburets. 10-ml pipettes.

Procedure: The following titration is carried out, to 10 g sample of honey contained in a 250 ml beaker; add 75 ml CO₂ free distilled water. Dissolve honey and stir the solution with a magnetic stirrer. Place the electrodes of a pH meter in the solution and record the initial pH. Then titrate the solution with 0.05 N NaOH. Add the NaOH at a rate so that individual drops just tend to merge into a steady stream (5.0 ml/min.). Stop adding NaOH when the pH reaches 8.5. Immediately add 10.0 ml 0.05 N NaOH. By means of a 10 ml pipette and without delay titrate back to pH 8.3 by adding 0.05 N NaOH by means of a 10 ml pipet and without delay titrate back to pH 8.3

by adding 0.05 N HCl from a 10-ml buret. The titration rate given is as rapid as found consistent with acceptable reproducibility. Titration to pH 8.5 is equivalent to maintenance of phenolphthalein pink for 10 seconds, since the pH falls to 8.3 in that time. Expression of results: The amount of NaOH added from the burette, minus the 'blank' correction is considered the measure of the free acid present, and the amount of HCl used substrated from 10 ml is measured of the lactone content. The sum of free acid and lactone is the total acidity.

c. Determination of Hydroxymethylfurfural (HMF)

It was determined according to Winkler (1955) as following, the reagents: Barbituric acid solution: 500 mg barbituric acid was transferred to 100 ml graduated flask using 70 ml water. Then the flask placed in a hot water-bath until all amount of barbituric acid was dissolved, cool and make up to volume. P-toluidin solution: Weight out 10 g P-toluidin, analytical grade, and dissolved in about 50 ml isopropanol by gentle warming in a water-bath then, transfer to a 100 ml graduated flask with isopropanol and add 10 ml glacial acetic acid. Cool and make up to volume with isopropanol. Keep solution in the dark. Don't use for at least 24 hours. Distilled water (oxygen free): Nitrogen gas was passed through boiling distilled water. Then water is cooled.

Procedure:

1. Preparation of test sample: 5 g of honey sample is weighted and dissolved without heating with oxygen free distilled water and transferred to a 25 ml graduated flask and made up to volume (honey solution). The sample should be tested after preparation without delay.

2. Photometric determination: 2.0 ml of honey solution is pipetted into each of two test tubes and 5.0 ml P-toluidine solution is added to each. Into one test tube 1 ml water is pipetted and into the other 1 ml barbituric acid solution and both mixtures are shaken. The tube with added water, serves as the water blank. The addition of reagents should be done without pause and should be finished in about 1-2 min. The extinction of the sample is read against the blank at 550 nm using a 1-cm cell, immediately the maximum value is reached.

3. Calculation and expression of results: The method may be calibrated by using a standard of HMF standardized by dissolving commercial or laboratory prepared HMF and assaying spectrophotometrically. The equation by which results may be roughly worked out is:
$$\text{mg /1000 g HMF} = \text{absorbance /thickness of layer} * 192 .$$

Results are expressed as mg HMF/Kg honey.

d. Determination of nitrogen content, Total Amino Acids and Proline:

Kjeldahl - Digestion unit, Vapodest 20s Distillation unit was used to determine nitrogen content. For total amino acids, acids hydrolysis of honeys was carried out according to Block *et al.* (1958). Instrument used, UV/Vis. Spectrophotometry, Jenway, England. Wave length (650 nm.). Determination proline content was done by using Harmonized methods of International honey commission (2009). Determination of proline. P. 59. Instrument used, UV/Vis.

Spectrophotometry, Jenway, England. Wave length (510 nm.).

e. Determination of Minerals:

Potassium, sodium and calcium were determined by flame photometer apparatus. Meanwhile, microelements (Mg, Zn, Mn, Fe, Cu, Co, Ni) were determined by Atomic Absorption 157 (International Labs).

f. Determination of Invertase activity:

Invertase activity was determined using the Siegenthaier method. As a substrate is used p- Nitrophenyl-alfa-D-glucopyranosid (pNPG) which is decomposed by invertase from honey to glucose and p-nitrophenol.

By modifying pH to 9.5 the enzymatic reaction is stopped and at the same time nitrophenol is transformed to nitrophenal anion which is equivalent to the transformed substrate and is determined spectrophotometrically at 400 nm (UVA/IS Spectrometer Lambda I I, Perkin Elmer, USA). The honey invertase activity was calculated from the measured absorbency by multiplying by the factor of 158.94 and calculated to a kilo of honey (U/kg). Then the value was expressed as invertase number (IN). The IN indicates the amount of sucrose per gram hydrolysed in 1 h by the enzymes contained in 100g of honey under test conditions (Bogdanov *et al.*, 1997).

g. Determination of Diastase activity:

Determination of diastase activity was evaluated spectrophotometrically based on the method of Schade *et al.* (1958) using the Shade method (UVA/IS Spectrometer Lambda II, Perkin Elmer, USA). The diastase activity is calculated as diastase number (DN). DN expresses units of diastase activity (Gothe unit). One unit is defined as the amount of enzyme that will convert 0.01 g of starch to the prescribed end-point in 1 h at 40 °C under the conditions of test (Bogdanov *et al.*, 1997).

h. Determination of glucose oxidase

Based out the method of White and Subers (1963). Reagents, 0.4 phosphate buffer pH 6.5 Peroxide reagent. Dilute 5 ml buffer, and 10 mg 0-dianisidine (3,3-dimethoxybenz iodine), 'Fluka A, G' in 2 ml 95% ethyl alcohol at 200 ml with distilled water. Make fresh daily. Peroxidase, 2 mg peroxidase (Boehringer, Mannheim) is dissolved in 50 ml 0.01 M phosphate buffer pH 6.5. A tissue culture Rollordrum operating at 20 rpm. in an incubator at 37°C is used. Narrow-mouth, screw-neck 8-oz. (225 ml) round flint glass bottles are used, with moulded plastic screw.

Procedure: Weight under minimal illumination 5 g honey to the nearest 0.01 g, add 5 ml buffer, transfer to a 25-ml volumetric flask, and make to volume with ; distilled water. After the buffer is added the enzyme, is no longer light-sensitive, and ordinary laboratory illumination may be used. To the 8-oz bottle is added 10 ml honey solution and 10 ml distilled water. The bottle is capped and waned to 37°C in a bath, without agitation. It is placed in the roller drum at 20 rpm., 37°C, for 1 hour.

Three test-tubes are meanwhile prepared for each sample: two containing 6.0 ml reagent and sufficient water to make 2.0 ml when added to' the sample volume, and the third (blank) tube containing water in place of the reagent. After the 1 hour's incubation, the bottle is removed, and an appropriate volume (0.1 to 2.0 ml depending on peroxide content) of the incubated solution is added to each tube, the contents mixed, and the absorbance at 400 run is determined between 5 and 10 minutes after the final mixing, and with a liner curve between the absorbance and H2O2'. The results of the assay was expressed as micrograms hydrogen peroxide accumulated per hour per gram of honey under the experimental conditions.

i. Determination of Sugars in honey:

Instrument used: HPLC Knauer,

Germany equipment with two pumps, R1 detector, column oven and clarity-chrom software. Instrument condition: Column: The flow rate was at adjusted at 1.5 ml/min, the column used was Luna NH₂ column for carbohydrate analysis, the column oven temperature kept constant at 40 °C, the RI detector operated at room temperature, the mobile phase was acetonitrile: HPLC grade: water (80:20,v:v). Sample preparation: 5 g of sample were dissolved in 12 ml methanol HPLC grade, Quantitatively transferred to measuring flask 50ml completed to the mark with HPLC grade water, sonicated for 20 min, Filtering through PTFE filter (0.2mm), kept at 0 °C until analysis. Standard preparation: Pipette 25ml methanol into a 100ml calibrated flask. Depending on the sugars to be analyzed, dissolve the amounts detailed below in approximately 40ml water and transfer quantitatively to the flask and fill to the mark with water. Fructose: 2.000g; glucose: 1.500g; sucrose: 0.250g; maltose: 0.150g. (Codex Alimentarius, 1993) in Fig. 2.

j. Determination of water soluble vitamins (WSV) in honey:

Instrument used: HPLC Knauer, Germany equipment with two pumps, UV detector, column oven and clarity-chrom software. Instrument condition: Column: Kinetex 2.6u C18 100x 4.6mm. the temperature kept constant at 22 C°, flow rate 0.5 ml/min. Mobile phase, 50m M phosphate buffer, pH=2.8: Methanol (90:10), wave length 254nm. Sample preparation: About 5g sample was weight accurately about 0.001g sample were dissolved in 5ml HPLC grade water sonicated for 15 min, then diluted to 50 ml by HPLC grade water, filtered by 0.25µ disposal PTFE syringe filter. Standard preparation: A stock solution of 2.5 mg of vitamin B12+ 4 mg of vitamin B6+ 5 mg of vitamin B1+ 1 mg of folic acid+ 20 mg of nicotinamide (B3)+ 6 mg of D-panthenol (B5) and 10 mg of Orotic acid (B13) were dissolved in 2 ml HPLC grade water, then 1 ml of this solution was sonicated in 5 ml HPLC grade water for 15 min. then filtered through 0.45µ disposal PTFE syringe filter (Ciulu *et al.*, 2011) in Fig 3.

RESULTS AND DISCUSSION

Relationship between geographical origin of production honeys and physical and chemical activity was illustrated in Tab. (1-5) and Fig. (2-5).

Physical properties:

Results in Table (1) show the major physical and chemical properties of the collected honey samples from Egypt and Saudi Arabia.

Water content

The initial moisture content of both cotton and salam honeys were measured. Data in table (1) showed that Saudi salam honey did not exceed the 20% allowed by (Codex Alimentarius, 1993). Average moisture content was 17.2% for salam honey, meanwhile cotton honey exceed the allowed by (Codex Alimentarius, 1993) giving 22.2%.

pH

The pH values of salam and cotton honey samples ranged from 3.79 to 3.81 table (1), respectively. These findings agreed with Bogdanov (1999) and Codex Alimentarius (1998) which specified a pH range of 3.42 to 6.10. This parameter is of great importance during extraction and storage of honey as it influences the texture, stability and shelf life of honey (Terra^b et al., 2004). According to Kamal et al. (2002) difference in pH may be due to variation of

different acids and minerals present in honey. Higher pH values obtained from honey harvested using traditional method could be as a result of fermentation due to inappropriate method of harvesting (Babarinde et al., 2011). All of the investigated Egyptian and Saudi honey samples were acidic (pH 3.53 - 4.03) (Table 1) and were within the limit (pH 3.4 to 6.1) that indicates freshness (Moniruzzaman et al., 2013).

Viscosity

The values for viscosity obtained were 16250 cps to 18000 cps for cotton and salam honeys, respectively. As water content was used as an indicator of viscosity, there are reflex relationship between water content and viscosity. The results of Saudi honey are consistent with those reported by Al-qarni et al., (2012) they found that all the tested Saudi honeys had relatively low water content (12.12%-17.32%) compared to Egyptian honeys which showed high water content (20.12%). Abu- Tarboush et al. (1992) and Kaakeh and Gade-Elhak (2005) attributed this low level of water content to the dry weather in the area of honey production. Moreover, water content in honey is responsible for its stability against fermentation and granulation.

Table (1): Mean values of some physical characteristics of cotton and salam honeys

Physical characters	Water content g/100g (%)	pH	Viscosity cps	Total acidity meq/Kg	Free Acidity meq/Kg	HMF mg/kg	Nitrogen %	Total amino acids g/100g	Proline mg/kg	Total minerals %
Cotton Egypt	22.2	3.81	16250	38.50	35.0	11.65	0.095	1.50	457.0	0.80
Salam KSA	17.2	3.79	18000	42.0	38.0	246.0	0.16	3.57	1024	0.36

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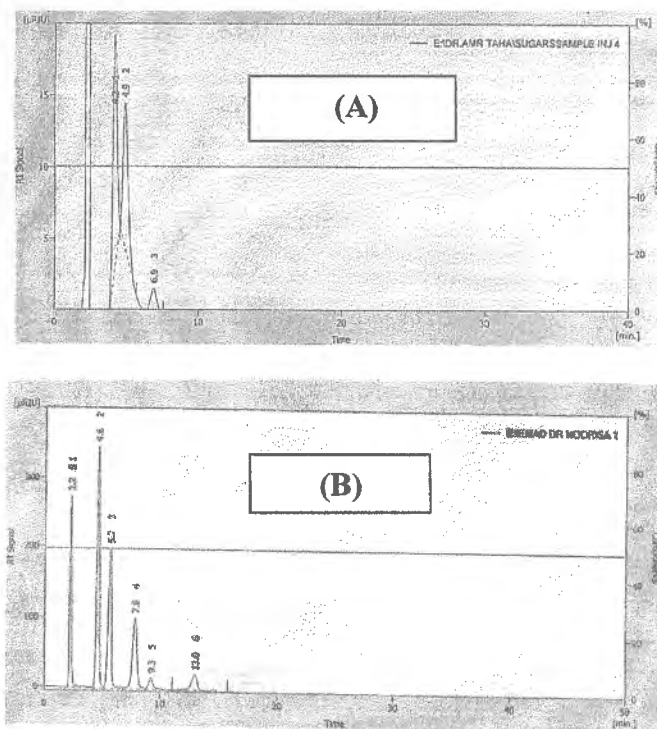


Fig (2). Estimation of some cotton (A) and salam (B) honey sugars

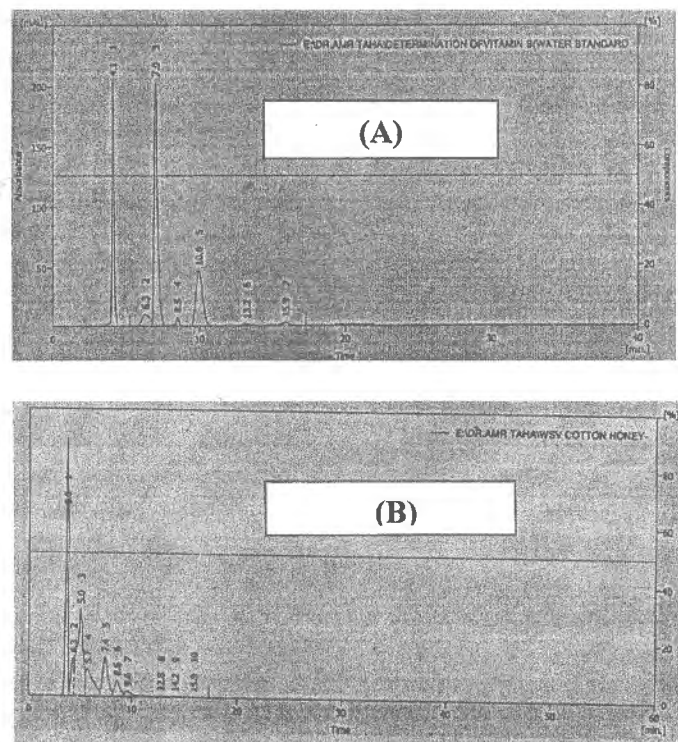


Fig (3). Estimation of some cotton (A) and salam (B) honey vitamins

Total acidity

The values of total acidity obtained ranged from 38.5 meq/kg to 42 meq/kg for cotton and salam honey, respectively. It's obvious that cotton honey total acidity value is within the range specified by Codex Alimentarius (1998) with a maximum limit of 40 meq/kg and this indicated the absence of undesirable fermentation (Babarinde *et al.*, 2011). Meanwhile, the value for salam honey exceed the maximum limit or standard giving 42.0 meq/kg for total acidity. Total acidity indicates the history of honey and possible alcohol and acid production by bacterial fermentation (Rodgers, 1979). Since some honeys have a higher natural acidity, Al-Doghairi *et al.* (2007) found a wide range of total acidity between (9.12 to 93.02 meq/kg) for Saudi honeys. Moreover, higher acidity value in honey harvested using traditional method could be due to floral sources. In addition, high value of acidity could also be due to fermentation of honey due to inappropriate method of harvesting which involved immature honey combs and brood that accelerate rate of fermentation. According to Costa *et al.* (1999) *Xerotolerant* yeast may also be responsible for high total acidity. Honey samples were therefore analyzed to determine the amount of free acid present. The values of free acidity obtained ranged from 35 meq/kg to 38 meq/kg for cotton and salam honey, respectively.

Hydroxymethylfurfural (HMF)

From the results in Table (1), the HMF content of the different honey samples ranged from 11.65 mg/kg to 246 mg/kg for cotton and salam honeys, respectively. The Saudi salam honey had very high HMF content being 246 mg/kg as its exceed the maximum limit or standard of 80 mg/kg specified by Codex Alimentarius (1993). However, the value of HMF in honey harvested using traditional method was higher than the value in honey harvested using modern method (Babarinde *et al.*, 2011). In addition Tosi *et al.* (2002) reported

that thermal treatment can increase HMF content of honey. Overheating of honey sample during processing or storage for very long period could lead to conversion of sugars to HMF (Saxena *et al.*, 2010). Therefore, honey treatment temperature and time must be limited when pasteurizing and stabilizing. According to Fallico *et al.* (2004), HMF concentration in honey is also related to honey composition (pH, acidity) particularly at low heating temperatures. Moreover, Alqarni, *et al.* (2012) indicated that 4 Saudi honeys had very high HMF content ranged from 101.80 mg/kg to 258.72 mg/kg, respectively.

Nitrogen content

Results in Table (1) show the value of nitrogen content as percentages. The nitrogen content percentage for cotton honey was 0.095% and 0.16% for salam honey. The nitrogen content which is indication of the presence of protein was found highest in salam honey harvested using traditional method. This finding is contrary with Babarinde *et al.* (2011) as they stated that nitrogen content in modern harvested honey was found higher than that in traditional harvested honey. Meanwhile, our result implies that more nitrogen content is retained in traditional harvesting method. Total protein content in honey can vary widely between 0.02% and 1.0% (Kaakeh and Gade-El Hak, 2005). High value of protein content more than 2 mg/g are due to high content of floral origin (Azeredo *et al.*, 2003).

Total amino acids and Proline

Data presented in Table (1) illustrated both total amino acids and proline existing in cotton and salam honeys. Taha and Eissa (2011) found that proline is the most important from a quantitative point of view of amino acids. Salam honey was superior of total amino acids presented (3.57 g/100g). Meanwhile, cotton honey presented (1.5 g/100g). Quantitative of proline amino acid existing in salam honey was more than twice

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in cotton honey presented 1024 mg/kg and 457 mg/kg, respectively. It has long been recognized from the literature Gilbert *et al.* (1981) and Goodall *et al.* (1995) that amino acids profiles could be used as chemical markers for botanical and geographical origin of honey.

Total minerals (Ash) content

Ash content and some minerals elements in both cotton and salam honeys were analyzed as it presents the minerals content of the honey. The values of the ash content of the honey samples ranged between 0.36-0.80 % (Table, 1) in salam and cotton honeys, respectively. The ash content values ranged from 0.095% to 0.518% (Adebiyi *et al.*, 2004). Moreover, Saxena *et al.* (2010) reported a range of 0.03%-0.43% ash content in some Indian honeys. Meanwhile, Taha and Eissa (2011) reported the range of ash content from 0.03% to 0.26% for Egyptian and Libyan honeys of different botanical origin. According to White and Landis (1980), dark honey is higher than lighter honey in ash content (minerals) and contains significant quantities of minerals.

In addition, the results in Table (2) ten different types of minerals Calcium Ca, Sodium Na, Potassium K, Magnesium Mg, Zinc Zn, Manganese Mn, Ferris Fe, Copper Cu, Cobalt Co and Nickel Ni were detected. For cotton honey, K, Mg, Ca and Na content were superior of all tested minerals presents 2018, 327, 287 and 153 ppm, respectively. For salam honey, Ca, Na and K content were superior of all tested minerals presents 625, 625 and 438 ppm, respectively. In addition, each of Fe, Cu, Co and Ni were not detected in salam honey. The same trend was observed for cotton honey for Co and

Ni. In general, it can be considered that the presence of these minerals is indication of contamination during processing, shipping or storage due to the use of steel galvanized containers (Corbella and Cozzolino, 2006). It's obvious that minerals in cotton honey exceed by 1.6 times minerals in salam honey. Furthermore, metal concentrations in the studied honeys were in safe levels for human consumption (Baroni *et al.*, 2009).

Enzymes in honey samples

Data in Table (3) showed the invertase, diastase and Glucose oxidase activity values for cotton and salam honey samples. The invertase activity in salam and cotton honeys was 4.60 and 74.86 μ /kg, respectively. The higher value of invertase in cotton honey, the same trend was observed in honeydew honeys which gets by means of salivary glands and the gut of plant-sucking insects (Crane, 1990). The reduction in invertase activity in salam honey giving 4.6 μ /kg may be due to heating processes during honey bottling or transport as invertase is more heat-sensitive than diastase (Beckmann *et al.*, 2011). These results are in agreement with Vorlova and Pridal (2002) they found that invertase values in acacia honey was in range 9.0 to 16.3. In addition, diastase number (DN) in cotton honey was in an acceptable range not less than 8 on Goth standard presented 16.9 μ /g. On the other hand, in salam honey diastase number DN was below the standard giving 6.50 μ /g. The relation of both enzymes expressed by the invertase/diastase ratio is cleared from Table (3). The invertase/diastase ratio for filtered cotton honey was 4.4. On contrary, the invertase/diastase ratio for salam honey was a much smaller presented 0.707.

Table (2). Minerals composition of cotton and salam honeys (ppm).

Minerals	K	Ca	Na	Mg	Zn	Mn	Fe	Cu	Co	Ni
Cotton	2018.0	287.0	153.0	327.0	5.7	3.3	22.4	1.49	0.0	0.0
Salam	438.0	625.0	625.0	13.0	4.0	2.0	0.0	0.0	0.0	0.0

Table (3). Values of some enzymes characteristics of cotton and salam honeys

Enzymes	Invertase μ /kg	Diastase μ /g	Glucose oxidase μ /g
Cotton	74.86	16.9	0.17
Salam	4.60	6.50	0.07

The activity of diastase (α -, β -, γ -amylase) is the important quality parameter of honey and the diastase number must not be less than or equal to 8. Diastase is used as a marker to evaluate the freshness or the heat damage of honey. When honey is adulterated by addition of inverted sucrose or hydrolysed starch namely high fructose corn syrup (HFCS), then such dilution of honey leads to the reduction of diastase number. Such adulteration can be masked by addition of foreign amylases. Enzymes are the most important and also the most interesting honey components. They are accountable for the conversion of nectar and honeydew to honey, and serve as a sensitive indicator of the honey treatment. In some countries, the specification of enzymes is a binding legal indicator (Bogdanov *et al.*, 1987; Codex Alimentarius, 1993). The results suggest that the proteolytic enzymes of honey can significantly change honey protein profile and thereby strongly influence quality and nutritional value of honey (Rossano *et al.*, 2012).

Sugar composition

The range and mean levels of Glucose, Fructose, Sucrose and Maltose in both salam and cotton honeys were analyzed (Table, 4).

The sucrose content of honey samples giving 3% for cotton honey harvested using modern method. On the other hand, the sucrose content of salam honey gave 7.3%. The presence of sucrose below 5% as specified by Codex Alimentarius (1998) indicates that the bees were not artificially fed with sugar. Although the analysis of

sugars in honey has to a large extent focused on honey adulteration, oligosaccharide profiles are also a potential tool to indicate botanical and geographical origin. Besides the two main constituents of honey, which are glucose and fructose, there are about 25 other oligosaccharides (disaccharides, tri saccharides and tetrasaccharides), which occur as relatively minor components. In Table (4) the mean levels percentage of glucose, fructose, maltose and sucrose in both salam and cotton honey samples were analyzed. Maltose was selected as oligosaccharide parameter to be used in the classification of Saudi and Egyptian honeys. Maltose was not found in salam honey samples. This finding is in agreement with Senyuva *et al.* (2009) they found that maltose was not found in either citrus or sunflower Turkish honey samples. Meanwhile, cotton honey was found to contain maltose at percentage 1.92%, but it is difficult to draw conclusions from single samples. Reducing sugars which include mainly glucose and fructose are the major constituent of honey (Kucuk *et al.*, 2007). A lime honey from Romanian had 42.49% of combined glucose and fructose in all the honey weight (Finola *et al.*, 2007). Crane (1990) reported that glucose and fructose which are the two major and primary sugars in honey are the main factor in determining the tendency of honey to crystallize.

Generally, the higher the glucose, the faster honey crystallizes, and the higher the fructose, the slower it crystallizes. This finding supported by Bogdanov (1993) stated that honey with a glucose content of 30% or more tends to granulate readily.

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Samples with glucose to water ratios of 1.7 or less were considered non- granulating, while samples with ratios of 2.1 or more predicted rapid granulation (White, 1975). From the result in table (4), the salam Saudi honey samples had higher values of fructose 37.7%, thus indicating they are less susceptible to early crystallization and this honey is of good quality (Kaakeh and GadelHak, 2005). On the other hand, glucose sugar was higher than fructose in cotton Egyptian honey giving 42.66% and 37.43%, respectively. Other factors that may cause crystallization include higher molecular weight sugars (oligosaccharides), acidity and available water (Crane, 1990).

Water-soluble vitamins (WSV)

According to Table (4) average concentration of water-soluble vitamins (mg/100g) of salam and cotton honeys of different botanical origin were detected. Each of vitamin B1 (Thiamine), B3 (Nicotinic acid), B5 (Pantothenic acid), B6 (Pyridoxine), B9 (Folic acid), B12 (Cobalamin), B13 (Orotic acid) was detected.

Results in Table (5) report the amount of the water soluble vitamin (WSV) in all honey samples analyzed. Data in table (5) showed some vitamins characteristics for cotton and salam honeys. It's cleared that B1 and B3 vitamins did not detected in cotton honey.

Also, B12 vitamin did not detected in salam honey. Meanwhile, Vitamins B3, B5 and B9 was in high values in salam honey presented (0.6, 0.2 and 0.1 mg/100g), respectively. Cotton honey was only superior of vitamin B6 giving 0.031 mg/100g. Further, data confirmed that cotton honey is not a vitamin rich food. Interestingly, the concentration of vitamin B3 (Niacin) was observed to be as high as 0.600 mg/100g and it seemed to be strongly dependent on the botanical origin of the honey samples (Ciulu *et al.*, 2011).

It can be presume an influence of the origin of the samples on the concentration of these analytics as well, but the low number of samples analyzed keeps us from drawing such a conclusion at this time. In the case of honey, has been shown that commercial filtration reduces its vitamin content due to the almost complete removal of pollen. Another factor that causes the loss of vitamins in honey is the oxidation of ascorbic acid by hydrogen peroxide produced by glucose oxidase (Crane, 1979). In conclusion, although the concentration of WSV in honey may be too low to generate interesting the field of nutrition, its potential correlation to the botanical origin of the samples may prove useful to determine the origin of honeys.

Table (4). Mean values of some sugars characteristics of Salam honey analysis

Sugar	Glucose %	Fructose %	Sucrose %	Maltose %
Cotton	42.66	37.43	3.0	1.92
Salam	34.3	37.7	7.3	N/A

N/A= Non detected

Table (5). Values of some vitamins characteristics (mg/100g) of cotton and salam honeys.

Vitamins	B1	B3	B5	B6	B9	B12	B13
Cotton	N/A	N/A	0.055	0.031	0.002	0.001	0.0015
Salam	0.02	0.600	0.20	0.017	0.10	N/A	0.001

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REFERENCES

- A. O. A. C. (1995). Official methods of analysis. (16th ed). Washington, DC: USA: Ass. Off. Ana. Chem..
- Abu-Tarboush, H.M., H.A. Al-Kahtani and M.S.A. El-Sarrag (1992). Floral-type identification and quality evaluation of some honey types. *Food Chem.*, 46, 13-17.
- Adebiyi, F.M., I. Akpan, E.I. Obiajunwa and H.B. Olaniyi (2004). Chemical/Physical Characterization of Nigerian Honey. *Pakistan Journal of Nutrition*, 3 (5): 278-281.
- Al-Doghairi, M.A., S. Al-Rehiyani, G.H. Ibrahim and K.A. Osman (2007). Physicochemical and antimicrobial properties of natural honeys produced in Al-Qassim region, Saudi Arabia. *Met. Environ. Arid Land Agric. Sci.*, 18 (2): 3-18.
- Alqarni, A.S. (2011). Beekeeping in Saudi Arabia: Current and Future (in Arabic), first ed., Saudi Society for Agricultural Sciences, King Saud Univ., Riyadh, 40 (21).
- Alqarni, A.S., A.A. Owayss and A.A. Mahmoud (2012). Physicochemical characteristics, total phenols and pigments of national and international honeys in Saudi Arabia. *Arabian Journal of Chemistry*, <http://dx.doi.org/10.1016/j.arabjc.2012.11.013>.
- Azeredo, L.C., S.R. De Souza, M.A.A. Azeredo and V.M.L. Dutra (2003). Protein contents and physicochemical properties in honey samples of *Apis mellifera* of different floral origins. *Food Chem.*, 80: 249-254.
- Babarinde, G.O., S.A. Babarinde, D.O. Adegbola and S.I. Ajayeoba (2011). Effects of harvesting methods on physicochemical and microbial qualities of honey. *J. Food Sci. Technol.*, 48 (5): 628-634.
- Baroni, M.V., M.L. Nores, M.P. Díaz, G.A. Chiabrando, J.P. Fassano, C. Costa and D.A. Wunderlin (2006). Determination of volatile organic compound patterns characteristic of five unifloral honey by solid-phase microextraction-gas chromatography-mass spectrometry coupled to chemometrics. *J. Agric. Food Chem.*, 54: 7235-7241.
- Baroni, M.V., C. Arrua, M.L. Nores, P. Fayé, M.P. Diaz, G.A. Chiabrando and D.A. Wunderlin, (2009). Composition of honey from Cordoba (Argentina): Assessment of North/South provenance by chemometrics. *Food Chemistry*, 114: 727-733.
- Beckmann, K., G. Beckh, C. Luellmann and K. Speer (2011). Characterization of filtered honey by electrophoresis of enzyme fractions. *Apidologie*, 42:59-66. doi: 10.1051/apido/2010036.
- Bogdanov, S. (1993). Liquefaction of honey. *Apiacta XXVIII*, 4-10.
- Bogdanov, S. (1999). Honey quality and international regulatory standards: Review by the International Honey Commission. *Bee World*, 80: 61-69.
- Bogdanov, S., K. Riender and M. Ruegg (1987). Neue Qualitätskriterien bei Honiguntersuchungen. *Apidologie*, 18: 267-278.
- Bogdanov, S., P. Martin and C. Lullman (1997). Harmonised method of the European Honey Commission. *Apidologie* (extra issue), pp: 59.
- Bogdanov, S., P. Martin and C. Lullmann (2002). Harmonised methods of the international honey commission. FAM, Liebefeld: Swiss Bee Research Centre.
- Ciulu, M., S. Solinas, I. Floris, A. Panzanelli, M.I. Pilo, P.C. Piu and Sanna N. Spano (2011). RP-HPLC determination of water-soluble vitamins in honey. *Talanta*, 83 (3): 924-929.
- Codex Alimentarius Commission, CAC (1998). Codex Alimentarius Draft revised for honey. CAD CX P 5/102, CI, 1998/12-S, FAO, Rome, Italy.
- Codex Alimentarius Standard for honey (1993). Standard for Honey, Ref. no. CL 1993/14, SH, Codex Alimentarius Commission, FAO/WHO, Rome.

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- Corbella, E. and D. Cozzolino (2006). Classification of the floral origin of Uruguayan honeys by chemical and physical characteristics combined with chemometrics. *LWT- Food Science and Technology*, 39: 534-539.
- Costa, L.S.M., M.L.S. Albuquerque, L.C. Trugo, L.M.C. Quinteiro, O.M. Barth, M. Ribeiro and C.A.B. De Maria (1999). Determination of non-volatile compounds of different botanical origin Brazilian honeys. *Food Chem.*, 65 (3): 347-352.
- Crane, E. (1979). A comprehensive survey. *Heinemann Intern. Bee Res. Ass. (IBRA)*. London, 3: 76.
- Crane, E. (1990). *Bees and Beekeeping*. Scientific, Practice and World Resources. First ed., Heinemann Newnes, Halley Court, Jordan Hill, Oxford OX2 8EJ, London, UK.
- Fallico, B., M. Zappala, E. Arena and A. Verzera (2004). Effects of conditioning on HMF content in unifloral honeys. *Food Chem.*, 85(2):305-313. doi: 10.1016/j.foodchem.2003.07.010.
- Finola, M.S., M.C. Lasagno and J.M. Marioli (2007). Microbiological and chemical characterization of honeys from central Argentina. *Food Chem.*, 100 (4):1649-1653.
- Gilbert, J., M.J. Shepherd, M.A. Wallwork and R.G. Harris (1981). Determination of the geographical origin of honeys by multivariate analysis of gas chromatographic data on their free amino acid content. *J. Apicultural Res.*, 20: 125-135.
- Goodall, I., M.J. Deniss, I. Parker and M. Sharman (1995). Contribution of high performance liquid chromatographic analysis of carbohydrates to authenticity testing of honey. *Journal of Chromatography A*, 706: 353-359.
- Harmonized methods of the international honey commission (2009). Determination of sugars by HPLC. pp:46.
- Kaakeh, W. and G.G. Gadelhak (2005). Sensory evaluation and chemical analysis of *Apis mellifera* honey from the Arab Gulf Region. *J. Food Drug Anal.*, 13 (4): 331-337.
- Kamal, A., S. Raza, N. Rashid, T. Hameed and M. Gilani (2002). Comparative study of honey Collected from different flora of Pakistan. *Online Journal of Biological Sciences*, 2: 626-627.
- Krell, R. (1996). Value-added products from beekeeping. *FAO Agricultural Services Bulletin No. 144*, Rome, ISBN: 92-5-103819-8.
- Kucuk, M.K., S. Kolayl, S. Karaoglu, E. Ulusoy, C. Baltac and F. Candan (2007). Biological activities and chemical composition of three honeys of different types from Anatolia. *Food Chem.*, 100: 526-534.
- Moniruzzaman, M., M.dl. Khalil, S.A. Sulaiman and S.H. Gan (2013). Physicochemical and antioxidant properties of Malaysian honeys produced by *Apis cerana*, *Apis dorsata* and *Apis mellifera*. *BMC Complement Altern Med.*, 13:43. February 23. doi: 10.1186/1472-6882-13-43.
- Muli, E., A. Munguti and S.K. Raina (2007). Quality of Honey Harvested and Processed Using Traditional Methods in Rural Areas of Kenya. *Acta Vet. Brno*, 76: 315-320.
- Nelly, S., K. Heaton, and J. Hoogewerff (2005). Tracing the geographical origin of food: The application of multi-element and multi-isotope analysis. *Trends in Food Science and Technology*, 16: 555-567.
- Rossano, R., M. Larocca, T. Polito, A.M. Perna, M.C. Padula, G. Martelli and P. Riccio (2012). What Are the Proteolytic Enzymes of Honey and What They Do Tell Us? A Fingerprint Analysis by 2-D Zymography of Unifloral Honeys. *PLoS One*, 7(11):e49164. doi: 10.1371/journal.pone.0049164.
- Rodgers, P.E.W. (1979). Honey quality-control. In: Crane, E. (Ed.), *Honey: A Comprehensive Survey*. Heinemann, London, pp:314-325.
- Saxena, S., S. Gautam and A. Sharma (2010). Physical, biochemical and antioxidant properties of some Indian honeys. *Food Chem.*, 118(2):391-397. doi: 10.1016/j.foodchem.2009.05.001.
- Senyuva, H.Z., J. Gilbert, S. Silici, A. Charlton, C. Dal, N. Gurel and D. Cimen (2009). Profiling Turkish honeys to determine authenticity using physical and chemical characteristics. *J. Agric. Food Chem.*, 57: 3911-3919. doi:10.1021/jf900039s.

- Serrano, S., R. Espejo, M. Villarejo and M.L. Jodral (2007). Diastase and invertase activities in Andalusian honeys. *Int. J. Food Sci. Technol.*, 42:76-79.
- Schade, JE, GL Marsh and JE Eckert (1958). Diastase activity and hydroxymethylefurfural in honey and their usefulness in detecting heat alteration. *J. Food Res.*, 23:446-464.
- Taha, AA, Asmaa Eissa, (2011). Chemical and physical properties of some Egyptian and Libyan honeys. *J. Plant Prot. and Path.*, Mansoura Univ., 2(8): 731-740.
- Terrab, A., A.F. Recamales, D. Hernanz and F.J. Heredia (2004). Characterisation of Spanish thyme honeys by their physicochemical characteristics and mineral contents. *Food Chemistry*, 88: 537-542.
- Tosi, E., M. Ciappini, E. Re and H. Lucero (2002). Honey thermal treatment effects on hydroxymethylefurfural content. *Food Chem.*, 77: 71-74.
- Vorlova, L. and A. Pridal (2002). Invertase and diastase activity in honeys of Czech province. *Acat Univ. Agric. Et Silviculturae Medeliana Brunensis Sbornik. Rodnik L 8, Rodnik L Cisló 5.*
- White, J.W. Jr, and W.D. Landis (1980). *Honey Composition and Properties. Beekeeping in the United States, Agriculture Handbook Number 335, Revised October, pp:82-91.*
- White, JW and MH Subers (1963). Studies on honey inhibine. A chemical assay. *J. Apic. Res.*, 2:93-100.
- White, JW, M.L. Riethof, M.H. Sobers and I. Kushnir (1962). Composition of American honeys. U.S., Dept. Agric., Tech. Bull., pp: 1-124.
- Winkler, O. (1955). Beitrag zum Nachweis und zur Bestimmung von Oxymethylufural in Honig und Kunsthonig z. *Lebensmittelunters. u. Porsch*, 102:161-167.
- Woodcock, T., G. Downey, JD Kelly and C. O'Donnell (2007). Geographical classification of honey samples by near-infrared spectroscopy: A feasibility study. *J. of Agric. and Food Chem.*, 55: 9128-9134.

تقييم جودة بعض الأعسال المصرية و السعودية

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المخلص العربي

أجريت هذه الدراسة بهدف تقييم بعض الخصائص الفيزيائية والكيميائية لعسل القطن المصرى الأحادى المصدر ومقارنته بعسل الأكاسيا (السلم) السعودى. أنتج عسل القطن من نباتات القطن المصرى بواسطة نحل هجين كرنيولى بينما أنتج عسل السلم بواسطة نحل العسل اليمنى. تم جمع ثلاث عينات عسل قطن فى شهر سبتمبر ٢٠١٤ من محافظة الشرقية ، بالإضافة إلى ذلك تم جمع ثلاث عينات عسل السلم خلال شهر مايو ٢٠١٥ من منطقة صابيا، المنطقة الجنوبية ، المملكة العربية السعودية.

تم تقدير بعض الصفات الطبيعية والكيميائية لكل من عسل القطن المصرى وعسل السلم السعودى بمعامل قسم سلامة وجودة الاغذية بكلية الزراعة جامعة القاهرة وخلصت النتائج الى:

- ان عسل السلم السعودى كان الأعلى لزوجة مقارنة بعسل القطن المصرى معطيا (١٨٠٠٠-١٦٢٥٠ cps) على التوالى.
- كان متوسط نتائج المحتوى المائى (١٧.٢-٢٢.٢)٪، pH (٣.٧٩-٣.٨١)، الحموضة الكلية (٣٨.٥-٤٢.٠ ملليمكافى/كجم)، HMF (١١.٥-٢٤٦ ملليجرام/كجم)، الأحماض الأمينية الكلية (١.٥-٣.٥٧ جم/١٠٠جم)، محتوى المعادن الكلية (٠.٣٦-٠.٨)٪ لكل من عسل القطن و السلم على التوالى.
- كان متوسط محتوى السكريات لكل من عسل القطن وعسل السلم هي (٤٢.٦٦-٣٤.٣)٪، (٣٧.٧-٣٧.٤٣)٪، (٣.٠-٧.٣)٪ لسكر الجلوكوز، الفركتوز و السكروز على التوالى.
- كانت معادن البوتاسيوم، الكالسيوم، الصوديوم و الماغنيسيوم هي الأعلى على كل المعادن التى تم تقديرها لكل من عسل القطن وعسل السلم على التوالى.
- لم يتم تقدير فيتامين B1، B3 فى عسل القطن. كذلك لم يتم تقدير فيتامين B12 فى عسل السلم.
- تفوق عسل القطن فقط فى قيمة فيتامين B6 معطيا (٠.٠٣ ملليجرام/١٠٠جم). بينما، كانت قيم فيتامين B3، B5 و B9 هي الأعلى فى عسل السلم معطيا (٠.٦، ٠.٢ و ٠.١ ملليجرام/١٠٠جم)، على التوالى.
- اثبت البحث انه يتم دائما تصنيف الأعسال طبقا إلى أصلها الجغرافى ويفضل إجراء المزيد من الدراسات على المصادر النباتية الأخرى لعمل نموذج متكامل لتصنيف الأعسال فى هذه المناطق.