# Morphometric differences between honeybees (*Apis mellifera* L.) in some areas of Al-Batnan, eastern Libya

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**الملخص**

أجريت الدراسة لقياس بعض الخصائص المورفولوجيه (Apis mellifera L.) لنحل العسل التي تم جمعها من أربع مناطق / مواقع في منطقة البطنان بشرق ليبيا وهي: طبرق، عكرمة، التميمي أم الرزم. كما هدفت الدراسة إلى تحديد تأثير الموقع على الخصائص المورفولوجيه المدروسة. جمعت أربعون عينة (عشرة / مواقع) من خلايا النحل خلال فصلي الربيع والصيف 2021 وتم قتل نحل العسل باستخدام الأيثير بنسبة 70٪ ثم تم تقدير القياسات الظاهرية للحشرة. تم اخضاع البيانات للتحليل الإحصائي أظهرت النتائج أن موقع التجميع أثر معنويا على جميع SPSS باستخدام برنامج القياسات المدروسة باستثناء عرض الترجيت. سجل نحل طبرق أكبر عرض للرأس (4.90 ملم) وعرض الترجيت (5.63 ملم) وطول جزء الفم (8.22 ملم) وطول الجناح الخلفي (6.51 ملم) وطول الجناح الأمامي (9.23 ملم). كان لنحل التميمي أكبر قيم لطول الهوائيات (5.09 مم) وطول قاعدي (3.10 مم) وطول الساق (3.94 مم) وعرض الجناح الخلفي (6.84 مم) وعرض الجناح الأمامي (9.37 مم). وبحسب النتائج السابقة، خلصت الدراسة إلى أن نحل التميمي كان يتسم بحجم جسم كبير بينما تميز نحل طبرق بأطول جزء من فمه. أوصت الدراسة بالحاجة إلى مزيد من الدراسات مع عدد كبير من النحل لاختيار واستخدام النحل في موقع معين.

**الكلمات المفتاحية:** نحل العسل ، الصفات المورفولوجية ، التوصيف ، ليبيا.

**Abstract:**
The study carried out to measure some morphological characteristics of honey bees (*Apis mellifera L.*) collected from four / locations in Al-Batnan region, Eastern Libya which are: Tobruk,

Akrama, Al-Tamimi and Umm Al-Razam. Also the study aimed to determine the effect of location on the studied morphological characteristics. Forty specimens (ten/location) were collected from the hives during spring and summer season, 2021. Honeybees were killed by Ether 70% then the morphometric measurements were estimated. The measured data were subjected to analysis of variance and means separation using SPSS. The result showed that the location of collection significantly affected all studied measurements except of tergite width. The bees of Tobruk recorded significantly greatest of head width (4.90 mm), tergite width (5.63 mm), mouthpart length (8.22 mm), hind wing length (6.51 mm) and fore wing length (9.23 mm). The bees of Al-Tamimi area had greatest values of antennae length (5.09 mm), basitarsus length (3.10 mm), tibia length (3.94 mm) hind wing width (6.84 mm) and fore wing width (9.37 mm). According to previous results, the study concluded that the bees of Al-Tamimi were characterized by large body size while the bees of Tobruk were characterized by longest of mouthpart. The study recommend that more studies are needed with large number of bees to select and use bees of a certain location.

**Key words**: Honeybee, Morphological traits, characterization, Libya.

## Introduction

Honeybees (*Apis mellifera L.*) were distributed all over the world, with treasured significance of its dietary and medicinal products, in addition to its important role in plant pollination. Globally, there are about 25 of honey bees subspecies belonged to the genus *Apis* (Ruttner *et al*., 1978 and 1992). While the recent researches mentioned about thirty-three distinct honey bee subspecies are distributed across all Africa (11 subspecies), Western Asia and the Middle East (9 subspecies), and Europe (13 subspecies) (Ilyasov et al. 2020). The first classification of honeybee strains used to be primarily based on the variations of the measurement and coloration (DuPraw, 1964 and 1965). Ruttner (1988) categorized honeybees in accordance to their proboscis measurements and chitin components. Several research have been carried out on the morphological aspects of honeybees due to the fact of its significance in the classification

of this genus (Ruttner, 1988; Meixner *et al*., 2007). The morphological characteristics of honeybees are based totally on the length, color, and the wing vein measurements (Abou-Shaara, 2013). Variation in morphological traits of honeybees such as wing length, wing width and proboscis size helps distinguish between honeybee subspecies (Buco *et al*., 1987; Rinderer *et al*., 1993; Crewe *et al*., 1994; Ftayeh *et al.*, 1994; Diniz-Filho and Malaspina, 1995 and Szymula *et al*., 2010).
The classification of honeybee subspecies as it is viewed an essential element in retaining biodiversity in honeybee farming (Tofilski, 2004; Abou-Shaara and Al-Ghamdi, 2012). Morphological measurements of honeybees may be associated to honey yield (Kolmes and Sam, 1991). Many researchers mentioned that the honey manufacturing can be higher when selecting bees with huge wings in the foreground (Edriss *et al*., 2002; Szabo and Lefkovitch, 1988). Mostajeran *et al*., (2002) proven that the highest-excellent honey is intently associated with quite a few morphological characteristics of bees, inclusive of proboscis's length, forewing and hind wing length, and leg length. On the other hand, Waddington (1989) explained that the dimension of the physical character of bees is associated with the manufacturing of honey. The present study was carried out to determine and compare the morphological characteristics of honeybees collected from four locations in Al-Batnan district, north eastern of Libya.

## Materials and methods:

### Collection and preparation of bees:

Ten individuals of honey bees were randomly captured and collected from each area in Al-Batnan region namely (Akrama, Tubrok, Al-Tamimi, Umm Al- Razam). To reap such right measurements of the proboscis the honeybees were killed in Ether 70% (Ruttner, 1988). Morphometric measurements were estimated and measured by C -20 Mitutoyo Corporation, Kawasaki.

### Morphometric Characters

The proboscis length was measured after fixing it from the base of the postmentum, then was stretched with rigorous care on a slide

(Fig. 1, B). The width of the head was taken from the pinnacle of the head to the mandible. The length of antennae was measured from scape to flagellum. The length and width of both fore and Hind wing were measured from medial of the outer edge. The total length of leg was measured and taken for decided through summation of all legs' parts, which were the femur (Fe), the tibia (Ti), and basitarsus (BL) (Fig.1, C).

The body measurement index such as tergite 3 and 4 were stretched and fixed with Arabic gum and then were measured throughout the centerline of third and fourth tergite (Fig1, A.). **Statistical analysis:** Statistical analysis was run by SPSS software. Analysis of variance (ANOVA) was applied to detect the significant effect of location on morphological measurement. While Duncan multiple range test (DMRT) was used to separate means.

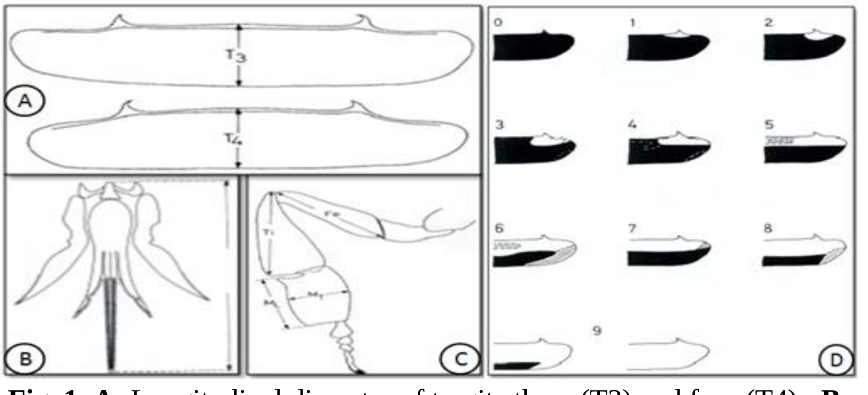


**Fig. 1. A-** Longitudinal diameter of tergite three (T3) and four (T4) ; **B-** (BL) Length of proboscis; **C-** Length of femur (Fe)bb, tibia (Ti) and basitarsus (bL)b; **D-** Classes of pigmentation of tergites 2-4 (Ruttner, 1988).

## Results and Discussion:

The overall means of head length (HL), head width (HW), Antennae length (ANT) and tergite three length (T3L) and tergite four length (T4L) were 4.42±0.37, 4.36±0.37, 5.02±0.06, 4.65±1.49 and 5.14±0.21 mm, respectively (table 1). These means greater than the previous findings reported by AL-Kahtani and Taha (2021) in Kingdom of Saudi Arabia who found that the means of Antennae length for Carniolan and Yemeni were 4.23±0.06 and 3.64±0.04

mm, respectively, 3rd tergite length were 2.33±0.01 and 2.03±0.01 mm and 4th tergite length were 2.30±0.01 and 1.95±0.01 mm.
Marghitas et al. (2008) found that in the mountain regions of Transylvania worker proboscis were longer(average = 6.21 mm) than that in lower regions(average = 5.99 mm) , and T3 length of all samples (P = 0,43154) and for T4 (P = 0,68815) . Moreover, the results showed that the location significantly (P<0.05) affected the head length, head width, Antennae length and tergite three length, however, insignificantly (P<0.05) influenced 4th tergite length. In addition, the results revealed that the hony bees of Umm Al-Razam recorded greatest head length, followed by those of Al- Tamimi (4.54 mm), while those of Tobruk (4.22 mm) and Akrama (4.05 mm) had the lowest head length. On the other hand, bees of Tobruk recorded significantly greatest of head width (4.90 mm) and tergite 3 width (5.63 mm), while bees of Al-Tamimi recorded the lowest of the corresponding values. The bees of Al-Tamimi had significantly longer antennae (5.09 mm) than that of the other bees collected from the other locations. The lengths of the 3rd and 4th tergites refer to the length and width of the abdomen and the size of the honey stomach, which affect the amount of gathering of nectar and honey yield (Helal *et al.*, 2003 and Taha, 2000).

**Table 1. Effect of location on some morphological characteristics head length, head width, antennae length, tergite 3 and tergite 4 length of honey bees**

| Location | HL | HW | ANT | T4L | T3L |
|---|---|---|---|---|---|
| **Al-Tamimi** | $4.54^{b}$±0.12 | $3.92^{c}$±0.07 | $5.09^{a}$±0.10 | $5.17^{a}$±0.27 | $2.12^{c}$±0.11 |
| **Umm Al-Razam** | $4.88^{a}$±0.22 | $4.28^{b}$±0.16 | $5.00^{b}$±0.00 | $5.03^{a}$±0.26 | $5.46^{b}$±0.17 |
| **Akrama** | $4.05^{c}$±0.16 | $4.34^{b}$±0.12 | $5.00^{b}$±0.00 | $5.14^{a}$±0.09 | $5.41^{b}$±0.11 |
| **Tobruk** | $4.22^{c}$±0.27 | $4.90^{a}$±0.12 | $5.00^{b}$±0.00 | $5.21^{a}$±0.15 | $5.63^{a}$±0.17 |
| **Overall** | **4.42±0.37** | **4.36±0.37** | **5.02±0.06** | **5.14±0.21** | **4.65±1.49** |
| **Sig. level** | * | * | * | NS | * |

*****: Significant at P<0.01; **NS**: Insignificant at P>0.05
**a,b,c**: means with same letters were significantly (P>0.05) different.
**HL**: head length; **HW**: head width; **ANT**: antennae length; **T3L**: tergite 3 length; **T4L**: tergite 4 length

Table 2 shows the influence of location on some morphological traits such as basitarsus length (BL), tibia length (TL), femur length (FL) and mouth part length (ML). The results showed the overall means of basitarsus length, tibia length, femur length and mouth part length were 2.30±0.48, 3.30±0.42, and 3.70±0.53 and 5.67±2.81 mm, respectively. AL-Kahtani and Taha (2021) studied two species of honey bee workers in Kingdom of Saudi Arabia namely Carniolan and Yemeni and found that the averages basitarsus length (6.20±0.56 and 5.28±0.53 mm), tibia length (3.09±0.02 and 2.55±0.03 mm), femur length (2.84±0.03 and 2.44±0.01 mm) for two species. Marghitas et al. (2008) found in his study in the mountain regions of Transylvania length of the leg present at samples from lower regions (average = 8.99 mm) and the mountain regions (average = 9.22 mm). femur (P = 0,00527), tibia (P = Moreover, the results revealed 0,0006), metatarsus (P = 0,00229). that the location significantly affected the above traits. The bees of Al-Tamimi region had significantly greatest basitarsus length (3.10 mm) and tibia length (3.94 mm), while they had the lowest values of femur length (2.85 mm) and mouthpart length (1.00 mm). On the other hand; the bees of Tobruk recorded the greatest mouth part length (8.22 mm), while the bees of Umm Al-Razam recoded greatest value of femur length (4.00 mm). This is agree to Allen's rule (Ruttner, 1988): the length of proboscis and leg are decreasing in warmer climates.

**Table 2. Influence of location on some morphological characteristics of honey bees**

| Location | BL | TL | FL | ML |
|---|---|---|---|---|
| **Al-Tamimi** | $3.10^{a}\pm0.14$ | $3.94^{a}\pm0.07$ | $2.85^{b}\pm0.34$ | $1.00^{d}\pm0.00$ |
| **Umm Al-Razam** | $2.05^{b}\pm0.06$ | $2.94^{c}\pm0.07$ | $4.00^{a}\pm0.01$ | $6.86^{b}\pm0.22$ |
| **Akrama** | $2.07^{b}\pm0.13$ | $3.03^{c}\pm0.09$ | $3.99^{a}\pm0.05$ | $6.60^{c}\pm0.21$ |
| **Tobruk** | $2.01^{b}\pm0.09$ | $3.28^{b}\pm0.30$ | $3.96^{a}\pm0.05$ | $8.22^{a}\pm0.22$ |
| **Overall** | **2.30±0.48** | **3.30±0.42** | **3.70±0.53** | **5.67±2.81** |
| **Sig. level** | * | * | * | * |
| | | | | |

*: Significant at P<0.01

**a,b,c,d**: means with same letters were significantly (P>0.05) different.
**BL**: Basitarsus length, **TL**: Tibia length, **FL**: Femur length, **ML**: Mouth part length

Hive location has also influenced some of morphological characteristics of honey bees (Table 3) such as hind wing width (HWW), hind wing length (HWL), fore wing width (FWW) and fore wing length (FWL). The results explained that the overall means of hind wing width, hind wing length, fore wing width and fore wing length were found to be 3.76±1.83, 5.72±1.19, 5.28±2.40 and 8.33±0.65 mm, respectively. AL-Kahtani and Taha (2021) studied two species of honey bee workers namely Carniolan and Yemeni and found the means of hind wing width for species were 2.21±0.01 and 1.67±0.01 mm, hind wing length were 6.74±0.02 and 5.85±0.01 mm, fore wing width 3.53±0.02 2.44±0.03 mm and fore wing 6.74±0.02 5.85±0.01 mm. Also, the results showed that the location had significant influence on the above characters.

**Table 3. Influence of location on some morphological characteristics of honey bees**

| Location | HWW | HWL | FWW | FWL |
|---|---|---|---|---|
| **Al-Tamimi** | $6.84^{a}$±0.29 | $3.71^{c}$±0.20 | $9.37^{a}$±0.34 | $7.83^{c}$±0.33 |
| **Umm Al-Razam** | $2.60^{c}$±0.10 | $6.35^{ab}$±0.10 | $3.72^{c}$±0.13 | $7.86^{c}$±0.12 |
| **Akrama** | $2.43^{c}$±0.24 | $6.31^{b}$±0.15 | $3.82^{c}$±0.08 | $8.39^{b}$±0.18 |
| **Tobruk** | $3.19^{b}$±0.20 | $6.51^{a}$±0.30 | $4.23^{b}$±0.13 | $9.23^{a}$±0.48 |
| **overall** | **3.76±1.83** | **5.72±1.19** | **5.28±2.40** | **8.33±0.65** |
| **Sig. level** | * | * | * | * |

*****: Significant at P<0.01
**a,b,c**: means with same letters were significantly (P>0.05) different.
**HWW**: Hind wing width, **HWL**: Hind wing length, **FWW**: Fore wing width, **FWL**: Fore wing length.

Some other factors that may impact on wing and body morphological characteristics were reviewed by Abou-Shaara (2013). Moreover; the bees of Al-Tamimi recorded significantly greatest hind wing width (6.84 mm) and fore wing width (9.37 mm), then values of those bees collected from Tobruk with corresponding values of 3.19 and 4.23 mm. while the bees collected from Umm Al-Razam and Akrama recorded the lowest values. On the other hand, the bees of Tobruk recorded the highest values of hind wing length (6.51 mm) and fore wing length (9.23 mm) followed by those values of bees which were collected from Akrama with corresponding lengths were 6.31 and 8.39 mm.

Here we agree with Bergmann's rule about the differences between geographic races is stating that the ecotypes are larger in cool climate than in the warm (Ruttner, 1988).

## Conclusion

The findings of this research concluded that the honeybees of AL-Tamimi and Tobruk locations were characterized by large body size, also the honeybees of Tobruk location were characterized by longest of mouthpart. The study recommend that more studies are needed with large number of bees to select and use bees of a certain location. Also the study recommend to use new method to characterize honeybees was called Scan Photo method developed by Abou-Shaara *et al.* (2011).

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