



## Honey bee worker as a bio-indicator for measuring environmental pollution in certain Upper Egypt Governorates.

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### Abstract:

Pollution is damage caused to water, air, etc. by harmful substance, it is considered one of the major environmental problem, which is causing many diseases. This study aimed to use honeybee's workers body as bio-indicator to monitor pollutants. Samples were collected from some Upper Egypt Governorates. Mass analyze coupled to Inductively Coupled Plasma (ICP) systems include double focusing magnetic-electrostatic sector systems with both single and multiple collector was used, as well as time of flight systems (both axial and orthogonal accelerators have been used). The highest pollinate Governorate was (0.575 ppm) in Beni-Suef as the lowest one was (0.256 ppm) in Asyut and Aswan. The highest pollinate elements was 2.294 ppm in manganese (less than the Egyptian's stander 0.02 ppm), but the lowest elements were - 0.356 ppm in boron (Just at the Egyptian's stander). Honey bee *Apis mellifera* L. (Hymenoptera: Apidae) could be used as bio-indicator in ecosystem to ecotoxicological

### Introduction:

Condition contamination by synthetic compounds and overwhelming metals quickened significantly during the most recent couple of decades because of mining, purifying, producing, utilization of horticultural composts, pesticides, metropolitan squanders, traffic outflows, modern effluents and mechanical synthetic concoctions and so forth. Wide event of metal contamination exists overall presently, including Egypt (Moussa and Abdelkhalek, 2007). The degree of ecological contamination and coming about human introduction to risky lethal substantial metals

in the earth is hard to survey. Compound investigation of the earth network is the most immediate way to deal with uncover the overwhelming metal status in nature, while it can't manage the cost of the incredible proof in the incorporated impact and conceivable danger of such contamination on life forms and biological system.

One of the conceivable elective ways to deal with this issue is the utilization of organic pointers to exhibit ecological contamination. This methodology has all the earmarks of being especially appropriate for showing presentation to possibly lethal

follow components. Natural observing inside a quality control program includes the orderly utilization of living creatures for acquiring quantitative data on changes in the earth, frequently because of anthropogenic exercises (Bargagli, 1998). Creepy crawlies give the foundation of natural checking in oceanic frameworks, where there are well-created systems for utilizing them to survey organic respectability. The utilization of creepy crawlies as bio-markers in earthly biological system, interestingly, has been far less eagerly grasped.

The bumble bee, *Apis mellifera* L. (Hymenoptera: Apidae) has been explored as bio-pointer to screen toxins (Leita *et al.*, 1996). Its engaging quality as a biological finder relies upon a few highlights, for example, high conceptive rate, huge flying reach since they regularly rummage to 2–3 km away from the apiary, the body is secured with hairs that gather different particles and increment by this mean, close contact with the encompassing condition, touchy to poisonous substances, and the conceivable utilization of honey bee items as markers for ecological contamination (Porrini *et al.*, 2003 and Stark, 2003). This last point is significant in light of the fact that honey bees and honey bee items can be utilized as collective and receptive markers (Billalov *et al.*, 1992). Because of preparation by exercises of people, including mining, purifying, producing, utilization of farming manures, pesticides, city squanders, traffic outflows, mechanical effluents and modern synthetic substances, contamination of soils by change metals, for example, cadmium (Cd), nickel (Ni), zinc (Zn), lead (Pb), copper (Cu), has expanded significantly during the most recent couple of decades (Chibuike and Obiora, 2014). Defilement of the earth, including Egypt, by metals is presently far reaching (Al-Nagger *et al.* 2013) bringing about harmfulness (Nordberg *et al.*, 2011).

The objective of the present investigation is to check the adequacy of a bio-marker based technique including the

examination of honey bee *A. mellifera* for the assurance of the natural contamination with overwhelming metals by looking at information acquired by various testing locales in various Governorates in Egypt.

### Materials and methods

Study was carried out in laboratory of healthy ministry in 2019. Honey bee samples were collected from different Governorate`s apiaries Upper, Egypt. with 40 km intervallic distances between each apiary.

#### 1. Samples:

**Samples were collected from Giza, Beni-Suef, Asyut, Aswan, and New Valley.**

#### 2.Apparatuses:

Balance, microwave, digestive and micro plasma [Inductively Coupled Plasma (ICP)]

#### 3.Procedure:

Samples were collected into plastic packages using gloves, were stored at  $-18^{\circ}\text{C}$  before analyses and were dried in microwave for 10 minute at  $120^{\circ}\text{C}$ . Dried bees (50 g) were placed into vessels with 8 ml of nitric acid ( $\text{HNO}_3$ ) and 2 ml of hydrogen peroxide ( $\text{H}_2\text{O}_2$ ) put in digestive per one hour then leaved it cold for 24 hours, samples were filtrated through 1–2.5  $\mu\text{m}$  filter paper and brought to a final volume of 25 ml with distilled water. Then analysis to determine the following heavy metal (Boron-Zinc-Ferric-Nickel-Lead-Molybdenum-Cadmium-Copper-Menganese- Chromium) in micro plasma [Inductively Coupled Plasma (ICP)], is highly sensitive and capable of multi-element trace analysis and ultra-trace analysis, often at the parts-per-trillion level. Testing for trace elements can be performed on a range of materials from super alloys to high purity materials.

Mode of action that coupling to mass spectrometry, the ions from the plasma are extracted through a series of cones into a mass spectrometer, usually a quadrupole. The ions are separated on the basis of their mass-to-charge ratio and a detector receives an ion signal proportional to the concentration. The concentration of a sample can be determined through calibration with certified reference material such as single or multi-element reference standards inductively coupled

plasma mass spectrometry (ICP-MS). Also lends itself to quantitative determinations through isotope dilution, a single point method based on an isotopically enriched standard.

Other mass analysers coupled to ICP systems include double focusing magnetic-electrostatic sector systems with both single and multiple collector, as well as time of flight systems

(both axial and orthogonal accelerators have been used). The concentration of a sample can be determined through calibration with certified reference material such as single or multi-element reference standards. ICP-MS also lends itself to quantitative determinations through isotope dilution, a single point method based on an isotopically enriched standard. Ceased to be discharged, the excess nitric acid was removed by increasing the temperature to 100°C. The solution was carefully evaporated until the perchloric acid began to evaporate. The solution was then cooled, 10 ml of distilled water was added, and the mixture was filtrated through a 1–2.5 µm filter paper and brought to a final volume of 25 ml with distilled water.

Microelements in the samples were quantified by atom-absorption spectrometry with an Analyst-400 system (Perkin-Elmer,

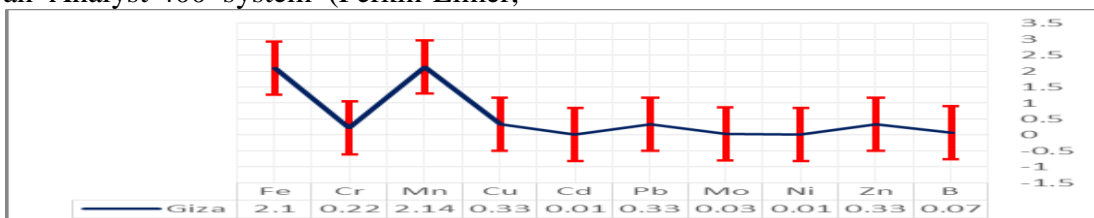
Waltham, MA, USA) with flame atomization. The following heavy metals were analyzed: Boron (B), zink (zn), nickel (Ni), molybdenum (Mo), lead (Pb), cadmium (Cd), copper (Cu), manganese (Mn), chromium (Cr) and iron (Fe). All samples were analyzed in duplicate.

**Results and discussion**

Data in Figure (1) showed the heavy metal (ppm) in honeybee workers samples in Giza Governorate. It's recorded the high value of heavy metal at manganese (2.14) while the nickel and cadmium recorded the low value (0.01).

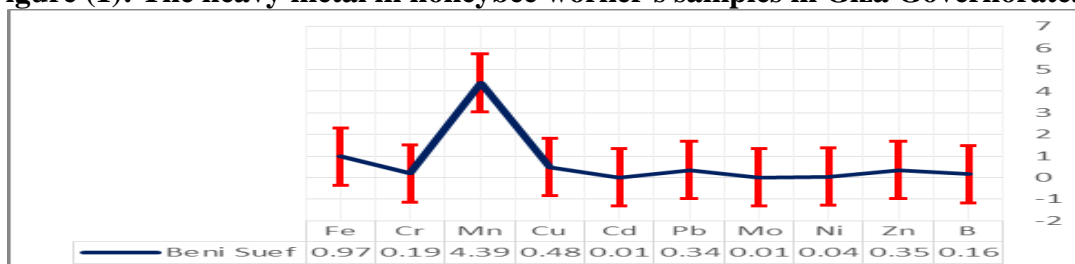
Data in Figure (2) showed the heavy metal (ppm) in honeybee workers samples in Beni-Suef Governorate. It's recorded the high value of heavy metal at manganese (4.39) while the low value was recorded at the cadmium and molybdenum (0.1).

Data in Figure (3) showed the heavy metal (ppm) in honey bee workers samples in Asyut Governorate. It's recorded the high value of heavy metal at ferric (1.45) while the nickel and cadmium recorded the low value (0).



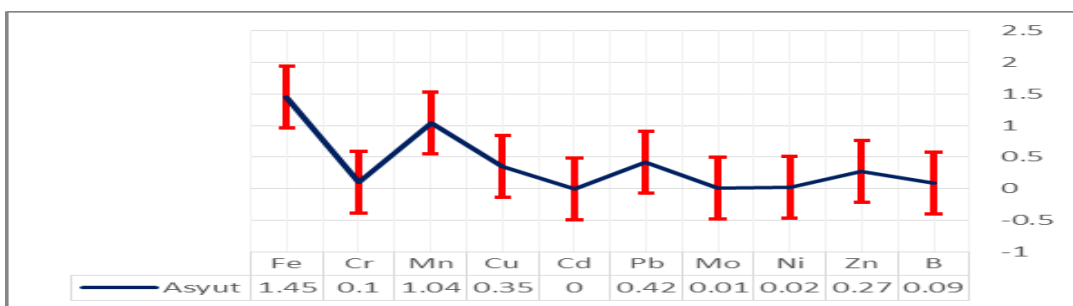
Boron (B), Zink (zn), nickel (Ni), molybdenum (Mo), lead (Pb), cadmium (Cd), copper (Cu), manganese (Mn), chromium (Cr) and iron (Fe)

**Figure (1): The heavy metal in honeybee worker's samples in Giza Governorate.**



Boron (b), Zink (zn), nickel (Ni), molybdenum (Mo), lead (Pb), cadmium (Cd), copper (Cu), manganese (Mn), chromium (Cr) and iron (Fe)

**Figure (2): The heavy metal in honeybee worker's samples in Beni-Suef Governorate.**

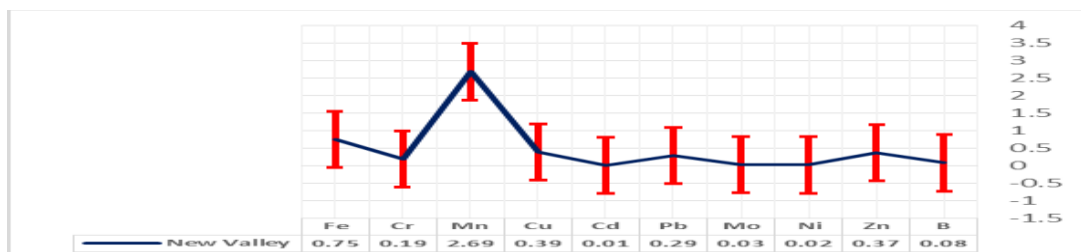


Boron (b), Zink (zn), nickel (Ni), molybdenum (Mo), lead (Pb), cadmium (Cd), copper (Cu), manganese (Mn), chromium (Cr) and iron (Fe)

**Figure (3): The heavy metal in honeybee worker's samples in Asyut Governorate.**

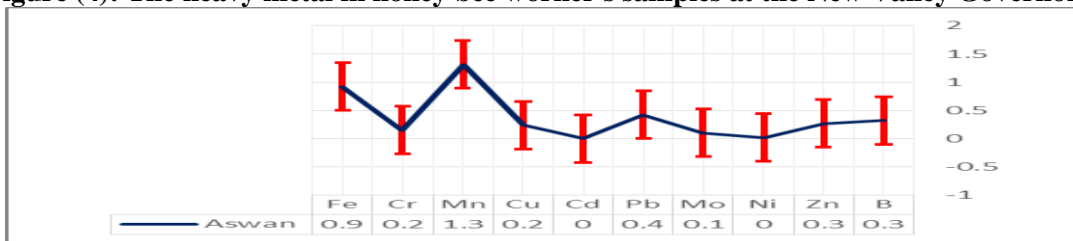
Data in Figure (4) showed the heavy metal in honeybee workers samples in New Valley Governorate. It's recorded the high value of heavy metal at manganese (2.69) while the low value was recorded at the cadmium (0.01). Data in Figure (5) showed

the heavy metal (ppm) in honeybee workers samples in Aswan Governorate. It's recorded the high value of heavy metal at manganese (1.3) while the cadmium and nickel recorded the low value (0).



Boron (b), Zink (zn), nickel (Ni), molybdenum (Mo), lead (Pb), cadmium (Cd), copper (Cu), manganese (Mn), chromium (Cr) and iron (Fe)

**Figure (4): The heavy metal in honey bee worker's samples at the New Valley Governorate.**



Boron (b), Zink (zn), nickel (Ni), molybdenum (Mo), lead (Pb), cadmium (Cd), copper (Cu), manganese (Mn), chromium (Cr) and iron (Fe)

**Figure (5): The heavy metal in honey bee worker's samples in Aswan Governorate.**

From the obtained results showed in Table (1) it could be summarized that, the high boron concentration was (-0.18 ppm) founded at Aswan. As the low was (-0.43 ppm) founded at Giza. While the high concentration of zinc was (0.36 ppm) founded at New Valley. Whereas the low concentration was (0.26 ppm) founded at Asyut and Aswan. But The high concentration of nickel was (0.02 ppm) founded at Beni-Suef . As the low one was (-0.01 ppm) founded at Giza. The high

molybdenum concentration was (0.03) founded at Aswan. As the low concentration was (-0.06 ppm) founded at Beni-Suef and Asyut. The high lead concentration was (0.41 ppm) founded at Asyut. As the low one was (0.28 ppm) founded at New Valley. The cadmium high concentration was (0.009 ppm) recorded the at Giza, Beni-Suef and New Valley. As the low was (-0.001 ppm) founded at Asyut and Aswan's workers body. The high concentration of copper was (0.47 ppm) founded at Beni Suef's . As the low was

(0.23 ppm) founded at Aswan's workers body. The manganese high concentration was (4.37 ppm) founded at Beni-Suef. As the low concentration was (1.02 ppm) founded at Asyut. The chromium recorded high

concentration at Giza, it was (0.17 ppm). As the low concentration was (0.05 ppm) founded at Asyut. The high concentration of Ferric founded at Giza was (1.6 ppm). As the low founded at New Valley was (0.25 ppm).

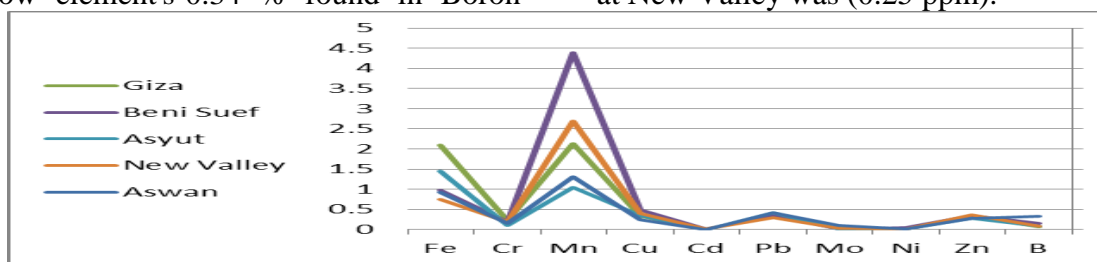
**Table (1): Heavy metal percentage in honey bee worker's samples from some Upper Egyptian Governorates.**

Governorates Differences	B	Zn	Ni	Mo	Pb	Cd	Cu	Mn	Cr	Fe	mean
Standards	0.5	0.01	0.02	0.07	0.01	0.001	0.01	0.02	0.05	0.5	0.119
Giza	-0.43	0.32	-0.01	-0.04	0.32	0.009	0.32	2.12	0.17	1.6	0.438
Beni-Suef	-0.34	0.34	0.02	-0.06	0.33	0.009	0.47	4.37	0.14	0.47	0.575
Asyut	-0.41	0.26	0	-0.06	0.41	-0.001	0.34	1.02	0.05	0.95	0.256
New Valley	-0.42	0.36	0	-0.04	0.28	0.009	0.38	2.67	0.14	0.25	0.363
Aswan	-0.18	0.26	0	0.03	0.41	-0.001	0.23	1.29	0.1	0.42	0.256
Mean	-0.356	0.308	0.002	-0.034	0.35	0.005	0.348	2.294	0.12	0.738	

**Boron (b), Zink (zn), nickel (Ni), molybdenum (Mo), lead (Pb), cadmium (Cd), copper (Cu), manganese (Mn), chromium (Cr) and iron (Fe)**

From the obtained results showed in Figure (6), it could be summarized that, the Giza Governorate has manganese was the high concentration (2.12 ppm). But the low element's was (-0.43 ppm) found in boron (less than the Egyptian's stander). The manganese recorded high concentration at Beni-Suef Governorate was (4.37 ppm) . As the low element's-0.34 % found in Boron

(less than the Egyptian's stander). However, the Asyut Governorate record that the high concentration was (1.02 ppm) founded in manganese (more than the Egyptian's stander). As the low one was (-0.41 ppm)(less than the Egyptian's stander). The high concentration of manganese founded at Aswan was (1.29 ppm). As the low founded at New Valley was (0.25 ppm).



**Boron (b), Zink (zn), nickel (Ni), molybdenum (Mo), lead (Pb), cadmium (Cd), copper (Cu), manganese (Mn), chromium (Cr) and iron (Fe)**

**Figure (6): Heavy metal in honey bee worker's samples from several Upper Egyptian Governorates.**

From the obtained data the following conclusion can be recommended; the most suitable Upper Egypt treatments Governorates for breeding honeybee was Asyut and Aswan. On the other hand, the Beni-Suef Governorate not recommended for breeding honey bee. The most pollution element was manganese and the less pollution was molybdenum.

Meany authors discussed this question and found that, lead accumulation happens slowly in young bees which feed mainly on pollen and is equally efficient when the contamination begins at foraging bees (Zhelyazkova *et al.*, 2004). The high content of cadmium on the surface of bees may occur as a result of very occasional atmospheric contamination, especially when the samples are not collected in the vicinity of industrial

areas (Perugini *et al.*, 2011 and Lambert *et al.*, 2012).

Porrini *et al.* (2003) indicated similar trends for distribution of lead and chromium, which are in higher concentrations on the surface than inside the body. It results from the fact that large part of chromium present in the environment is in the atmosphere (Seigneur and Constantinou, 1995).

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