Identification of Honeybees, _Apis Mellifera_ L. Based on Some Morphometric Analysis

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**ABSTRACT**

The honeybee (_Apis mellifera_ L.) one of the most vital societal insects. The importance of honeybee is the major pollinators, agricultural productions and honey production in worldwide. Nine different districts were randomly selected from El-Beheira governorate, Egypt to assess the subspecies and identification percent of mixing among colonies via estimating cubital index characters to determinate honeybees’ races. Overall means were 2.52. Analysis of variance is highly Significant differences (P value =0.00) at according to Tukey's Studied Range (HSD) test (α=0.05) for the different locations. Overall percentage for previous districts, the highest percent was 28.51% for the group of _A_. _m_. _ligustica_ or _A_. _m_. _carnica_, 21.54% for _A_. _m_. _mellifera_. Also, the category of _A_. _m_. _lamarkii_ percentage is 17.13%. Furthermore, _A_. _m_. _yemenitica_ or _syriaca_ category, multiplied by the percentage of 16.41%. The percentage of 16.41% for the of _Apis mellifera_ spp. we indicate that the Egyptian honeybee "_A.m. lamarkii_" percentage was lower than _A_. _m_. _carnica_ and _A_. _m_. _ligustica_ in Egypt.

**Keywords:** _Apis mellifera_ Races, Morphometric characters, cubital index, El-Beheira and Egypt.

1. Introduction

Honey bee one of the most vital societal insects. The importance of honey bee is the major pollinators and are important for numerous agricultural. Worldwide, insect pollination is estimated around 9.5 % and honey productions. Honey world production about 1.4 million tons/year (Gallai et al., 2009) (FAO/WHO, 2007). In Africa, honeybees are the very important hive products and is the major tool of producers venturing in beekeeping. (Sagwa, 2021).

In fact, National honeybee is _Apis mellifera lamarkii_ since 5000 years. This _A_. _m_. _lamarkii_ is lived in the local circumstances of the region. Then it was prevalent out Egypt (Hassona, 2017). Morphometric methods showed a vital role for classification honeybee subspecies. _Apis mellifera_ spp. are different based on behavior, physiological and morphological several taxonomy tool for example biochemical and morphometrics (Salehi and Nazemi-Rafie 2020; Ruttner, 1988). Estimating morphometric characters of honey bee in different time is very vital for races (Abou-Shaara and Ahmed, 2015). In Egypt, _A_. _m_. _lamarkii_ is being bred in a limited region of Assuit in Upper Egypt. By the time, honey bees in other regions of Egypt have gained some morphological, physiological and behavioral characters from different genetic resources (Eid et al., 2010).

To classify and compare the honeybee populations of Turkey, Syria and Iran based on their morphometric traits along the common border in the Southeast of Turkey (Ozbakır and Firath, 2013) used the univariate analysis and their results demonstrated that there are significant different between all the studies characters of honeybee samples (P <0.001) from the different locations. Cubital index is an essential characteristic of the wing veins used for determination of honey bees’ subspecies (Zaja et
al., 2017). Therefore, this current study aimed to identify the types of the honeybee races *Apis mellifera* subspecies based on cubital index character from different location in El-Beheira governorate, Egypt used to Scan Photo technique to investigate the morphometric variability of national honeybee.

2. Materials and Methods

2.1. Study area and Sample collection

From each apiary collected 5 colonies with 30 honeybee workers. Samples collected in summer 2019 at nine districts from ElBehira governorate, Table 1 and Figure 1. Usually, 10 honeybee workers from 5 to 6 colonies per colony was measured in morphometric studies. As a minimum, 30 wing Estimating per colony was measured. furthermore, from 30:50 (Hassona, 2012; Meixner et al., 2007; Smith et al., 1997).

**Table 1:** Samples number of honeybees collected from El-Beheira governorate for morphometric analysis.

| Districts       | Apiary № | Colony № | Worker № |
|-----------------|----------|----------|----------|
| Damanhour       | 2.0      | 10.0     | 300      |
| Shubrakhit      | 1.0      | 5.0      | 150      |
| Abu Al Matamir  | 2.0      | 10.0     | 300      |
| Abu Hummus      | 1.0      | 5.0      | 150      |
| Idku            | 2.0      | 10.0     | 300      |
| Kom Hamada      | 2.0      | 10.0     | 300      |
| Badr            | 1.0      | 5.0      | 150      |
| Itay Al Barud   | 1.0      | 5.0      | 150      |
| Nubariyah       | 1.0      | 5.0      | 150      |
| Total           | 13       | 65       | 1650     |

Fig. 1: Localities which worker honeybees collected for analysis in current study. (1) Damanhour, 31.0393°N 30.4674°E; (2) Shubrakhit, 31.0272°N 30.7136°E; (3) Abu Al Matamir, 30.9081°N 30.1743°E; (4) Abu Hummus, 31.0834°N 30.3097°E; (5) Idku, 31.3043°N 30.3004°E; (6) Kom Hamada, 30.7574°N 30.6978°E; (7) Badr, 30.5766°N 30.7115°E; (8) Itay Al Barud, 30.8857°N 30.6632°E and (9) Nubariyah, 30.6667°N 30.0667°E

2.2. Cubital index determination:

The forewings were transferred to transparent paper, scanned them with computer, Hp scanner, then transferred them to ImageJ v.1.52a program (Rasband, 2017) as a photo to measure the part a (C-B) and part b (B-A). After that, the measurements putted in Excel sheet to calculate the value of cubital index (a/b) in each wing for each worker sample (Figure 2). The data were in Excel sheet divided into
special categories of cubital index (≥ or ≤ 2.00 to 4.5) for *Apis mellifera* sp. (Ruttner, 1986) to indicate the frequency and variety of the (cubital index) in different experimented colonies.

Fig. 2: Cubital index (CI=cb/ba) in the forewing of honey bee worker (the photo was taken by Hassona, 2017).

2.3. Statistical analysis

The statistical analysis by SPSS program v 25.0 (IBM Corp, Released 2017). The obtained data were statistically analyzed by calculating the means. Analysis of variance "ANOVA" was carried out to check the significant differences between the samples. The Tukey's Studied Range (HSD) test was determined in p=0.05. The percent ratio of the multiplied computed in the current samples.

3. Results and Discussion

3.1. Biometric analysis of Cubital index (CI)

Results in Table 2 showed that the means of cubital index (C.I) were 2.69, 2.54, 2.71, 2.65, 2.30, 2.43, 2.46, 2.53 and 2.36 ratio for Damanhour, Shubrakhit, Abu Al Matamir, Abu Hummus, Idku, Kom Hamada, Badr, Itay Al Barud and Nubariyah, respectively. The maximum means was documented for the colonies belonging to Abu Al Matamir district (2.71±0.61), whereas the minimum was (2.30±0.46) in Idku district. Analysis of variance (ANOVA) in Table 2 and Figure 3 presented very highly Significant differences (P value =0.00) for the different locations was and F. value was 20.4.

The results demonstrated a significant difference between the samples collected from Abu Al Matamir, Shubrakhit, on the other hand, the results indicated that there are no significant between (Idku with Nubariyah) and (Kom Hamada with Badr). Also, there are no significant between Damanhour, Abu Al Matamir and Abu Hummus. Such as, there was significant between the samples collected from Idku and Itay Al Barud. The overall means of CI ranged among (2.12 to 2.67) at El-Manzla in El-Dakahlia Government (Hassona, 2017). In Beheira Governorate, the cubital index(CI) ranged among 2.45 to 3.38 reported by (Eid et al., 2010).

Table 2: Descriptive statistics and compare means of cubital index for the honeybee forewings

| Biometric analysis | Mean ± S.D | min | max | General mean | F Value | P Value |
|--------------------|------------|-----|-----|--------------|---------|---------|
| Damanhour          | 2.69b      | 0.62| 1.69| 4.79         |         |         |
| Shubrakhit         | 2.54bcd    | 0.51| 1.47| 4.26         |         |         |
| Abu Al Matamir     | 2.71a      | 0.61| 1.41| 4.63         |         |         |
| Abu Hummus         | 2.65abc    | 0.56| 1.45| 4.98         |         |         |
| Idku               | 2.30e      | 0.46| 1.31| 4.87         |         |         |
| Kom Hamada         | 2.43de     | 0.46| 1.6 | 3.97         |         |         |
| Badr               | 2.46de     | 0.4 | 1.74| 4.31         |         |         |
| Itay Al Barud      | 2.53cd     | 0.46| 1.73| 4.03         |         |         |
| Nubariyah          | 2.36c      | 0.39| 1.48| 3.62         | 2.52    | 20.4    | 0.00    |

*Means in the same column followed by the same letter(s) are not significantly different according to Tukey's Studied Range (HSD) test (α=0.05).*
3.2. Percentage of A. m. subspecies in the nine districts at El-Beheira governorate

Cubital index category of *Apis mellifera* (1.65 - 2.95) corresponding to Rinderer, (1986). When it's compared mean with cubital index for *A. m. subspecies* category of Damhanour belong to the category of *Apis mellifera* (2.5 - 2.9). In addition, the mean CI in Damanhour, Shubrakhit, Abu Al Matamir, Abu Hummus and Italy Al Barud (2.69, 2.54, 2.71, 2.65 and 2.53) close of the category of *A.m. ligustica* or *A.m. carnica* (2.5 – 2.9). On the other hand, Idku district was (2.30) nearly to *A.m. yemenitica* or *A.m. syriaca* (2.1 – 2.3). While CI mean from Kom Hamada, Badr, and Nubariyah districts (2.43, 2.46 and 2.36) may be its closely *A. m. lamarckii* (2.3 – 2.5).

The results in Table 3 showed the highest percentage of *A. mellifera mellifera* category (1.89 - 2.00) was 37% in Idku district. On the other hand, the lowest percentage was 13.33% in Abu Hummus district. The highest percent Category of *A.m. yemenitica* or *A.m. syriaca* (2.1-2.3) was 21.33% in Itay Al Barud and the lowest percentage (13.00%) in Abu Al Matamir. The third category *A. m. lamarckii* "Egyptian honeybee" (2.3 -2.5) was highest in Nubariyah by 27.33% and lowest in Damanhour by 11.67%. In Badr district was the highest percentage of *A.m. ligustica* or *A.m. carnica* category (2.5 – 2.9) by 36.67% and the lowest in Idku district by 17.67%. The last category *Apis mellifera* spp. "Unknown honeybee" (2.9-3.1) is highest percent in Idku by 37.00% and the lowest percent in Abu Hummus by 13.33%.

In Table 3 and Figure 4 as showed that overall percentage for All districts, the highest percent was 28.51% for the group of *A. m. ligustica* or *A. m. carnica*, 21.54% for *A. m. mellifera*. Also, the category of *A. m. lamarkii* percentage is 17.13%. Furthermore, *A. m. yemenitica* or *syriaca* category, multiplied by the percentage of 16.41%. The percentage of 16.41% for the of *Apis mellifera* spp. The study results agreed with (Mazeed, 2011), who indicated that *Apis mellifera carnica* percentage was higher than *A.m. lamarckii* in El-Beheira, Egypt. On the other hand, the results disagree with (Hassona, 2017), who indicated that *A.m. lamarckii* was higher than *A. m. carnica* in Dakhilia governorate, Egypt. Unknown honey bees may be hybrids from different races and cannot be identified reported by (Guzman-Novoa and Page Jr, 1994).
**Table 3.** Percentage of *A. m. subspecies* in the nine districts in El-Beheira governorate

| *Apis m. subspecies* | Damanhour % | Shubrakhit % | Abu Al Matamir % | Abu Hummus % | Idku % | Kom Hamada % | Badr % | Itay Al Barud % | Nubariyah % | General % |
|----------------------|-------------|---------------|-------------------|--------------|-------|-------------|-------|----------------|-------------|-----------|
| *A. m. mellifera* (1.89–2.00) | 17.00 | 20.00 | 13.67 | 13.33 | 37.00 | 26.00 | 17.33 | 16.00 | 26.00 | 21.54 |
| *A. m. yemenitica* or *A. m. syriaca* (2.1–2.3) | 14.33 | 15.33 | 13.00 | 13.33 | 18.33 | 18.33 | 20.67 | 21.33 | 14.67 | 16.41 |
| *A. m. lamarckii* (2.3–2.5) | 11.67 | 17.33 | 14.67 | 18.00 | 18.67 | 16.33 | 19.33 | 18.00 | 27.33 | 17.13 |
| *A. m. ligustica* or *A. m. carnica* (2.5–2.9) | 28.67 | 31.33 | 32.67 | 33.33 | 17.67 | 26.67 | 36.67 | 30.00 | 28.00 | 28.51 |
| *Apis mellifera* spp. (2.9–3.1) | 17.00 | 20.00 | 13.67 | 13.33 | 37.00 | 26.00 | 17.33 | 16.00 | 26.00 | 16.41 |
Fig. 4: Percentage of A. m. subspecies in El-Beheira governorate, Egypt

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