COMPARATIVE STUDIES ON SOME EGYPTIAN HONEYS

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ABSTRACT

The present work was carried out to evaluate the physical, chemical and nutritional properties of some prevalent Egyptian honeys such as clover, cotton, sunflower and citrus honeys. A comparison of the antimicrobial activities of these honeys against some selected microbial culture was also examined. The obtained results indicated that clover honey had the highest nutritional quality, followed by cotton and citrus honeys. Clover honey contain low moisture and high percentage of, total soluble solids (T.S.S), total carbohydrates and protein contents. The lowest pH was measured in citrus honey, followed by sunflower honey. The citrus honey had more free acid, lactone and total acidity than that of all analyzed honeys. Fructose and glucose are the main sugars found in all tested honeys. Clover honey contained the highest amount of fructose followed by cotton honey, while citrus honey had the lowest quantities of glucose. The data revealed that cotton and sunflower honeys seem to be more prone to granulate which contain slightly low amount of Fructose/glucose. The lowest percentage of di-saccharides was detected in cotton and clover honeys. Cotton honey contained the highest percentage of potassium, sodium, manganese, copper and zinc, while citrus honey had high levels of calcium and phosphorus. The nutritive value of Egyptian honey was high because it contain noticeable amount of all indispensable amino acids. The highest amount of indispensable amino acids were detected in clover honey, while citrus and cotton honey had moderate amount of these amino acids. The present results showed that clover honey gave the best qualities among all investigated honeys. Citrus honey was showed better results than both of cotton and sunflower honeys and accepted more by the panelists. All honey types possess stronger antimicrobial activity, especially for fungi and yeast than that of phenol 1%. The antibacterial activities of clover and citrus honeys possess stronger inhibition effects than that of the other tested honeys. In general, *Bacillus subtilis* was the major sensitive microorganisms to all honey types, followed by *Pseudomonas spp.*

INTRODUCTION

Honey is popularly used in Egypt since ancient times. Its utilization in curing many diseases is well established (**Russo *et al.*, 2002**). There is an increasing interest in the use of honey for the treatment of bacterial infections (**Molan *et al.* 1988**). Honeybee products such as honey and propolis were possesses several biological activities such as antinflammtory, immunostimulatiory, antiviva and antibacterial (***Russo et al.*, 2002**). Consumption of honey show considerable increases in recent years. The population reduced the refined sugar consumption and people seem to be more aware of honey. Besides carbohydrates, honey also has other components such as mineral salts, amino acid and proteins (**Beltz and Groush, 1987**).

In Egypt, there are regulations for honey, but not for the different types of unifloral honeys (citrus, cotton, sunflower, clover, soybean, etc.), which are the types in demand. Clover honey is one of the main unifloral honeys consumed in Egypt, followed by cotton and citrus (orange) honeys. **Shawer *et al.* (1987)**.Recently, sunflower honey was produced in Egypt. There was much evidence indicate that the pollination by insects, especially honey bees was of great importance to the production of sunflower seed (**Krause and Wilson, 1981 and Freund and Furgala, 1982**).

The information on the composition of honey, especially its variability may be considered as a useful method in differentiating between genuine and adulterated honey (**White and Rudyj, 1978**). Honey is essentially a concentrated aqueous solution of invert sugar, but it also contains a very complex mixture of other carbohydrates, amino and organic acids, minerals, several enzymes, pigments, aroma substances, pollen grains, lactones and waxes (**White, 1979 and Lee *et al.* 1991**).

Each kind of honey has a characteristic chemical composition, which could be used for its identification (**Shawer *et al.* 1987**). The honey is considered as one of the most complex mixtures of produced carbohydrates in nature (**White, 1979**). The same author also stated that the major carbohydrates in honey are glucose and fructose, which constitute 65-75% of the total soluble solid in honey and 85-95% of honey carbohydrates.

The physical and chemical properties are important factors in quality control for honey and in differentiating between various kinds of honey. The present work was carried out to

evaluate the physical, chemical and nutritional properties of some prevalent Egyptian honeys. The present study also designed in order to compare the antimicrobial activities of the Egyptian honeys against some selected microbial culture.

MATERIALS AND METHODS

Materials :

The honey types were chosen as representative of floral of honey in Egypt. Four types of honey produced in Kafr El-Sheikh and El-Behaira Governornate-Egypt named clover, cotton, sunflower and citrus honeys. Honey samples were collected from private Apiary during seasons 2003. One kilogram of each type of honey was placed in plastic containers and stored at room temperature until used.

Methods :

Chemical composition of different types of honey:

Moisture content of all honey samples were determined using the values of refractive index at 20°C **A.O.A.C. (1990)**. Protein, ash, reducing sugars, sucrose, higher sugars and total acidity were also measured according to the method of **A.O.A.C. (1990)**, Minerals such as calcium, potassium, magnesium, iron, copper, sodium, zenic, cadmium and manganese were detected in the ashed materials using the atomic absorption spectrophotometer Perken Elmer Model 2180 as outlined by **Pearson (1976)**. Total phosphorus was analysed according to the method described by the method of **A.O.A.C. (1990)**.

The amino acids composition of different types of honey were determined after acid hydrolysis (HCl 6N) according to the method described by **Pellet and Young (1980)**, using Backman Amino Acid analyzer (Model 119 CL).

Total soluble solids (T.S.S) were measured by means of an Abbe refractometer with the correction of the temperature variation. Colour was examined by vision. Acidity, free acidity and lactone content were determined as described by **White *et al.* (1962)**. The pH values were examined using glass rod pH-meter (Unicam-pH meter Pw 8410 digital pH meter).

Organoleptic evaluation of honey types:

Organoleptic properties of the investigated honeys were carried out according to the method reported by **Molander (1960)** by twenty panalests. Organoleptic scores were recorded according to the following judging scale :

Very good (8-9), Good (6-7), Fair (4-5), Poor (2-3) and very poor (0-7).

Antimicrobial activity of some honeys :

The disc-diffusion method was used to study the antimicobial activity of this Egyptian honeys against some selected microorganisms, named *Bacillus subtilis*, *Pseudomonas spp.*, *Aspergallis niger* and *Candida guilderimondii* FTI 20037. These bacteria and fungi were kindly provided by the Microbiology Department, Faculty of Agriculture-Tanta University. Yeast strain was obtained from Department of Chemical Engineering, University of Vigo, Las Lagoas, Ourense, Spain. These microorganisms were checked for purity and identify. The cultures were stored in a refrigerator at 5°C and reactivated monthly on the suitable medium for each microorganisms as described by **Conner and Beuchat (1984)**.

The honey samples were diluted with 70% ethanol to give solution of 1, 25, 50 and 100% (v/v). Appropriate amounts of media were poured into sterile plates (100 mm diameter), left to solidify, at room temperature. The organisms were cultivated on the surface of the previous media. A sterile disc, 6 mm diameter of Whitman No. 1 filter paper was dipped in the appropriate honey solution blotted, then placed on the surface of inoculated plates.

The inhibitory effect of the 70% ethanol and 1% of phenol solution (w/v) were also tested by placing disc saturated with only 70% ethanol or placing discs saturated with phenol solution on each inoculated plate. The plates of bacteria were incubated at 30°C for 48 hours, whereas the plates of fungi and yeast were incubated at 25°C for 48 hours. The results were recorded by measuring the zone of inhibition (mm) around the discs. All tests conducted in triplicates with four discs per plate. The bacteria were cultured on Nutrient agar, while fungi and yeast inoculated on Sabourand-dextrose agar as recommended by **Difico (1974)**. Both types of organisms were inoculated on the surface of the agar plates.

Media :

Nutrient agar medium :

Nutrient agar medium was used to detect the total count of bacteria, activation, and antibacterial study.

The medium consists of : (Meat extract, 3.0 gm; Peptone, 5.0 gm; Sodium chloride, 5.0 gm; Agar, 15.0 gm; Distilled water, 1.0 liter; pH, 6.8) as reported by **Difco (1974)**.

Sabouround's medium :

Sabouround's medium was used to study the effect of garlic cloves oil on the growth of fungi and yeast, it consists of : (Glucose, 40.0 gm; Peptone, 10.0 gm; Agar, 20.0 m; Distilled water, 1.0 liter, pH, 5.6±0.2) as outlined in **Difco (1974)**.

RESULTS AND DISCUSSION

Chemical composition of honeys :

Recently, many types of honey were produced in Egypt such as clover, citrus, sunflower cotton honeys. New information about the composition of different varieties of Egyptian honeys are necessary needed. The results in Table (1) represent some physical and chemical properties of honeys. Moisture is one of the most important characteristics of honey influence keeping quality, granulation and body (**White, 1975**). The results showed that, clover honey contained the lowest percentage of moisture (13.60%) comparable to the other produced honeys. Citrus honey contained the highest percentage (17.30%) of moisture. It is well known that honey with high water content is readily susceptible to fermentation by osmophilic yeast. Yeast fermentation may be negligible when water contents is less than 17.1%, while between 17.1 and 20% fermentation depends on the count of osmophilic yeast buds (**Beltz and Groush, 1987**). None of the investigated honeys showed such high moisture content (Table 1), except citrus honey was found to hold high moisture content (17.3%).

As expected from the low moisture content, the total soluble solids (T.S.S.) of all tested honey were present in high percentage. Clover honey contained the highest percentage of T.S.S. (86.4%) followed by cotton honey (85.0%). Citrus honey contain the lowest T.S.S., which reached 82.7%. These results may indicated an overall better quality of produced honeys.

Carbohydrates play the main role in the characterization of all types of honey. Clover honey contained the highest levels of total carbohydrates (82.89%), followed by cotton honey (82.81%), while citrus honey contained the lowest levels of total carbohydrates (80.90%).

The presence of proteins causes honey to have a lower surface tension than it would have otherwise, which produces a marked tendency to foam and form scum and encourages formation of fine air bubbles (**White, 1975**). The average amount of protein detected in the analyzed honeys were very low which ranged between 0.22 to 0.58%. Clover honey had,

highest percentage of protein (0.58%). On the other hand, protein contents of citrus and cotton honeys were almost the same. These values agree with the results obtained by **Beltz and Groush (1987)** and are slightly higher than that obtained by **Gomez *et al.* (1993)**.

Table (1): Some physical and chemical characterization of Egyptian honeys (based on wet weight).

Constituents \ Honeys	Clover honey	Cotton honey	Sunflower honey	Citrus honey
Moisture %	13.60	15.00	16.10	17.30
T.S.S. %*	86.40	85.00	83.90	82.70
Total carbohydrates	82.89	82.81	81.73	80.90
Protein %	0.58	0.30	0.22	0.28
Ash %	0.16	0.33	0.29	0.09
Undetermined %	2.77	1.56	1.65	1.43
pH	4.20	4.31	3.84	3.78
Free acidity (meq/kg)	18.10	24.86	18.87	22.75
Lactone (meq/kg)	5.20	5.67	8.20	10.20
Total acidity (meq/kg)	23.30	30.53	27.07	32.95
Colour	Light half of amber	Amber	Dark	Light half of white

* Total soluble solids.

The results in Table (1) indicated that the cotton and sunflower honeys contained the highest amount of ash which reached to 0.334 and 0.293%, respectively. The lowest amount of ash was detected in citrus honey (0.09%). The undetermined components was calculated by subtracting the sum of moisture, total carbohydrates, protein and ash from 100. These values were ranged between 1.43 to 2.77% in all types of honey. The pH was found in the analyzed honeys corresponded to that of a floral honey (Table 1). Citrus honey had the lowest pH (3.78), followed by sunflower honey (3.84). On the other hand clover and cotton honeys showed the highest pH (4.20 to 4.31). Parameters for acidity was used to determine the degree of deterioration of the honey. The lactone is a newly found component of honey. Lactones may be considered as a reserve acidity, since by chemically adding water (hydrolysis) an acid is formed **(White, 1979)**. The acidity in honey contributes not only to the flavour, but also partially responsible for the excellent stability of honey against microorganisms **(White and Subers, 1963)**. The results in Table (1) indicated that citrus honey contained more free acid, lactone and the total acidity than those of all analyzed honeys. Sunflower honey shows considerably greater content of lactone (8.20 meq/kg), while clover honey had lower free acidity (18.10 meq/kg) and lactone (5.20 meq/kg)

compared with other honey types. The results obtained in Table (1) indicated that each kind of honey has a characteristic chemical composition, which could be used for its identification.

Mono and oligosaccharides in honeys :

The PHLC analysis of honey carbohydrates indicted that the investigated honeys contained many kinds of mono and oligosaccharides, which were found to play a great role in both the taste and also the nutritional values of these honeys (Table 2). Fructose and glucose are the main sugars present in all analyzed honeys. Clover honey contained the highest percentage of fructose (40.10%), followed by cotton honey (39.44%) than that of sunflower (38.72%) and citrus (38.65%) honeys. On the other hand, citrus honey had the lowest percentage of glucose (31.80%), while the highest amount were detected in cotton honey (36.91%). The present results confirms those reported by **Beltz and Groush (1987)** since they reported that fructose and glucose are the predominant sugars in honey.

Table (2): Mono-, di-and higher sugar contents of some Egyptian honeys (% of wet weight).

Honeys / Sugars	Clover honey	Cotton honey	Sunflower honey	Citrus honey
Fructose	40.10	39.44	38.72	38.65
Glucose	33.26	36.91	33.69	31.80
Sucrose	1.44	1.18	2.65	1.93
Maltose	6.60	4.80	5.85	7.10
Higher sugars	1.49	0.48	0.82	1.42
Fructose/glucose	1.21	1.07	1.15	1.22
Glucose/water	2.45	2.46	2.09	1.84

The results revealed that cotton and sunflower honeys contained moderate amount of fructose and glucose, which may be more prone to granulate. The sugar analysis results indicate that fructose and glucose contents are similar to those reported by **Serra (1989)** and **Gomez *et al.* (1993)** for Spanish honeys. Maltose was the main di-saccharides in all types of analyzed honeys, which varied according to the floral origin. Citrus honey contained the highest level of maltose (7.10%), while cotton honey had the lowest level of maltose (4.80%) among all samples. Sucrose was found in relatively smaller percentage in the tested honeys. Cotton honey contained the lowest percentage of sucrose (1.18%), while sunflower honey had the high amount of sucrose (2.65).

The lowest amount of other higher sugar was found in cotton honey, while, the highest amounts of these sugar were detected in clover honey.

Minerals content of honeys :

Mineral content is known to be one of the main factors affecting the colour of honey (**Mattos *et al.* 1998**). Among the minerals, sodium appeared in the greatest proportion, followed by potassium, magnesium, phosphorus and calcium (Table 3). All honey samples under investigation were found to be free from cadmium. Zinc was found in trace amount in all studied honeys. **Shawer *et al.* (1987)** reported that, cotton honey contained the highest content of magnesium, potassium sodium and calcium. The same author also indicated that clover honey contained a great amount of potassium, sodium and iron.

Cotton honey contained the highest percentage of potassium (10.05), sodium (12.00), manganese (3.50), copper (1.59) and zinc (0.50) compared to all other honey types, while sunflower and cotton honeys had the highest levels of magnesium (9.38 and 9.36 mg/100g, respectively). On he other hand, citrus honey contained high levels of calcium (7.43, mg/100gm), phosphorus (14.90) and iron (3.14 mg/100 g honey).

It could be concluded that Egyptian honeys are good source of minerals especially, sodium, potassium, magnesium, phosphorus and calcium. These results are similar to those reported previously by **White (1978) and Mattos *et al.* (1998).**

Gomez *et al.* (1993) found that Spanish commercial Eucalyptus honeys contain high amounts of potassium 385.6 (mg/kg), sodium (77.7 mg/kg), calcium (155.3 mg/kg), magnesium (39.05 mg/kg) and iron (8.73 mg/kg).

Table (3): Minerals content of some Egyptian honeys (mg/100 of honey).

Honeys / Minerals	Clover honey	Cotton honey	Sunflower honey	Citrus honey
Calcium	4.59	5.22	5.17	7.43
Potassium	9.44	10.05	7.01	7.65
Magnesium	7.35	9.36	9.38	6.64
Iron	1.91	2.12	2.28	3.14
Copper	1.05	1.59	0.84	1.36
Sodium	8.70	12.00	10.00	9.40
Zinc	0.30	0.50	0.10	0.20
Cadmium	0.00	0.00	0.00	0.00
Phosphorus	6.20	9.50	8.80	14.90
Manganese	2.20	3.50	3.20	2.70

Amino acid contents of honeys:

Table (1) reported that the amount of protein in honey is very low. Amino acid composition of the four studies honey are given in Table (4). The detected indispensable amino acids in clover and citrus honeys recorded the highest total values 112.15 and 88.18 (mg/100 g of honey, respectively). While the lowest value was observed in sunflower honey 58.28 (mg/100 g sample). Threonine was the predominant among the indispensable amino acids in all investigated honeys.

Generally, the data in Table (4) revealed that all four honeys contained the same indispensable amino acids, but its amount varied greatly according to the type of honey. Clover honey contained high values of leucine, isoleucine, phenylalanine, threonine and tyrosine, but it contain the lowest amount of methionine. Cotton honey had the highest amount of methionine (3.77) and valine (8.54, mg/100 g sample). The highest value of lysine was detected in citrus honey.

Table (4): Amino acids content of some Egyptian honeys (mg/100 of honey).

Honeys / Amino acids	Clover honey	Cotton honey	Sunflower honey	Citrus honey
Indispensable amino acids :				
Leucine	11.50	7.57	6.20	8.10
Isoleucine	10.15	7.05	5.13	8.71
Lysine	9.48	8.91	7.75	10.50
Methionine	1.27	3.77	3.10	1.54
Phenylalanine	11.60	3.08	3.50	7.80
Threonine	49.80	30.20	17.80	38.90
Valine	8.15	8.54	7.10	8.33
Tyrosine	10.20	3.00	7.70	4.30
Total indispensable A.A.	112.15	72.12	58.28	88.18
Dispensable amino acids :				
Histidine	12.80	12.18	6.10	11.60
Arginine	8.65	7.73	7.45	7.30
Alanine	8.54	9.43	7.70	9.60
Cysteine	-	1.22	1.30	-
Aspartic acid	40.00	20.40	22.25	21.80
Glutamic acid	45.20	21.60	23.10	21.30
Glycine	6.00	6.75	5.90	7.15
Proline	89.90	98.75	73.00	68.20
Serine	6.23	10.20	3.00	19.80
Total dispensable A.A.	217.32	188.26	149.80	166.75
Total amino acids	329.47	260.38	208.08	254.93

It could be stated that the nutritional value of Egyptian honey is very high because it contain all of indispensable amino acids, which suggests that honey will markedly contribute to the

supply of indispensable amino acids in the human diet. The results indicated that proline was the major dispensable amino acids present in all investigated honeys proteins. The concentration of proline was ranged between 68.20 to 98.75 (mg/100 g of honey) in citrus and cotton honeys, respectively. These values are similar values to the ones obtained by **Campus *et al.* (1993) and Gomez *et al.* (1993).** Glutamic and aspartic acids, were found in moderate amounts in all investigated honeys. Cysteine is the limiting amino acid in all studied honeys. Clover honey had the highest value of glutamic acid, aspartic acid, histidine and arginine, while cotton honey had the highest percentage of proline. Citrus honey contained the highest levels of alanine, glycine and serine.

Organoleptic qualities of honey :

The intrinsic changes in honey quality were classified into five categories according to the total scores of their organoleptic qualities. These categories were very good, good, accepted, poor and very poor. Investigated honey samples show that all honeys were free from any insect fragments, sand particles, undesirable flavours and any fermentation. As shown in Table (5) the panel test judgment of Egyptian honeys refereed to their colour, taste, odour, viscosity, sourness and general appearance. The results revealed that the floral origin effected the organoleptic properties of honey. The results showed that clover honey had the best qualities compare with all investigated honeys. The mean values of colour, flavour (taste and odour) and viscosity of clover honey were higher than all of the studied honeys. Citrus honey was characterized by the highest value of sourness compared with all other honeys. Citrus honey showed better results than both of cotton and sunflower honeys and accepted more by the panelists, which may be due to the pleasant flavour of citrus flower. The inferior colour, taste, odour and general appearance were recorded for sunflower honey.

Table (5): Sensory evaluation of some Egyptian honeys.

Honeys / Organoleptic properties	Clover honey	Cotton honey	Sunflower honey	Citrus honey
Colour	8	6	5	7
Taste	9	7	6	7
Odour	8	7	6	7
Viscosity	8	6	6	5
Sourness	7	7	8	9
General appearance	8	7	6	7

A comparison of the antimicrobial activities of honeys

The antimicrobial activities of the examined four honeys produced in Egypt were tested toward some selected microorganisms such as *Bacillus subltilis, Pseudomonas spp., Aspergallis niger* and *Candida guilerimondii.* using four concentrations of (1, 25, 50 and 100%). The antimicrobial effects of honeys and ethanol 70% (as a diluents), were compared with phenol 1%. The diameters of the inhibition zones were used as criterion of antimicrobial spectra (total inhibition zones, mm) and the obtained results are given in Table (6). The results cleared that there is no inhibitory affect of honeys at concentration of 1% against all microorganisms.

Table (6): Inhibition zones diameter (mm) of Egyptian honeys toward some microorganisms.

Treatments \ Microorganisms		Diameters of inhibition zones (mm)				Total inhibition zones (mm)
		Bacillus subtilis	*Pseudomonas* spp.	*Aspergallis niger*	*Candida guilerimondii*	
Ethanol	70%	0.00	0.00	0.00	0.00	0.00
Phenol	1%	14.00	11.25	0.00	0.00	25.25
Clover honey :	1%	0.50	0.00	0.00	0.00	0.00
	25%	15.75	12.50	11.50	10.75	50.50
	50%	27.25	20.50	18.50	15.00	81.25
	100%	32.00	28.25	25.00	21.25	106.50
Cotton honey :	1%	0.00	0.00	0.00	0.00	0.00
	25%	12.25	11.75	10.25	10.00	44.25
	50%	22.50	20.00	18.75	15.50	76.75
	100%	28.00	24.75	21.50	18.00	92.25
Sunflower honey	1%	0.00	0.00	0.00	0.00	0.00
	25%	11.75	8.50	8.00	8.25	36.50
	50%	24.50	21.25	18.75	15.50	80.00
	100%	29.75	26.50	22.25	19.75	98.25
Citrus honey	1%	0.00	0.00	0.00	0.00	0.00
	25%	15.00	12.00	11.25	11.00	49.25
	50%	25.75	20.00	17.25	15.50	78.50
	100%	31.50	27.75	24.50	20.75	104.50

The all concentrations of clover honey possess the highest inhibition zones against the four microorganisms, followed by citrus honey. Simultaneously, all honeys had no effect against all microorganisms at concentration less than 25%. Generally, the results in Table (6) revealed that, with increasing the honey concentrations, the inhibitor zones (mm) were gradually increased. Cotton honey had the lowest inhibition effect against

all microorganisms, especially at concentrations 50 and 100%, while sunflower honey possess the lowest inhibition effect at concentration 25%. The differences in inhibition activity could be due to varying levels of other antibacterial compounds coming from the nectar sources (**Dustman, 1979**). **Popeskovic *et al.* (1983)** also found differences in the antibacterial activity of honey from different floral sources.

All honey samples posses stronger antimicrobial activity, especially toward fungi and yeast than that of phenol 1%. The antibacterial activities of clover and citrus honeys had stronger inhibition effects than that of phenol 1%. All honey samples at concentration of 100% had inhibition effect against all microorganisms higher than that of phenol 1%, since the inhibition zone was two time greater than the phenol one.

The antibacterial properties of honey was due to the high osmolarity and was correlated with the amount of hydrogen peroxide produced by the action of glucose oxidase in the honey (**White and Subers, 1963**). In general, the data showed that *Bacillus subtilis* was the most sensitive microorganisms to all honey types at the most applied concentrtions, followed by *Pseudomonas spp.* On the other hand, *Candida guilerimondii* was the most resistant microorganisms to all honey types at the most applied concentration, followed by *Aspergallis niger*. These results are in general agreement with those obtained by **Manuela-Rios *et al.* (2001)** they found that antibacterial activity of some honeys produced in Venezuela was characterized high effect against some selected bacterial strains.

From the above mentioned results, it should be concluded that honey is not a suitable medium for microorganisms for two reasons, it is fairly acid and it is too high in sugar content for growth to occur. This killing of bacteria by high sugar content is called osmotic effect.

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الملخص العربى

دراسات مقارنة بين بعض الأعسال المصرية

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أجرى هذا البحث لدراسة التقييم الفيزيائى والكيماوى والغذائى لبعض أنواع الأعسال المنتشرة فى مصر مثل عسل البرسيم والقطن وعباد الشمس والموالح وتهدف هذه الدراسة ايضا مقارنة الصفات المضادة للميكروبات لهذه الأعسال على بعض السلالات الميكروبية حيث أثبتت النتائج المتحصل عليها أن عسل البرسيم ذو صفات غذائية عالية مقارنة بالأنواع الأخرى يليه عسل القطن ثم الموالح، فقد أحتوى عسل البرسيم على معدلات منخفضة من الرطوبة وعالية من كل من المواد الصلبة الكلية الذائبة والكربوهيدرات والبروتين، بينما تميز عسل القطن باحتوائه على معدلات عالية أيضا من المواد الصلبة الكلية الذائبة والكربوهديدرات والرماد. وتميز عسل الموالح عن الأعسال الأخرى بانخفاض درجات الـ pH لاحتوائه على نسبه عالية من الحموضة الحرة واللاكتون والحموضه الكلية. أثبتت الدراسة أن سكر الفركتوز والجلوكوز من أهم وأكثر السكرات الأحادية إنتشارا فى العسل حيث احتوى عسل البرسيم على كميات عالية من الفركتوز يليه عسل القطن، كما احتوى عسل الموالح على أقل المعدلات من سكر الجلوكوز. أوضحت النتائج أيضا أن عسل القطن وعباد الشمس له قابليه لظاهرة التحبب لانخفاض معدلات الفركتوز إلى الجلوكوز بهما. كما تميز عسل القطن والبرسيم بانخفاض نسبة السكرات الثنائية بهما. وأوضحت النتائج أن الأعسال المصرية تعتبر مصدرا جيدا للأملاح المعدنية خاصة الصوديوم والبوتاسيوم والماغنسيوم والفسفور والكالسيوم حيث أحتوى عسل القطن على أعلى نسبة من البوتاسيوم والصوديوم والمنجنيز والنحاس والزنك، بينما تميز عسل الموالح بارتفاع محتواه من الكالسيوم والفسفور. وبينت النتائج أن الأعسال المصرية ذات قيمة غذائية عالية لاحتوائها على معظم الأحماض الأمينية الأساسية وخاصة عسل البرسيم والموالح وأثبتت النتائج أن عسل البرسيم ذات صفات غذائية وعضوية حسية عالية بالمقارنة ببالقى أنواع العسل، أما عسل الموالح فقد أعطى نتائج جيدة خاصة من ناحية الخواص العضوية الحسية بالمقارنة بعسل القطن وعباد الشمس حيث كان أكثر قبولا بالنسبة للمتذوقين. أما بالنسبة للنشاط المضاد للميكروبات لهذه الأعسال على بعض سلالات البكتريا والفطر والخميرة فقد أثبتت الدراسة أن عسل البرسيم والموالح لهما تأثير مضاد قوى على الميكروبات بصفة عامه على جميع التركيزات المستخدمة كما أثبتت النتائج أن جميع الأعسال المختبرة لها تأثير مضاد للميكروبات خاصة الفطريات والخمائر بالمقارنة بالفينول ١%، كما أن التأثير المضاد للبكتريا بالنسبة لعسل البرسيم والموالح كان قوى جدا عنه فى حالة التأثير المضاد للفينول ١%، وبصفة عامة فإن بكتيريا *Bacillus subtilis* كانت أكثر الميكروبات حساسية للعسل يليها بكتريا *Pseudomonas spp.* .