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Qualitative Criteria of Different Libyan Honey Types

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***Abstract**: 11 different samples of Libyan local and imported honey were investigated for their qualitative criteria. The local or national honey samples were provided by professional beekeepers and mellisopalynology method was used to determine their qualitative criteria. The qualitative analysis of the samples showed that the presence of pollen content was differed among the samples. Almost samples were high in their purity while the pollen content was more than 44%. The honey sample of Thymus capitatus* L. *has a value of 92% of the total presence of the pollens where some imported samples appeared with a value of 0%. In addition, other qualitative characteristics such as color, PH, viscosity and moisture content were also assayed..*

1. Introduction

In Libya, the most workers in beekeeping and their production are existing in the coastal regions of the country (northern part) because of abundance and distribution of plant species in this area. This occurs according to the amounts of rainfalls especially in EL-Gabal EL-Akhdar area, which receive around 700 ml/year, while most of the country (about 90%) has desert climatic conditions [8, 9].

The quality of honey can be determined normally based on its physical, botanical and chemical properties and this can be achieved by analysis of pollen content and physical/ chemical characteristics.

Pollen analysis of honey, or melissopalynology, is a method of quality control in which pollens can play an important role in determining the commercial value of honey in the international market [12].

The differences in physicochemical properties of honey samples, such as ash content, acidity, moisture content and viscosity are due to regional and floral differences [2, 11]. The sensory properties such as color, aroma and taste of honey vary according to the geographical and seasonal conditions as well as the floral source. Thus, the honey type is change according to plant which bees are foraging.

In this study, we evaluated different samples of Libyan honey types, in addition, imported ones to shade some light on their qualitative characteristics and to find out some standards which can be used as criteria in production of the local honey.

2. Materials and methods

2.1 Honey samples collection:

National or local honey samples were collected from many different local beekeepers while the imported ones were purchased from local market. 11 samples were collected for their resource, color and other characteristics. The types of imported and local honey samples, their common and scientific names, date and place of production assemble are shown in table (1).

2.2 Determination of pH:

The pH of honey samples were determined by measuring out 10 mL of the sample into a clean beaker and its pH was determined using a pH meter. (Hanna, Germany)

2.3 Determination of moisture content:

The moisture content of the sample was determined by measuring 5g of the sample and placed into a pre-weighed aluminum drying dish. The sample was dried to constant weight in an oven at 105 Cº for 4 h under vacuum and calculated.

2.4 Determination of ash content:

Five gram of the sample was weighed out into a porcelain crucible previously ignited and weighed. Organic matter was charred by igniting the sample on a hot plate in the fume cupboard. The crucible were then placed in the muffle furnace and maintained at 600 Cº for 6 h. They were then cooled in a desiccator and weighed immediately. The percentage of Ash was calculated.

Table 1. The types of imported and local honey samples, their scientific names, date and place of production.

No.	Plant name	Source	Date
1	*Thymus capitatus* L.	East of Libya	2015
2	*Thymus capitatus* L.	West of Libya	2015
3	*Eucalyptus leucoxylon.*	East of Libya	2014
4	*zizaphus lotus*	East of Libya	2015
5	*Ceratonia siliqua*	El-Gabal Akhdar	2015
6	*Cynara cornigera*	El-Gabal Akhdar	2014
7	-------	France	2016
8	-------	India	2014
9	-------	U. A. E	2014
10	*Nigella sativa*	Egypt	2014
11	-------	Germany	2014

2.5 Honey color:

Color intensity was determined according to Ferreira *et al.,* (2009). 50% (w/v) of the honey sample was diluted with distilled water, homogenized, and centrifuged at 3200 rpm for five minutes. Absorbance was measured at different wave lengths using a spectrophotometer (Hanna Germany), and color was determined using the Pfund scale according to (U.S.D.A).

2.6 Determination of viscosity:

The viscosity of honey was measured by timing how long it takes for a mass to fall through a fixed volume. 50 ml of the honey sample was placed into separate measuring cylinder. Left over night to rest, Placed into a water bath at 37 Cº. A marble was placed on top of the honey and time how long it takes for the object to touch the bottom of the measuring cylinder was determined. The viscosity was calculated.

2.7 Preparation of honey samples for mellisopalynology:

Honey sample was prepared followed the standardized method which described previously by Andrada and Cristina (2005, Bilisik *et al.,* (2008) and Louveaux *et al.,* (1970). Briefly, 10 g of homogenized honey were dissolved in 20 ml of distilled water and centrifuged for 10 min at 1000 g at ca. 25000 rpm. To completely dissolve the remaining sugar crystals, the decanted sediment were washing with 10 ml of distilled water. After another centrifugation, the sediment were suspending in 5 ml of 1:1 glycerin : distilled water and then centrifuged again, decanted, and mounted with glycerin jelly on microscope slides which sealed with paraffin.

2.8 Microscopic analysis:

The analysis of the pollen slides was carrying out with an optical microscope at X400, in order to make sound identification of the pollen types. The amounts and percentage of pollens were counted.

3. Results and discussions:

The results of investigations for all honey sample are shown in table (2). The highest moisture content was found in the sample of *Ceratonia siliqua* (22%) while the lowest moisture content was observed in sample of *Cynara cornigera* (11.21%).

Table 2. Results of viscosity, moisture, PH and ash content of 11 honey samples collected from Libya.

Sample	Vis.(Pa.s)	PH	Moisture	Ash
1	206.91	3.47	16.04%	83.96%
2	775.67	3.71	12.56%	87.44%
3	84.8	3.83	14.06%	85.94%
4	223.91	3.34	14.94%	85.06%
5	55.69	3.92	22 02%	77.98%
6	265.23	3.48	11.21%	88.79%
7	182.563	3.53	14.25%	85.75%
8	78.58	3.81	15.07%	84.93%
9	175.99	3.92	15.73%	84.63%
10	468.16	4.05	11.77%	88.23%
11	150.66	3.61	13.86%	86.14%

Measuring PH value showed that the highest value was 4.05 (*Nigella sativa*), on the other hand the lowest value was the PH of *zizphus lotus* (3.34). Different degrees of viscosity of honey at the same conditions of temperature where obtained. The highest viscosity was for the species *Thymus capitatus* (775.67 Pa S), and the lowest was recoded for *Ceratonia siliqua* (55.69 Pa S).

The color of honey samples ranged from white to extra light amber (Table 3) with the exception of the *Nigella stavia* sample (Imported sample from Egypt), which was not within the color gradation, it was close to the greening (Figure 1).

Figure 1. The grading of color of different honey types which started from white (left) to extra light amber (right).

Table 3. Grading of color of honey samples according to pfund scale of USAD.

Sample	Color
1	light amber
2	extra light amber
3	light amber
4	light amber
5	light amber
6	extra light amber
7	light amber
8	light amber
9	White
10	\
11	extra light amber

The all samples investigated in this study, whether they imported or local honey samples, showed high degree of transparency when they tested at 635 nm wave length. The results of the investigation of T% were higher than 99% for all samples as they appeared in table (4).

Table 4. Measurements of the absorbance transparency at 635nm.

Sample	T%	Abs
1	99.72	0.28
2	99.85	0.15
3	99.68	0.32
4	99.9	0.095
5	99.75	0.25
6	99.505	0.49
7	99.85	0.15
8	99.6	0.4
9	99.84	0.16
10	99.77	0.23
11	99.84	0.16

Mellisopalynology showed that the highest pollen frequency was noted for *Thymus capitatus* (93.02%), *Eucalyptus* (89.28%), *nigella stavia* (80%) and *Cynara cornigera* (77.58%). The sample (No. 2) of *Thymus capitates* had a very large variation in the number of pollens. While the imported samples from Germany and United Arab Emirates (No.9 and 11), respectively, were completely free from pollens (Table 5).

Table 5. Frequent pollen contents (%) in honey samples. Note the absence of pollens in imported samples number 9 and 11 while the high content was observed in sample number 1 *Thymus capitatus.*

Sample	Frequent
1	93.02%
2	----------
3	89.28%
4	37.07%
5	79.54%
6	52.77%
7	80.16%
8	65.57%
9	---------
10	80%
11	---------

It's clear from this study that the honey samples were differed in their characters. this pointed to the plant origin which affect by many abiotic factors such as rainfall [9]. An important parameter of honey is its color, which reflects the floral source [3]. and can be determined by spectrophotometric measurement of the absorbance of a 50% honey solution at 635 nm and classified according to the Pfund scale [10].

Results of the color of the various honey samples obtained from different locations showed that honey samples were from white to extra light amber of color grading. However, the color of honey varies from almost colorless to nearly black according to its botanical origin as El abidi and El shatshat (2017) showed in their study of *Arbutus pavarii* honey type, and condition of storage. Honey color is the first physical property perceived by the consumer [5], and it is an important parameter in determining the quality and market value of honey sample.

The results of the pH in this study showed that the pH values (4.05 -3.34) fell within the prescribed acidic range of 3.54 to 5.5 [5]. This indicates that all the samples were within the acidity range that supports shelve stability of the honey samples and thus prevent spoilage by microorganisms [14].

Honey normally has low moisture content and it depends on the materials collected by the bees during foraging on the flora [14]. It could be that the honeys samples were harvested prior to complete maturation from uncapped frames or that honeys absorbed moisture from environment during storage period; furthermore, moisture content of honey can vary depending on different factors such as the floral and geographical origin, climate conditions and honey bee type [2]. In addition, harvesting methods. This might clear in the results of El abidi and El shatshat (2016) of *zizaphus lotus* honey sample which flowers from April to June when the moisture in the area is very low according to the rainfall season.

The effect of climatic factors, geographical location and also pasture plants season for bees, are factors that affect the diversity of pollen in local honey samples. This was clear because some samples revealed high purity with high amount of pollens like *Thymus capitatus*, *Ceratonia siliqua* which distributed in El-Gabal El-Akhdar area (North eastern of Libya), While samples from other locals were differed in pollens content.

From obvious tests, using mellisopalenology (and of course other parameters) as a method of qualitative parameter for Libyan honey can be accepted because of the clear presence of the pollen content of the samples that increased above 45% which used as international value for purity. In our results, all samples produced locally showed high percentage of pollen content and here, we suggested 60% as a value of purity for the local honey using mellisopalenology. The most imported honey samples showed very weak results and this pointed to that the purity and origin of this samples are not clear enough and therefore, encouraging producing local honey must take in account. In addition, the imported honey from different countries must be under more control from the authorities and should, at least, within the international characteristics of pollen content and physical parameters.

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