Determination of the Heavy Metals in The Libyan Honeys

El- Ansary, O*; Ahmed K. Mourad; Osman A. Zaghloul; O. El-Barbary and Fadel Abubakr Kassam
* Dept. of Applied Entomology, Fac. Of Agric, Alex. Univ., Egypt
Dept. of Pant Port. Fac. Of Agric, Saba Basha Alex. Univ., Egypt

ABSTRACT

Levels of heavy metals, Copper, Iron, Manganese , Zink , Cadmium and Lead were determined in 32 Libyan honeys collected from beekeepers and markets. Atomic absorption spectrometer was used in this study. Copper was ranged between 0.1 to 0.55 mg/kg, Iron between 0.25 to 144.95, Manganese between 0.25 to 2.9, Zink between 4.85 to 11.94, Cadmium was not detected and Lead between 1 to 233 mg/kg. The guide line values according to international recommendations were 5,15,5,0.1 and 1 mg/kg for Copper, Iron, Zink, Cadmium and Lead ,in respect , while the manganese was not mentioned.

MATERIALS AND METHODS

The present work was curried out on 32 extracted honey samples collected along the year of 2007 from Libyan country (16 samples from beekeepers and another 16 from markets).

All honey samples were labeled by different serial numbers and accompanied with its type, date of harvesting and regions as shown in table (1) (honeys from beekeepers) and in table (2) (honeys from markets).

Preparation of Samples:

Liquid Strained honey was suggested to be the form of all honey samples. A tight jar its weight capacity was half kg of honey sample, was selected for packaging till the time of analysis.

Each Sample was represented by three replicates. Before weighting portions for determination, free granulated strained honey samples were mixed thoroughly by stirring or shaking. Liquefying process was achieved for granulated by placing closed container without submerging in water bath for 30 minutes at 60°C or even at higher temperature at 65°C, if necessary, and Shaking until the Sample was liquefied. Then the sample was then mixed and cooled rapidly as soon as the sample was completely liquefied.

In the case of foreign matter (wax, sticks, bees, particles of comb, ext.), sample was heated to reach 40°C in water bath and strain through cheesecloth in hot water funnel.

Determination of honey metals level in honey:

The determination of heavy metals residue was accomplished by using atomic absorption techniques, according to Salama *et al.*, (1994).

The pre-analysis of honey samples and determination of metal ions by using atomic absorption spectrometer was carried out in the soil and water Activity Unit of the Information Services and Training (SWUIST), Faculty of Agriculture EL-Shatby, University of Alexandria.

The following steps were carried out for the honey samples:

1- Ten grams of honey sample was dissolved in 20 ml of concentrated nitric acid.

2- The sample solution was digested by hearting on a hot plate at 110°C for 2 hours and then the temperature increased to 250°C for 2-3 hours.

3- The remaining amount of samples after digestion was dissolved in solution of HCL: water (1:1) and the volume adjusted to be 100 ml.

Detection limits of Atomic Absorption Spectrometer :

Limits of detection are expressed as the lowest concentration of an element in solution which can be detected with 95% certainly.

The heavy metals subjected to study were copper, iron, manganese, zinc, cadmium and lead.

Statistical analysis was achieved by using the program of SPSS statistics.

Table (1): The honey samples collected from beekeepers of great Jamahiriya provinces

Sample No	Honey type	Place of collected honey	Harvesting date
1	Eucalyptus (cerwal) honey	Quarsha Benghazi	August 2007
2	Eucalyptus (cerwal) honey	Tripoli	June 2007
3	Thyme honey	EL-Abiar Benghazi	May 2007
4	Thyme honey	Salntah El-Bidaa	April 2007
5	Thyme honey	Tripoli El-khoms	July 2007
6	Libd (onopordum) honey	Egdabia	April 2007
7	Kaamol (Artichoke) honey	Nowfia	July 2007
8	Mela honey	EL-Makaly Tobrok	June 2007
9	Rabiey (spring) honey	EL-Gabal EL-Akhder	July 2007
10	EL-Mann honey	Sousa coast	January 2007
11	Nabk (sidre) honey	Wadi EL-Bab Sluge	April 2007
12	Nabk (sidre) honey	Tripoli	June 2007
13	Hanone honey	Lamolodah	June 2007
14	Citrus honey	Tripoli	June 2007
15	Citrus honey	Sabha EL-Ziagen	April 2007
16	Alfalfa	Sabha EL-Ziagen	June 2007

Table (2): The honey samples collected from markets of great Jamahiriya

Sample No	Honey type	Place of collected honey	Harvesting date
1	Hanone honey	Wadi EL-Kofe	January 2007
2	Hanone honey	EL-Gabal EL-Gharby	June 2007
3	Nabk (sidre) honey	Wadi EL-Bab Sluge	June 2007
4	Nabk (sidre) honey	East of Benghazi	June 2007
5	Nabk (sidre) honey	EL-Abiar	April 2007
6	Nabk (sidre) honey	EL-Bidaa	July 2007
7	Nabk (sidre) honey	Tripoli	July 2007
8	Thyme honey	East of Benghazi	April 2007
9	Thyme honey	Shahat	June 2007
10	Thyme honey	Tripoli El-Khoms	August 2007
11	Rabiey (spring) honey	Benghazi	August 2007
12	Rabiey (spring) honey	EL-Gabal EL-Akhder	June 2007
13	Mela honey	Shahat	April 2007
14	El-Mann (Elarar) honey	Shahat	April 2007
15	Citrus honey	Tripoli	June 2007
16	Eucalyptus (cerwal) honey	Tripoli	January 2007

RESULTS AND DISCUSSION

Heavy metals:

So far, the different international honey standards did not include the levels of heavy metals may found in the honey. Only, there are recommendations about the maximum levels of heavy metals allowed in honey. These recommendations were pronounced by four organizations which are:

1- Department of Pesticide Regulation (DPR) and the United States Environmental Protection Agency (U.S.EPA) standard maximum residue levels (MRLS), (1995).

2- Revised Codex Alimentarius Commission Standard for honey, (2001).

3- MRL proposal for the EU, (2000).

4- Agricultural and Processed Food Products Export Development Authority (APEDA) for monitoring of drugs, pesticides and heavy metals residue limit in honey, (2008).

Copper level in honey samples:

The honey samples collected from beekeepers and markets contained accepted levels of copper according to the data found in tables (3) and (4) and the figures of (1) and (2).

According to DPR and U.S.EPA standard MRLS, (1995) and EPEDA (2008) the maximum residue level of copper is 1mg/kg, while the Revised Codex Alimentarius Commission Standard (2001) recommended the MRLS of copper is 5mg/kg, in honey.

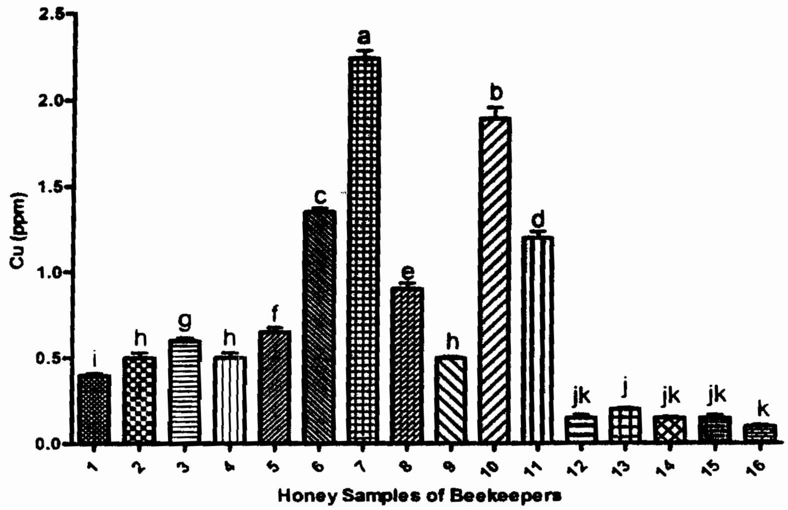
Table (3): Analysis of the heavy metals in ppm for the honey samples collected from beekeepers.

Sample No.	Cu	Fe	Mn	Zn	Cd	Pb
1	0.40	1.70	2.90	5.43	N.D.	5.50
2	0.50	0.45	0.30	5.58	N.D.	9.00
3	0.60	31.85	1.10	5.26	N.D.	9.00
4	0.50	1.05	0.90	6.06	N.D.	17.50
5	0.65	0.35	1.05	6.73	N.D.	5.50
6	1.35	144.95	1.65	7.26	N.D.	8.00
7	2.25	18.10	2.15	7.13	N.D.	8.50
8	0.90	11.75	0.45	6.01	N.D.	6.00
9	0.50	0.50	0.95	5.54	N.D.	1.50
10	1.90	42.25	1.15	6.92	N.D.	8.00
11	1.20	37.85	1.35	4.85	N.D.	8.50
12	0.15	0.54	0.25	5.70	N.D.	5.50
13	0.20	0.55	0.80	10.51	N.D.	5.00
14	0.15	0.40	0.80	9.68	N.D.	3.00
15	0.15	0.35	1.15	7.32	N.D.	232.00
16	0.10	0.35	0.25	9.78	N.D.	4.50
Total	**11.5**	**292.99**	**17.2**	**109.76**	—	**337**
X	**0.71**	**18.31**	**1.075**	**6.86**	—	**21.063**

Table (4): Analysis of the heavy metals in ppm for the honey samples collected from markets.

Sample No.	Cu	Fe	Mn	Zn	Cd	Pb
1	0.35	0.55	0.85	6.24	N.D.	7.00
2	0.35	0.54	0.83	6.22	N.D.	6.95
3	0.35	0.55	0.50	9.66	N.D.	4.50
4	0.30	19.95	2.05	7.11	N.D.	4.50
5	0.55	5.20	0.45	6.20	N.D.	7.50
6	0.10	8.85	0.40	5.79	N.D.	5.50
7	0.50	0.65	1.75	11.51	N.D.	4.50
8	0.20	0.60	0.60	5.52	N.D.	1.00
9	0.35	2.00	0.85	7.40	N.D.	8.50
10	0.35	2.13	0.90	7.20	N.D.	8.40
11	0.15	65.65	2.65	7.64	N.D.	1.50
12	0.30	1.40	1.65	10.86	N.D.	4.50
13	0.20	0.25	0.45	9.83	N.D.	3.50
14	0.45	0.50	1.95	11.94	N.D.	5.00
15	0.45	0.60	2.20	5.28	N.D.	6.00
16	0.25	0.70	1.15	7.42	N.D.	4.50
Total	**5.2**	**110.12**	**19.23**	**125.82**	------	**83.35**
X	**0.33**	**6.88**	**1.2**	**7.86**	------	**5.21**

Figure (1) :Copper level in honey samples of beekeepers.



Figure(2): Copper level in honey samples of markets.

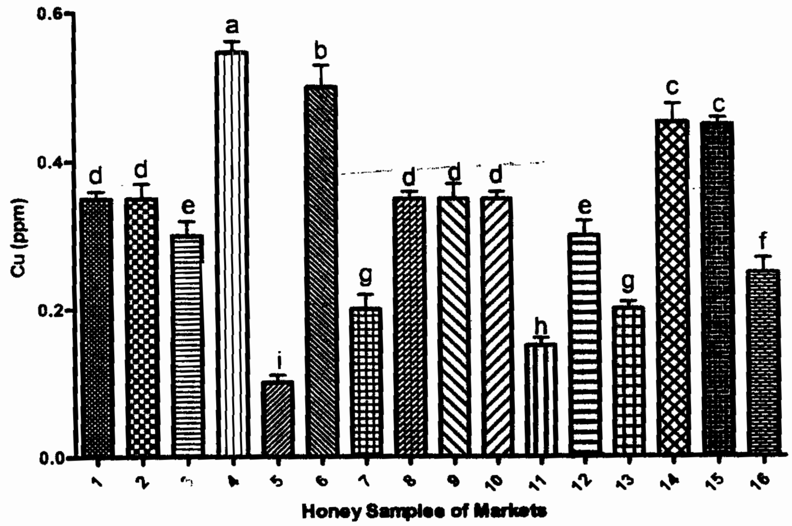


Figure (3) :Iron level in honey samples of beekeepers.

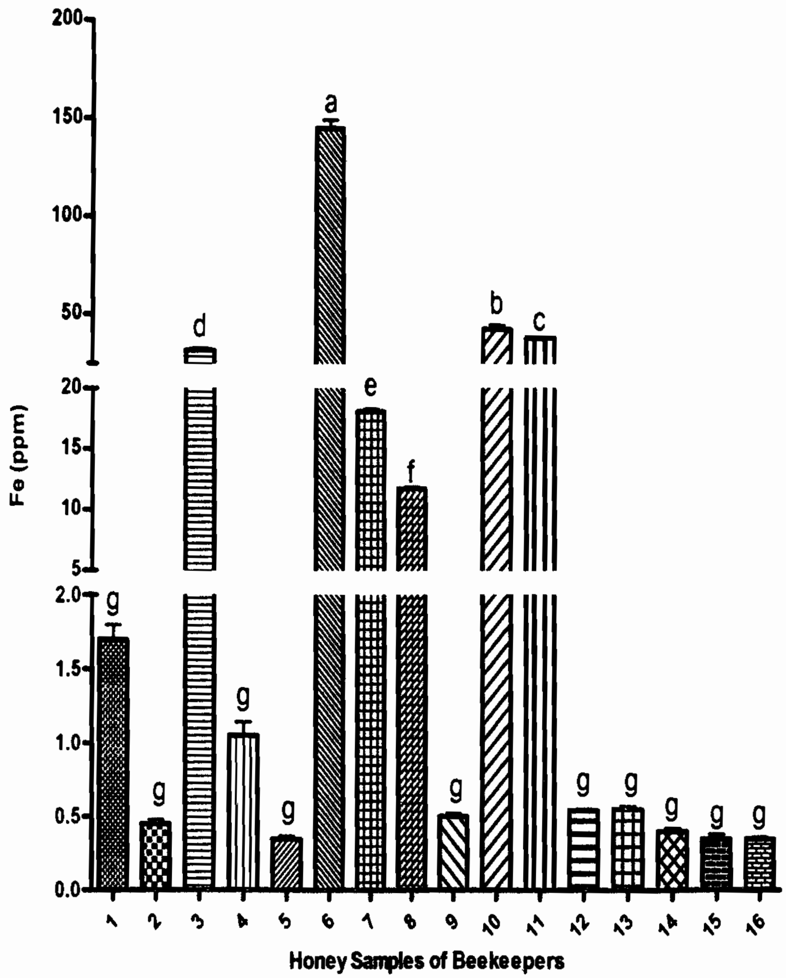


Figure (4) : Iron level in honey samples of markets.

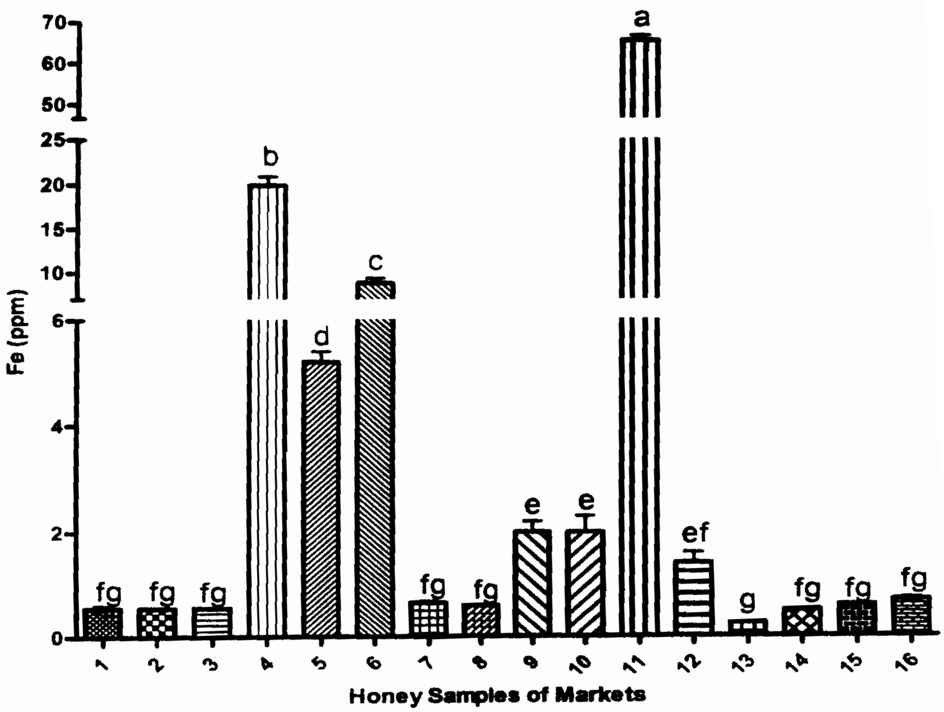


Figure (5) :Manganese level in honey samples of beekeepers.

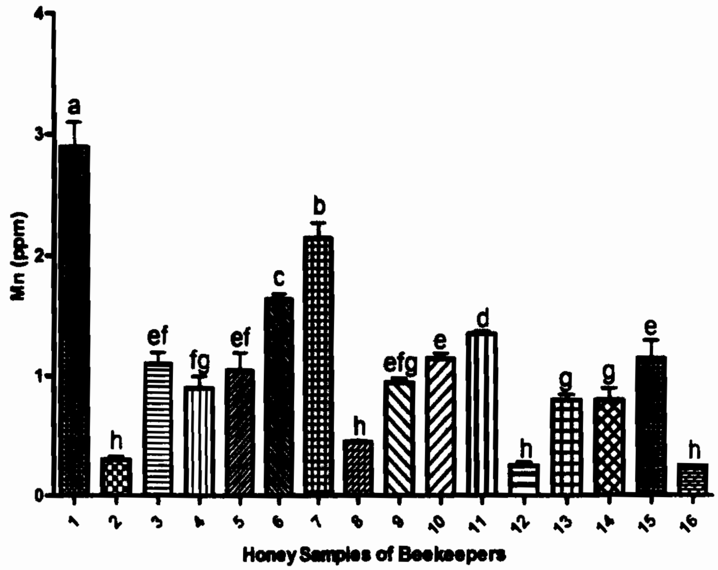


Figure (6) :Manganese level in honey samples of markets

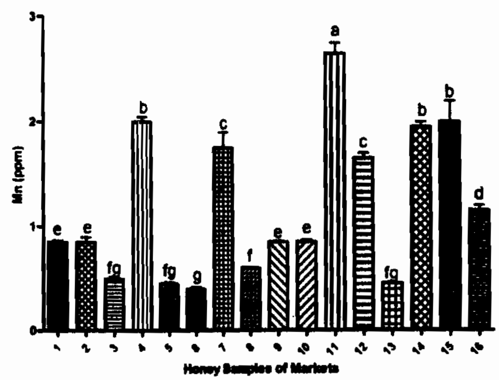


Figure (7) :Zinc level in honey samples of beekeepers.

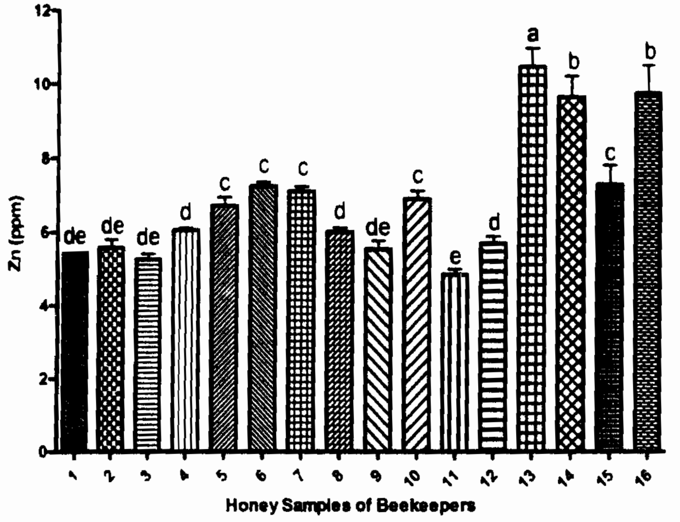


Figure (8) :Zinc level in honey samples of markets.

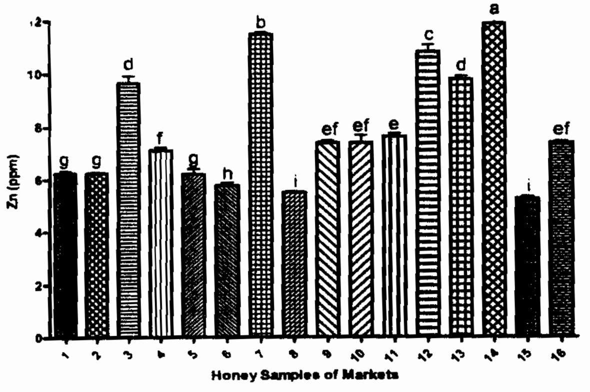


Figure (9) :Lead level in honey samples of beekeepers.

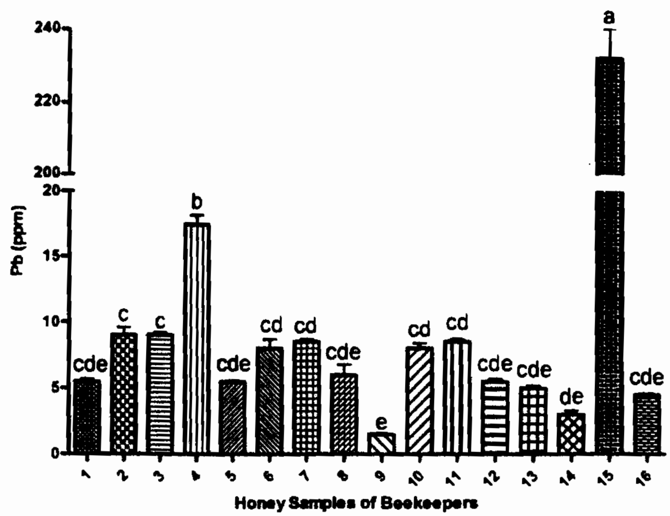
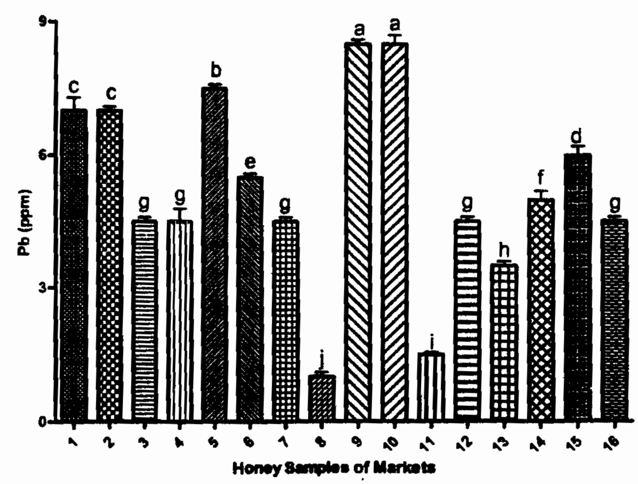


Figure (10) :Lead level in honey samples of markets.



Accordingly, all the analyzed honey samples collected from markets (16 samples) and 12 samples collected from beekeepers were accepted from DPR and U.S.EPA of (1995) and APEDA of (2008).

The four samples refused were Libd honey (1.35 mg/kg), Kaamol honey (2.25 mg/kg), El-Mann honey (1.9 mg/kg) and Nabk honey (1.2 mg/kg), (table 3).

On the other hand all the analyzed 32 honey samples were accepted from the standpoint of the revised Codex Alimentarius Commission Standard of (2001) since the maximum residue limit of copper is 5mg/kg.

It is clear that all the copper levels in the Libyan honey samples were ranged between 0.1 to 2.25 mg/kg for the samples of beekeepers with an average of 0.72 mg/kg, and between 0.1 to 0.55 mg/kg for the samples of markets with an average of 0.33 mg/kg. The average value of Cu level in the Libyan honey samples were below the guide line value of 5 mg/kg according to Codex 2001.

This fact was concurrent with Gomaa (2009) who found that the average copper value in the Egyptian honey is 3.25 mg/kg. Also, Osman *et .al* (2007) found that the samples collected from Al-Qassim region in Saudi Arabia were ranged between 0.206 to 0.389 mg/kg with an average of 0.19 mg/kg.

Gomaa (2009) reported that the high copper level values in some Egyptian honey samples may be attributed to the existing of sources of pollution near to the apiaries as fertilizers company, recycling drainage station and high ways. He also evaluated the copper level in the drainage surface water samples and found it was below the maximum level (0.03mg) according to the Environmental Protection Administration (EPA), (1998).

On the other hand, the average intake amount of water needs to be gathered by bee colony may be calculated according to the explanation of El-Ansary (2007), and was 284 gm (ml)/day and reached to maximum amount 454 gm (ml)/day in the strong colony. He also added, the bee workers start their activity of gathering and storing water from early spring and stop only before the honey flow sign begins unless the honey bees collecting nectar with a high concentration of sugars.

According to the previous explanation, the expected average amount of Cu intake only from gathering and storing water by the colony during the apiary season may be calculated theoretically as follows:

- In spring citrus season, the period of gathering and storing water may be extended for approximately 17 days. It means that the expected average daily intake amount of Cu during this period for the colony may be estimated to reach 0.0289 mg.

- The period of gathering water through clover season may be extended for approximately 22 days. It means that the expected average daily intake amount of Cu during this period for the colony may be estimated to reach 0.037 mg.
- Activity of gathering and storing water may be continued from the mid of June till the flow sign of cotton honey begins (the mid of august). This period may be extended for approximately 15 days. It means that the expected average daily intake amount of Cu during this period for the colony may be estimated to reach 0.1275 mg.

Also, according to El-Ansary (2007), the small amounts of the storing water in the colony may be used only to dilute the storage honey in combs especially in the high temperature periods. Therefore, few contents (less than the previously mentioned content of Cu in the colony) of Cu are expected to translocate to the storage honey in the colony during the process of honey dilution by water. Therefore, other sources of pollutions in the same location may be responsible in raising the level of Cu of the previous honey samples.

The major source of copper may be the flotation of sulfide ores, production of wood preservatives electroplating azo-dye manufacture, as a mordant for textile dyes, in petroleum refining and the manufacture of copper compounds.

Finally, statistical analysis summarized in figure (1) illustrated that there are differences between all samples (collected from beekeepers) except the samples of 12, 14 and 15, from the standpoint of the Cu content. The same trend was found in the honey samples of markets which summarized in figure (2).

Iron level in honey samples:

Iron level was mentioned by the revised Codex standards (2001), which stipulate the maximum level of iron is 15 mg/kg honey.

According to the data of table (3) and figure (3) concerning with samples collected from the beekeepers, eleven honey samples were accepted (Fe levels were less than 15 ppm) and five samples were refused.

Data of table (4) and figure (4) illustrated the levels of Fe amounts in ppm for 16 honey samples collected from markets. Two honey samples only were refused.

These honey samples may have a negative effect on the human health. This fact meets the review of W.H.O. (2006) who reported the mechanism of iron transportation and uptake in plasma and tissues. In the plasma of a healthy individual, essentially all detectable iron will be associated with transferring (Martin *et al.*, 1987).

The obtained data illustrated that the Fe levels in the most Libyan honeys were ranged between 0.25 to 11.75 ppm. These values of Fe levels were below the guideline value of 15 ppm (15 mg/kg) according to Codex Alimentarius Commission (2001). This fact was in agree with Gomaa (2009) who found that the Fe levels in the most Egyptian honey samples were ranged between (0.653 – 13.316 mg/kg). Also, it was in agreed with Osman *et al* (2007) who found that the highest content of Fe was (3.195 mg/kg) in Al-Malida honey and the lowest Fe was in the honey of Buraidah (0.31 mg/kg).

Fe overload as a result of dietary intake is unusual in the normal population as found by EVM (the Expert Group on Vitamins and Minerals), (2003). Therefore, the recorded Fe levels do not pose a health risk to consumers because the concentrations in all tested samples were below the guideline value of 15 mg/kg according to Codex Alimentarius Commission, (2001).

Statistical analysis of the data found in figure (3) (honeys collected from beekeepers) illustrated that there are no differences between the Fe levels in the ten honey samples of 1, 2, 4, 5, 9, 12, 13, 14, 15, and 16 while there are a significant differences among the other 6 samples and between them and the previous ten samples. Also, it is clear to illustrate that 5 samples from the previous 6 samples were refused from Codex (2001).

On the other hand, when the Fe levels in the honey samples collected from markets were statistically analyzed as found in figure (4), there were 8 honey samples with non significant differences in the Fe levels.

Finally the honey samples of Nabk from East of Benghazi (19.95) and Rabiey from Benghazi (65.65) were highly differences from the Fe levels.

Manganese level in honey samples:

Manganese level was not mentioned by the international standards. According to the data of tables (3) and (4) the variation limits of Mn level in honey samples collected from beekeepers were ranged between 0.25 to 2.9 mg/kg with an average of 1.075 mg/kg. In the honey samples collected from markets the Mn levels were ranged between 0.4 to 2.65 mg/kg with an average of 1.20 mg/kg.

The general average of Mn in Libyan honey was 1.14 mg/kg.

According to El-Ansary (2007) the lower limit of Mn in the American light amber honey is 0.17 mg/kg, while the maximum limit is 0.44 with an average of 0.3. On the other hand, the lower limit of Mn in the dark amber honey is 0.52 while the maximum limit is 9.53 mg/kg with an average of 4.09 mg/kg. It means that the Mn was found in the Libyan honey in the limits of its existence in the American honey. Statistical analysis of data found in tables (3) and (4) and the figures (5) and (6) illustrated that the levels of Manganese in the honeys collected from beekeepers displayed significant differences between them.

Zinc level in honey samples:

Zinc level was mentioned by the revised Codex Standards (2001), which stipulate the maximum level of zinc as 5 mg/kg honey.

According to tables (3) and (4) and figures (7) and (8), the zinc levels in honeys collected from beekeepers were ranged between 4.85 to 10.51 mg/kg honey, with an average of 6.86 mg/kg. it was noticed that 15 honey samples were refused from the standpoint of zinc level according to Codex standards (2001), while one honey sample only (Nabk from Wadi El-Bab, (4.85 mg/kg)) was accepted.

On the other hand, all the honey samples collected from markets contained zinc levels ranged from 5.28 to 11.94 mg/kg with an average of 7.86 mg/kg. It means that all these honey samples were refused.

The high zinc levels in the previous honeys may have a negative effect on the human health. This fact meets the review of Osman *et al.* (2007) who found that zinc is a nutritionally essential metal but high intake of it results in gastrointestinal distress and diarrhea, Goyer (1986). Moreover, poisoning incidents with symptoms of gastrointestinal distress, nausea and diarrhea have been reported after a single or short-term exposure to concentrations of zinc in water or beverages of 1000-2500 mg/liter. Similar symptoms occasionally leading to death have been reported following the inadvertent intravenous administration of large doses of zinc. Kidney dialysis patients exposed to zinc through the use of water stored in galvanized units have developed symptoms of zinc toxicity that were reversible when the water was subjected to activated carbon filtration, (W.H.O., 2000). The Egyptian honeys were analyzed by Gomaa (2009) and the zinc levels were determined. He reported that the high zinc levels in the Egyptian honey samples may be attributed to the existing of sources of pollution near to the apiaries.

The levels of zinc are positively affected with other sources of pollutions industries emission and the agriculture usage of zinc compounds (zinc sulphate and zinc complex with organic materials) as plant fertilizers.

This explanation meets the review of W.H.O. (2001) who reported that, zinc in the atmosphere is primarily bound to aerosol particles. The size of particle is determined by the source of zinc emission. A major proportion of the zinc released from industrial processes is adsorbed on particles that are small enough to be in the respirable range. The transport and distribution of atmospheric zinc vary according to the size of particles and the properties of the zinc compounds concerned. Zinc is removed from the atmosphere by dry and wet deposition. Low densities and diameters can be transported over long distances.

As previously mentioned, all Libyan honey samples were refused from the standpoint of zinc level (more than 5 mg/kg). It may be explained as the sources of pollution exist beside the apiaries. These sources may be the sweetening water station at Darna city, Oil refine station at Ras Lanof, Darna cement factory, Sweetening water station at Sousa city, the nearest of honey beehives to the general road, the general road which pass through the flora of El-Gabal El-Akhdar and the near of the sources of the nectar and pollens from the general road.

On the other hand, when the data of zinc levels found in table (3) in honey samples of beekeepers were statistically analyzed the results were summarized in figure (7).

Also the honeys of Thyme from Tripoli, Libd from Egdabia, Kaamol from Benghazi, El-Mann from Sousa and Citrus from Sabha have no significant differences between them but differ from the other honeys. The honey samples of Citrus from Tripoli, Alfalfa from Sabha and Hannone from Lamolodah scored a high content of zinc values which were 9.68, 9.78 and 10.51 mg/kg, in respect.

The data of honey samples collected from markets conceming zinc values (table 4) were statistically analyzed and summarized in figure (8).

Lead levels in honey samples:

According to DPR and U.S.EPA (1995) and APEDA (2008), the maximum residue level of lead in honey is 0.08 mg/kg. The Revised Codex Alimentarius Commission Standard for honey stipulated 0.1 mg/kg, while the MRL proposal for the EU (2000) stipulated 1 mg/kg.

The obtained data of tables (3) and (4) and the figures of (9) and (10) illustrated that the lead residues in the honey samples collected from beekeepers were ranged between 1.5 to 233 mg/kg with an average of 21.063 mg/kg.

Also, the obtained data showed that the lead residues in honeys collected from markets were ranged between 1 to 8.5 mg/kg with an average of 4.86 mg/kg. These results emphasized that all honey samples were refused from the international standards concerning the lead residues except one sample (Thyme honey from markets of East of Benghazi) which scored 1 mg lead/kg honey, and accepted only from MRL proposal for the EU (2000).

Gomaa (2009) reported that the lead levels in the Egyptian honey samples were ranged between 0.018 to 53.809 mg/kg with an average value of 13.91 mg/kg. It was above the guideline value of 1 mg/kg of the used standards. These results were not agreed with Osman *et.al.* (2007) who found that the honey samples collected from different areas of Al-Midhnab, followed by Unayza, Al-Malida, Al-Toaymat and Buraidah regions in Saudi Arabia with mean values of 0.08, 0.07, 0.062, 0.055 and 0.038 mg/kg, respectively.

On the other hand, Gomaa (2009) tried to explain the high levels of lead in some Egyptian honeys which may be attributed to pollution sources near to the apiaries as El-Nobaria factory for recycling drainage sanitation and Abu-Qeir and Alex-Fert for fertilizers company. In addition, Agricom for pesticides company, Tanta for soap and oil products company, Tanta for linen and weaving company, Egypt for fertilizers company and Petroleum refining company.

According to El-Ansary (2007), the small amounts of the storing water in the colony may be used only to dilute the storage honey in the combs and regulate the temperature. Therefore, few contents (less than the previously mentioned content of Pb in the colony) of Pb are expected to translocate to the storage honey in the colony during the process of honey dilution by water. Therefore, other sources of pollutions in the same location may be responsible in raising the level of Pb of the previous honey samples.

The levels of Pb are positively correlated with traffic volume and proximity of roads highways. According to W.H.O. report, (1989) this explanation was agreed with most lead deposited is found within 500 m of the road and within the upper few centimeters of soil. It may be assumed that lead levels in soil and biota are not influenced by traffic at distances from roads greater than this.

In addition, airborne emission of petroleum refining company and power stations may be considered other major sources of contamination with lead. This explanation was concurrent with the pollution of the environment occurs through the smelting and refining of lead, the burning of petroleum fuels containing lead additives and, to a lesser extent, the smelting of other metals and the burning of coal and oil. Metallic lead deriving from shotgun cartridges or used as fishing weights is lost in the environment and often remains available to organisms.

On the contrary, the obtained results of the safe lead level values in the Egyptian honey samples may be attributed to the existing of sources of pollution far from the apiaries. Data of Gomaa (2009), the contamination of Libyan honey by lead may be attributed to the stations, factories and

general road previously mentioned. The previous sources are far from locations by more than 500 meters. Consequently, the translocation of lead to the apiary is difficult, according to W.H.O. (1989).

Statistical analysis of the data found in table (3) concerning the levels of lead in the honey samples collected from beekeepers illustrated that there are 12 honeys have no significant differences between them.
On the other hand, the data of the honeys collected from markets (table 4) concerning the levels of lead was summarized as shown in figure (10).

Cadmium levels in honey samples:

The DPR & U.S.EPA MRLs (1995) and (APEDA) (2008) for monitoring of drugs, pesticides and heavy metals residue limit in honey stipulated that the maximum level of cadmium is 0.008 mg/kg. Moreover, proposal for the EU. standard (2000) and Revised Codex standard (2001) stipulated that the maximum level of cadmium is 0.1 and 0.05 mg/kg, in respect.

According to the data of tables (3) & (4) all the honey samples were free from cadmium.

According to Gomaa (2009) the cadmium levels in the Egyptian honey samples were ranged between (0.0000-0.0820 mg/kg) with an average value of 0.0145 mg/kg. The average value of Cd level in the Egyptian honey samples were below the guideline value of 0.05 mg/kg of the used standards. These results were agreed with Osman *et.al* (2007) who found that the honey samples collected from different areas of Al-Malida, Al-Midhnab, Al-Toaymat, Unayza and Buraidah regions in Saudi Arabia with mean values of 0.037, 0.004, 0.003, 0.003 and 0.002 mg/kg, respectively. The concentration of Cd in all tested samples was below the guideline value of 0.05 mg/kg according to (Codex Alimentarius Commission 2001).

The levels of Cd are positively correlated with traffic volume and proximity of roads highways. This explanation was agreed with the report of W.H.O., (1992) who illustrated that the major route of exposure to cadmium for the non-smoking general population is via food; the contribution from other pathways to total uptake is small.

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الملخص العربى

تحديد المعادن الثقيلة في العسل الليبي

أسامة الأنصارى- أحمد كمال مراد- عثمان أحمد زغلول
عمر محمد البربرى- فضل أبو بكر قاسم
كلية الزراعة (الشاطبى - جامعة الأسكندرية)
كلية الزراعة - سابباشا - جامعة الأسكندرية

ان مستويات المعادن الثقيلة لكل من النحاس والحديد والمنجنيز والزنك والكادميوم والرصــــاص قد تم تحديدها فى 32 عينة من الأعسال الليبية والتى تم جمعها من النحالين والأسواق. ولقد استخدم فـــى هذه الدراسة مقياس طيف الامتصاص الذرى، هذا وقد تراوح النحاس بين 0.1 الـــى 0.55 ملجـــم/كجـــم والحديد من 0.25 الى 144.95 و المنجنيز بين 0.25 الى 2.9 و الزنـــك بـــين 4.85 الـــى 11.94 و الكادميوم لم يتم اكتشافه أما الرصاص فقد تراوح بين 1 الى 233 ملجم/كجم .

هذا والقيمة الدليلية لهذه المعادن طبقا للتوصيات العالميـــة لا تزيـــد عـــن 5، 15، 5، 0.1، 1 ملجم/كجم لكل من النحاس والحديد والزنك و الكادميوم و الرصاص على الترتيب بينما معدن المنجنيز لم يتم ذكره.