

Taxonomy of genus *Brachymeria* species (Hymenoptera: Chalcididae) in Egyptian fauna

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Abstract:

Brachymeria Westwood (Hymenoptera: Chalcididae) is widely distributed and it considered the most common genus of chalcid parasites of many pests of agricultural importance in Egypt. The valid species of *Brachymeria* which are studied : *B. aegyptiaca* Masi, *B. albicrus* Klug , *B. ancilla* Masi, *B. brevicornis* Klug, *B. excarinata* Gahan, *B. femorata* Panzer , *B. fonscolombeii* Dufour , *B. kassalensis* Kirby, *B. libyca* Masi as the first record in Egypt , *B. minuta* Linnaeus, *B. somalica* Masi , *B. vicina* Walker , and recorded from Egypt. This study is including description which support by illustration photography; distribution data and key of 12 *Brachymeria* species. The hosts of some species in Egypt are showed .DNA sequences of *B. femorata* obtained.

Introduction

Chalcidids comprise a very important beneficial group of parasitoids .Many species of the family are important parasitoids that have been used successfully for the biological control of many insect pest species. The genus *Brachymeria* Westwood , belongs to the subfamily Chalcidinae. Apparently, there are almost 300 species of *Brachymeria* in the world (Noyes, 2011). *Brachymeria* parasitize of the mature larvae and pupae with wide range species of various orders. They play significant role in the ecosystem of various economic important crops. In Egypt *Brachymeria* includes the most common and wide taxa distributed of the family Chalcididae .Many species

of this genus are primary endoparasitoids of families Lepidoptera; Diptera and Coloeoptera. On the other hand , sometime hyperparasitic species are found on parasitize on Diptera (Tachinidae) and Hymenoptera (ichneumonid). Therefore the identification of the species concerned are highly important of many host-parasite which study for biological control involving this genus (Joseph *et al.*, 1973). Accurate techniques to detect and identify parasitoids are a prerequisite for understanding and managing host-parasitoid needed to interactions: for example, they are measure and monitor parasitism rates (Agusti *et al.*, 2005).

Today parasitoids have been detected within hosts of Diptera, Lepidoptera, Heteroptera, and Coleoptera by DNA-based methods. These studies, utilizing the Polymerase Chain Reaction (PCR), have shown that parasitoid detection is possible at high specificity and sensitivity level (Greenstone, 2006). Studies on the taxonomy, ecology and genetic of parasitoids can be supply the basic information which necessary for biological control and for its efficient operations as strategy point undertaking integrated control plan in Egypt.

Materials and methods

1. Morphological methods:

The taxonomic study of family Chalcididae in Egypt depending on specimens which collected from the field survey and as well as the materials which kept in the main reference insect collections in Egypt. The Egyptian insect collection included, Ministry of Agriculture, Ain Shams University, Cairo University, and Al-Azhar University. The identifications or compare of specimens and terms were, mostly, carried out using Bouček (1952, 1956 and 1988); Habu (1960); Masi (1929 and 1936); Nikol'skaya (1952); Joseph *et al.* (1973) and Narendran and Achterberg (2016). Descriptions of all specimens were based mainly upon external morphological characters of the adult males and females whatever available. Some parts of insects measured by the gradual lens, then compare them. Using the Sony lens 20.1 Mega pixels. The different body orientation of the insects were photography as well as the parts in the description object. All examination, descriptions, distinction, measurement process and Photographer operations for specimens were made by use of a stereoscopic binocular microscope.

2. Genetic method:

Due to the relative numerical abundance of *B. femorata* parasitoid in the field and their accessibility in some areas were used in the genetic experiment as follow:

2.1. Collected the parasitoids :

Pieris rapae (L.) (Lepidoptera : Pieridae) pupae collected from the fields of cabbage, (1/2 Fadden), located in Qaha, Qalyubia during September and October, pupa stages of cabbage worm were collected in cloth bags, closed with rubber band and transferred to laboratory. The collected parasitoid pupae were confined individually in test tube (1.5×1.5 cm.), covered by muslin cloth and tightened with a rubber band. A droplets of pure bee honey were put inside the glass tube wall for feeding by emerged parasitoids and kept under laboratory condition. Six live individuals from the parasitoid were used for the experiment. All the follow steps are specific to protocols of each of GeneJET Genomic DNA Purification Kit #K0721, #K0722. (Zilinskiene, 2012) and PCR Purification Spin Protocol (QIAquick Spin Handbook 03/2008).

2.2. Primer 28s :

F(GACCCGTCTTGAAACACGGA3')R (5' TGCGAAGGAACCAGCTACTA 3')

2.3. Machines used:

The PCR machine used is "Veriti 96 Well Thermal Cycler" from Applied Biosystems. The sequencer details is "3500 Genetic Analyzer" Applied Biosystems. Gel documentation (G:BOX) (SYNGENE model 680XHR) Made in UK. Species and related species were identified by the GeneBank.

Results and discussion

1. Key of *Brachymeria* species in Egypt:

- 1- Preorbital carina and postorbital carina present.....3
 - Preorbital carina and postorbital carina absent..... *B. albicrus* Klug.

- 2-Preorbital carina present and postorbital carina absent.....7
 - Preorbital carina absent and postorbital carina present.....8
 3-Sixth abdominal tergite weakly pitted and sparsely bristled.....4
 - Sixth abdominal tergite with coarse dense punctures and covered with dense bristles.....6
 4- Hind femora length more than or at least 1.80-2.00 times of width, with apical patch; hind tibia red, with sub basal and apical patches. apical patch of hind femora ;sub basal and apical patches of the hind tibia whitish.....*B. fonscolombei* Dufour.
 - Hind femora length equal or less 1.80 times of width, mostly black, apical yellow; hind tibia mostly black. Apical and subbasal part yellow or brownish-yellow.5
 5-scape, mostly light color, hind femur with expanded yellow spot apically, and dark parts of tibiae reddish*B. brevicorinis* Klug.
 -scape dorsally dark color and tibiae dark parts brownish black*B. minuta* L.
 6- Hind femur less elongate ,shiny, covered with pubescence, with one big reddish patch, and apical with yellowish ring ; provided with 12 black teeth*B. vicina* Walker
 -Hind femur more elongate, weakly shining , outer part pubescence, brownish red and yellow; provided with 11 dark brown teeth*B. ancilla* Masi
 7-Hind tibia black with basal slightly reddish and clear yellowish patches subbasally and apically , scrobe extended to front ocellus..... *B. excarinata* Gahan
 - Hind tibia yellowish, scrobe slightly distant from front ocellus.....*B. somalica* Masi
 8 -Hind coxae dentate below. *B. kassalensis* Kirby.
 - Hind coxa not dentate below.....9
 9- Antenna, mostly black..... 10
 -Antenna completely orange - reddish*B. libyca* Masi
 10- Hind femur black in median dorsal*B. femorata* Panzer
 - Hind femur black, opaque with small yellow mark apically....*B. aegyptiaca* Masi

2. Description:

2.1. *Brachymeria aegyptiaca* Masi, 1931 (Figure ,1) :

Body : Length 4.0 mm, black, with short erected silver hairs.

Head: Flat dorsally ,provided with three bright yellow ocelli, compound eyes yellow, dim , ovate and protruding ; face with minute sculpture ; scrobe area deep dark; epistoma tubercle obliterate, clypeus margin motivate ; postorbital carina thin and perpendicular. occiput little oblique behind eyes and narrow; ocelli small ,circular and scattered, compound eyes small developed and into circle; width of ocellar area equal three fourth of inter-ocular space width at level of hind ocelli; scrobe cavity narrow; interorbital space high equal wide ; antenna black yellowish ;radical strong, small and yellow , scape brown ;pedicel bright brown, ball shaped and elongate; flagellum dark brown and 9 flagellomeres, 1st and 2nd flagellomere elongate, other seven flagellomeres long equal width ; club rounded end.

Thorax: Long equal one and half times of width with dense shallow punctured ; pronotum black, basal ridge, interrupted in middle with angle apically and rounded in median third ; parapsidal furrows deep ; scutellum convex , flatten, with rounded apical; scutellum with complete apex ; scutum and scutellum contiguous and symmetrically; propodeum plated; thorax sloping gradually behind scutellum ; tegula yellowish and triangular shaped with silver short hairs distally; forewing with marginal vein length equal one-half of sub –marginal vein , three times of post marginal vein , and equal four times of stigma vein length ; veins brown and submarginal base yellow ;leg yellowish and brown, covered with soft short hairs ; femur apex yellow with short spot; anterior tibia black, proximal and distal

thirds yellow with black median or proximal half yellow and distal half black brownish; tarsi yellow, rufous with five segmented, ended with two black thin claws; hind legs enlarged; hind coxa fusiform, hairy and blackish; trochanter brownish, rounded and covered with hairs; hind femur strong, black, dorso-ventral bright, covered with small silver soft hairs, distal yellowish, external margin with dense, punctate and provided 10 teeth perfectly clear; teeth of distal margin small and convergent, last two teeth invisible; hind tibia yellowish brown, equal femur in length, curved shaped, proximal and distal yellowish, large with reddish black ring in ventral median, apex truncated, arolium brownish and short.

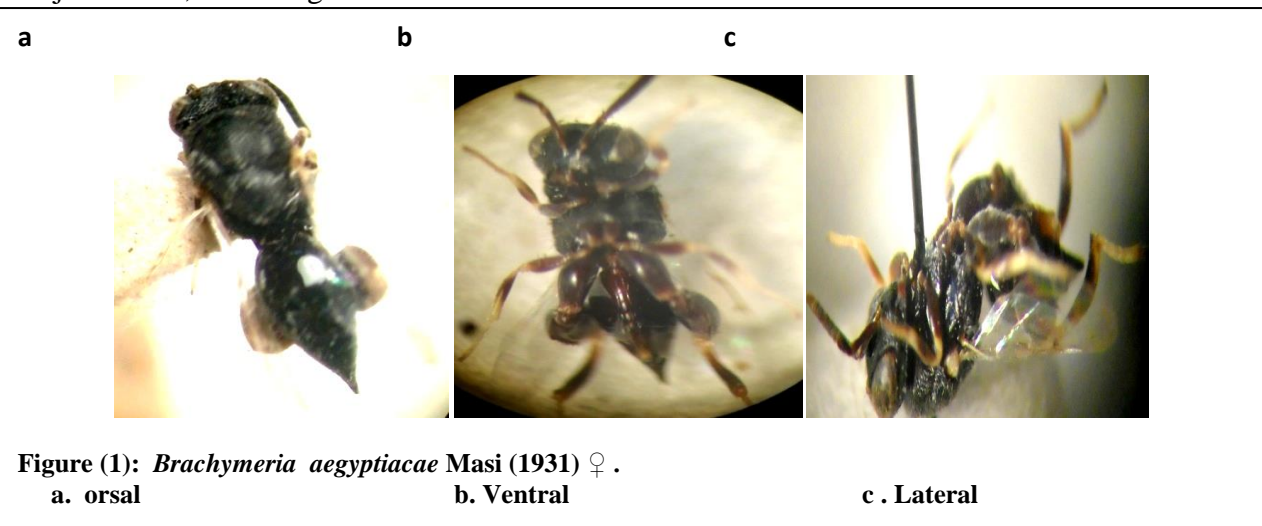
Abdomen: Glazy, spindle, conical and with pointed apical consisted 7 segments, first 4 segments separate and rest of conjunctivitis; 1st tergite smooth and

dorsal bright black; 1st and 2nd segments glazy dorso-ventrally; 3rd and 4th tergites covered with one row of bristled; from 5th tergite to last segment covered with silver hairs, 5th segment with punctures and bristles; tergites 2-5 with finely reticulate and covered with scales; 6th tergite small, last two segmented formed genital capsule.

Specimens

examined: 1♀, Alexandria, 5.9.2013; 1♀, Faiyum, 10.2016; 1♀, Giza 30-11-2014; 1♀, Giza 23.11.2014; 1♂, Mitghamer, 16.11.2014; 1♀, Wadi Al-Arish 9.2014; 2♀, Wadi El Natrun, 10.2015 and 11.2017 on Olive, Pomegranate from *Virachola livia* and *Palpita unionalis* pupae. **Geographical zone:** Costal stripes, Lower Egypt and Sinai.

Distribution: Cyprus (Bouček, 1956), Iraq (Al-Maliky and Al-Izzi, 1986) and Palestine.



2.2. Brachymeria albicrus Klug, 1834
(Pseudochalcis indica Mani, 1935)

(Figure ,2):

Body: Female length 5 - 5.5 mm; black with reddish; fatness; covered with small silver and pubescence.

Head: Flat; punctate; vertex with interspaces between pits rugose; occiput with strong sloping; ocelli brownish;

distance between median and lateral ocellus equal 0.4 times of interocellar distance; face covered with dense velvet short silver hairs; height of compound eyes equal 2.3 times of width; scrobe length 1.5 times of width; inter antennal projection triangular; malar space height equal 0.22 times of eye height; frons without preorbital carina, postorbital

carina absent; antennae stout; scape not exceeding to front ocellus; club biarticulate.

Thorax: Punctuate, width equal two thirds of length, pronotum plano concave; mesoscutum less half of length thorax; scutellum rounded ,bilobate raised proximally, wide equal long , perpendicularly declined posteriorly; metathorax scabrous; propodeum with acute lateral tooth ; tegula triangular shape and light yellowish. Wings limpid; veins brownish .First and second legs light yellow, third legs reddish. Hind coxae hairy , ventral with densely minute punctured; hind femora red, enlarged, strong, equal 1.75 times of wide , with minutely punctured, distal margin with a row of 13 black teeth not equal in

size ; hind tibia curved , equal femur in length; tarsi yellowish , 5th tarsomeres claws dark brownish .

Abdomen: Reddish, ovate .smooth 6th covered with dense tuft hairs; hypopygium smooth; ovipositor short.

Specimens examined: 2 ♀, Aswan, 21.6.2013; 1♀, Wadi El Natrun, 9.2014 on pomegranate by *Danais chrysippus* pupae.

Geographical zone: Upper Egypt and Western Desert.

Distribution: Ethiopia (Azerefeagne, 1999), India (Gowri *et al.*, 2016), Iran (Lotfalizadeh *et al.*, 2012), Nepal (Walker, 1846), Pakistan (Fry, 1989) Papua New Guinea (Narendran and Joseph, 1975) and Somal.

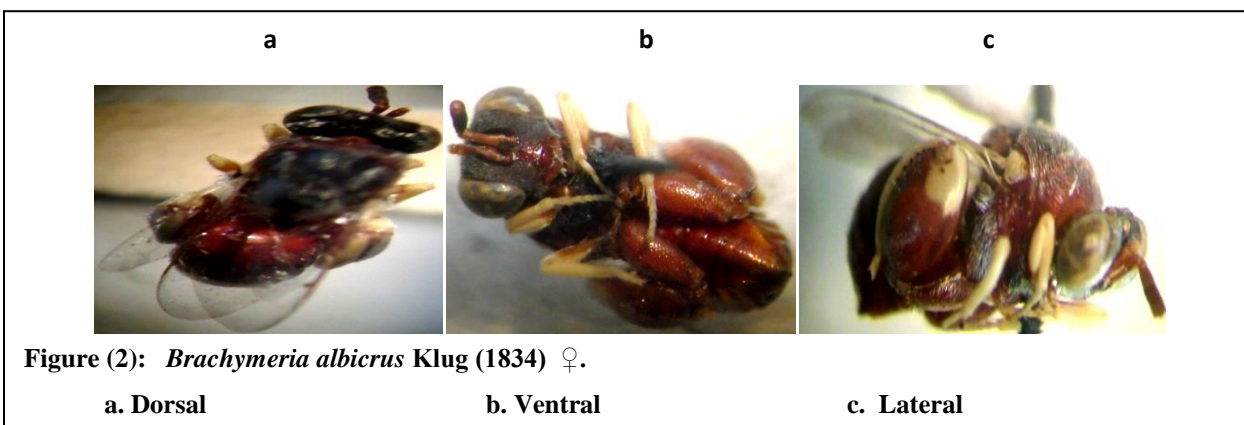


Figure (2): *Brachymeria albicrus* Klug (1834) ♀.

a. Dorsal

b. Ventral

c. Lateral

2.3. *Brachymeria anecilla* Masi, 1951a (Figure , 3):

Body: Length 4 mm width 0.8 mm ,black; covered with short white hairs and some fuzz.

Head: Blackish; equal thorax width with dense punctures; dorsal pitted, ocelli small , circular and dark brown; distance between lateral ocelli equal three times of distance between compound eye and lateral ocellus; scrobe cavity touching median ocellus; eyes leather texture, color black brown and convex shaped; malar space trapezoid form; preorbital carinae, genal carinae , clypeus and inter-antennal projection distinct;

right mandible with two blunt teeth; antennae brownish red and stout ; torulus circular; scape slightly yellowish and short; pedicel length equal width; ring segment narrow and transverse; flagellum coarse, thickened towards apex, first basal segments long and narrow , segments 3-7 transverse; club semi spire.

Thorax: Curved; densely punctured, hairy; pronotum long laterally and short medially ; scutellum nearly rounded, moderately convex, divided in two lobes; propodeum provided laterally with small triangular tooth; tegulae yellowish and triangular shaped, wings hyaline; veins dark brown, forewing covered abdominal

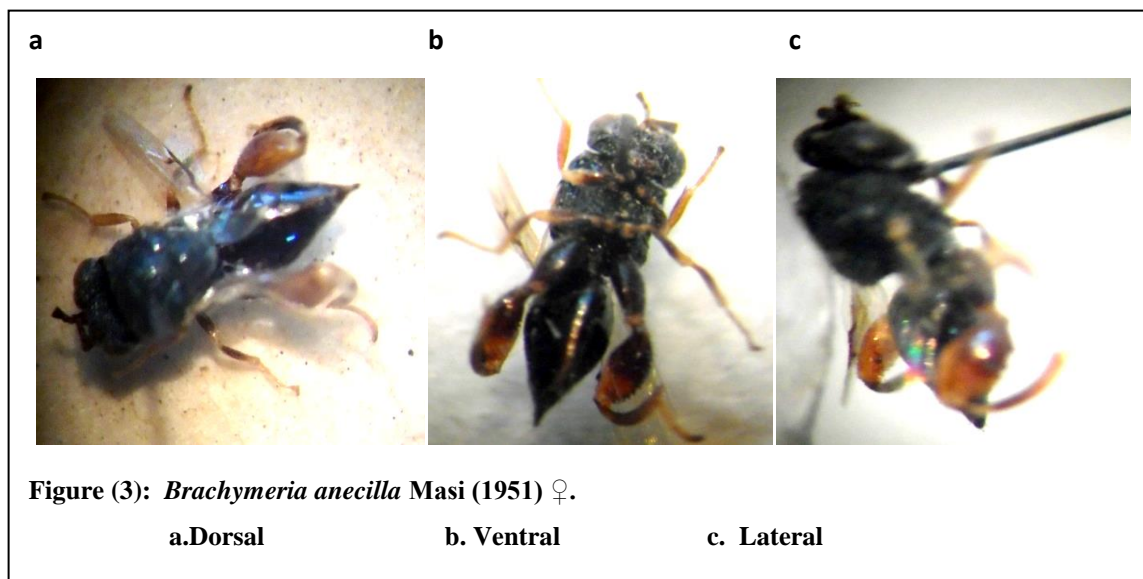
segmented; marginal vein of hind wing yellowish and equal two times of post-marginal vein or equal one half of sub-marginal vein or equal one and half stigma vein ; 1st coxa blackish; trochanter black, fumer brown yellowish; tibia yellowish with spurs; tarsus yellowish with 5 tarsomeres, 1st tarsomere length large; arolium and claws brown; second leg brownish and yellowish; third legs enlarged and robust ; hind coxa spindle shaped , black with simple yellow ring distally, trochanter oblong, with circular bit, and dark brownish; hind fumer enlarged, elongate, weakly shining , outer side with pubescence, brownish red with yellow; lower margin with small dark brown with 11 teeth; hind tibia yellow with

middle brownish red; hind tarsi yellowish red.

Abdomen: Conical shaped , shiny black and brown on ventral side; female end pointed, as small funnel, nearly as long as thorax; with dorsal white prominent specks, 1st tergite shiny and enlarged followed by second tergite; 2nd tergite equal one- quarter of 1st and covered with long bristles; each of 3rd ,4th and 5th tergites equal quarter of second tergite; 6th tergite hairy with densely punctured; segments 7-8 compressed laterally; ovipositor sheath blackish ,more visible in dorsal and ventral .

Specimens examined: ♀, Giza, 15.10.2013, Sweeping

Geographical Zone: Lower Egypt



2.4. *Brachymeria brevicornis* Klug, 1834 (*Chalcis brevicornis* Klug, 1834) (Figure ,4):

Body: Female length 3 - 6 mm, male length 3-4 mm . body black covered with silver hair.

Head: Wide equal 2.5 times of long; distance between lateral ocellus and compound eye equal 0.88 times of median ocellus diameter; mandible elongate, brown and red ,with two black

teeth; clypeus conspicuously transverse, with piliferous points; postorbital carina present; gena with sparse puncturation, frons with preorbital carina; eyes small ;scape not reaching to median ocellus, long 3.6 times of wide ,pedicel transverse; flagellum dark brown to black , fusiform ;funiculars transverse and decreasing progressively in length; club

red yellowish ; tapering from base to apex.

Thorax: Long equal 1.37 times of broad; mesonotum with golden setae and punctures; scutellum long 0.88 times of broad; propodeum steeply sloped. Fore wing long equal 2.8 of broad; marginal vein long equal 2.38 times of postmarginal vein; hindcoxa moderately slender; hindfemur long 1.8 times of broad ; ventral margin with 12 teeth progressively closer to each other; tarsi yellowish. *Abdomen* oval shape, equal 1.79 times of broad; punctured anterior

laterally. 1st tergite smooth with concave posterior margin; 2nd tergite with piliferous points basally and setae laterally; tergites 3–5 with setae subapically; 6th tergites covered with setae and piliferous points; ovipositor sheath short.

Specimens examined: ♂, Cairo, 11-10-2016; ♀, Cairo, 27.10. 2016; ♀, Giza, 8.2016 ; ♀, Qaha, 9.2015; ♀, Nag Hamadi, 20.9.2017 on Cotton from *Earias insulana* pupae

Geographical zone: Lower Egypt and Upper Egypt.

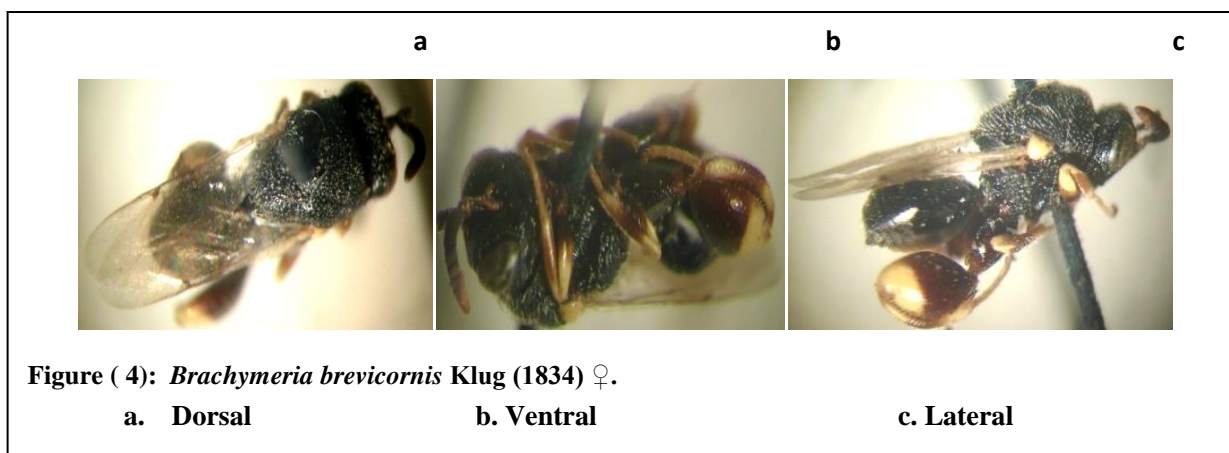


Figure (4): *Brachymeria brevicornis* Klug (1834) ♀.

a. Dorsal

b. Ventral

c. Lateral

2.5. *Brachymeria excarinata* Gahan, 1925 (*B. apantelesi* Risbec, 1956)

(Figure, 5):

Body: Length 3 mm, shiny; black with yellowish, reddish or brownish spots; covered with silver pubescence and bristles.

Head: Width less thorax width ;dorsal with weakly pitted; vertex umbilicate punctate; width of ocellar area equal 0.75 of interocular space at level of hind ocelli; interocellar distance equal 2.33 times as wide as hind ocelli major axis; eyes brown and convex , width of eye equal 0.75 of height; dorsal frons irregularly carinate and ventral faintly carinate; preorbital carinae distinct ;scrobe polished , reaching to front ocellus and deep; inter – antennal projection narrow; malar space height

less half of compound eye height; postorbital carina absent; fronto-genal suture complete; front and hind genal angle rounded; clypeus shining with few shallow punctures; right mandible with three pointed tooth ;antenna blackish , not stout; scape elongate ,brown , smooth ,equal combined segments 4 to 7 in length and apical one-third contracted; pedicel black; flagellum with same thickness; segments 4 - 10 equal in length; club brownish red equal two times of segment 10 .

Thorax: Pronotum with apical rounded, lateral carinate; parapsidal furrows as shallow grooved ;scutellum apical narrow explanate and reflexed , outer margin covered with long silver hairs, posterior margin slightly declined, not bilobed; wide equal 1.2 times of long ;propodeum

powerful declined ; tegulae yellow with basal reddish brown ; wings hyaline; veins dark reddish brown , length of fore wing equal 1.6 times of width; postmarginal vein less one half of marginal vein; legs black with yellow ; hind tibiae curved, black with reddish basal and subbasally, apex with long yellow patch ,with brown outer side ,inner side with patch becoming brownish and attaining both ventro-lateral carina and apical margin , equal hind femur length; hind coxae with distinct dense punctures, pubescence and distinct microsculpture ventrally; hind femur enlarged , width equal 0.4 of length ; outer side with dense pubescent, distinct reticulate and minute punctures ; inner side with less pubescent, and distinct punctures ;outer ventral margin with 12 teeth; basal with one large tooth; tarsi 5

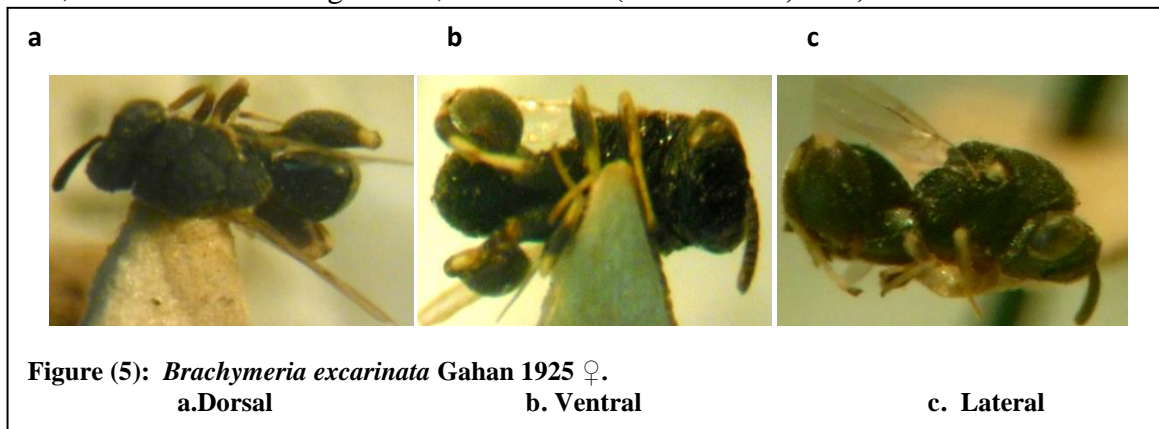
segments and yellowish ; claws and arolium dark reddish brown.

Abdomen: Black, shiny with partially brownish, short, covered with silver hairs; width less length; pointed posteriorly; 1st tergite smooth and long; 2nd tergite finely dense punctate and bristles dorsally, lateral with distinct microsculpture ; 6th tergite very rough with shallow bristled pits and distinct microsculpture; epipygium fairly compressed form sides, with middle carinate; genitalia elongate.

Specimens examined: 2♀, Helwan 27.9. 2014, Sugercane

Geographical zone: Lower Egypt

Distribution : Cameroon (**Narendran and Achterberg , 2016**) , China, India , Iran, Japan, Papua New Guinea, Philippines (**Herting, 1975**), Taiwan (**Chien *et al.* ,1984**) and Vietnam.



2.6. *Brachymeria femorata* Panzer, 1801 (*Chalcis ornatipes* Cameron, 1906) (Figure,6):

Body: Length 4.2 - 6.5 mm, black ; with yellow brown, batches and covered with silver pubescence hairs.

Head: Black , half-shiny; triangular shaped ; width of head converges with thorax width; vertex flat ; scrobe deep and smooth faintly rugose ; ocelli rounded and dark brownish ; width of ocellar area equal 0.75 of interocular space at level of hind ocelli ; compound

eyes glabrous, black, with yellow or dim brown and convex; preorbital carinae not existing; postorbital carina distinctly; antenna black and stout , funicle with trichoid sensillae on ventral side (male) ; club long equal 2 times of segment 10th with slight red end.

Thorax: Thick structure, dorsal with pits, inter spaces between pits narrow and carinate; pronotum irregular shaped; scutum width approximates the length; scutellum fairly high laterally, semi-circular and less scutum, strongly, with

scutellum declined with long silver hair posteriorly, apical part widely and reflexed, apex emarginated and bilobed; propodeum slope, coarsely sculptured with one sharp protuberance; tegulae white yellowish and blackish base; wings hyaline with small black particles and beginnings orange color; fore wing length equal 2.7 times of wide; veins yellowish and dark red brown, margin vein equal 0.55 of submarginal, post margin equal 0.25 of marginal; legs shiny, black brown and yellowish; hind legs strong, hind coxa spindle shape, reddish brown with basal black; hind femur enlarged, reddish brown with yellowish white spot distally; length equal 1.9 times of width, ventro-distally with one small protuberance; ventral margin saws shaped with ten brownish red and black large and acute teeth; hind tibia reddish brown with yellow spots, inner margin dark brown; tarsus brownish and 9 segmented.

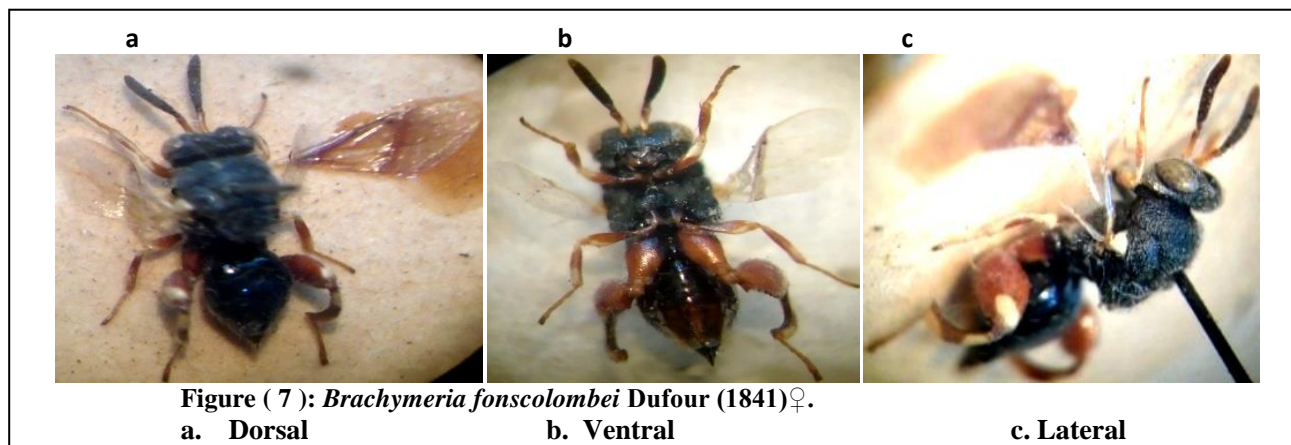
Abdomen: Semi-conical, smooth and shiny, pointed posteriorly, less thorax

length, equal thorax width; 1st tergite smooth; 2nd tergite with sparse minute punctures on dorsal base except middle, 6th tergite with weakly pitted and distinct microsculptures. Genital cepsoul covered with long hairs laterally and 2 yellow line; hypopygium copper; epipygim sides compressed; ovipositor sheath visible above.

Specimen examined: ♀, Cairo, 27.8.2014 Grasses.

Geographical zone: Lower Egypt.

Distribution: Afrotropical, Australasian, Bangladesh (**Chowdhury and Howlader, 1978**), Brazil (**Marchiori et al., 2003**), China, Europe, India, Indonesia (**Heller and Günther, 1936**), Indopacific, Iran, Jamaica (**De Santis, 1979**), Japan (**Pujade, 1994**), Malaysia, Mexico, Mongolia (**Bouček, 1952**), North Africa, Palestine, Philippines, Somalia (**Masi, 1938**), South Africa (**Cameron, 1911**), Thailand, Vietnam and Zambia.



2.8. *Brachymeria kassalensis* Kirby, 1886 (*B. bengalensis pulchellae* Joseph, Narendran and Joy, 1972) (Figure,8):

Body: Length 5- 6 mm. dark black with silver hairs, some parts half shiny and other shiny with finely and densely puncture.

Head: Black and brownish distally, width slightly more thorax width; occiput sloping behind compound eyes; width of interocular space equal 2.5 times of interocellar distance, latter equal 3.2 times of ocellocuar distance; compound eyes large, convex, brown yellowish,

height equal 2.5 times of width; scrobe deep, smooth and reach to front ocellus, length equal 1.78 times of width; frons without preorbital carina; postorbital carina reaching to genotemporal margin; genal carina bifurcate; malar space equal one-third of compound eye height; mandible black with brownish end; antenna geniculate, branched, elongate; scape black; radical brownish and black, scape not exceeding to front ocellus, long equal one to three combined flagellomeres; pedicel small, length equal approximately width, semi rounded; funicle black; 1st flagellomere less thicker; 1st to 3rd flagellomeres with long more wide, 4th to 6th flagellomeres roughly square, 7th flagellomere transversed; club divided in two segments and with reddish round end.

Thorax: With high level of head and abdomen, width equal abdomen width and more long; rounded reticulate; with densely umbilicate and close pits; pits interspaces curly shaped; pronotum plano concave; parapsidal furrows shallow; scutellum convex, width equal approximately three - quarters of length; propodeum coarsely sculptured; tegulae triangular shape, with blackish base; fore wing length equal 2.7 of width; base of submarginal veins yellowish; marginal veins length equal 0.6 of submarginal veins length, postmarginal veins length

slightly more three- fifth of marginal veins length, stigma vein equal one-quarter of postmarginal veins; hind coxae obclavate shape, hairy, black, minute dense pitted; hind femora thickened with minute pitted, denticulated (12 black teeth), reddish-brown, tip with large yellow spot, length equal 1.75 times of width; hind tibiae light yellow, with reddish-brown ring basally and long ventral carina, equal with fumer length, curved and thickness; tarsi yellowish, 5th segments, with claws black.

Abdomen: Ovate; length less pronotum; scutum and scutellum combined, width less three- fifth of length, middle high, ventral side black brownish; 1st tergite shagreen dorsally; 2nd tergite middle with small sparsely minute punctures, base and proximal part glazy, lateral sides with dense pitted and bristles; 3rd tergite completely pitted; tergite 4-5 punctured at proximal half; the 6th tergite with dense punctured and bristled. Ovipositor sheath clearly visible from dorsal side.

Specimen examined: ♀, Halayeb 22.1.2014 and ♂, Halayeb, 4.2.2016.

Geographical zone: Upper Egypt

Distribution: Ethiopia (Masi, 1951b), India (Narendran, 1986), Senegal, South Africa, (Prinsloo, 1980), Sudan (Kirby, 1886) and West Africa.

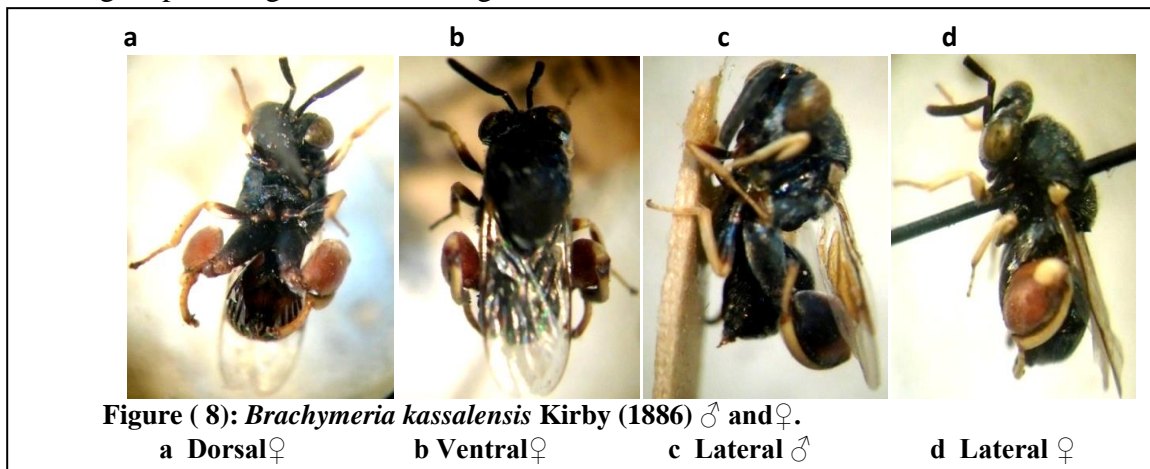


Figure (8): *Brachymeria kassalensis* Kirby (1886) ♂ and ♀.

a Dorsal ♀

b Ventral ♀

c Lateral ♂

d Lateral ♀

**2.9. *Brachymeria libyca* Masi , 1926
(*Chalcis libyca* Masi, 1926) (Figure,9):**

Body: Length 5 mm ,black, some parts covered with whitish hairs and pubescence.

Head: Densely punctured, smooth and some parts rough; length slightly less width; sloping straightly behind eyes in front, upper as two lobes, one high and other reduced; vertex pitted , middle part slightly thin ; ocelli oval shape, bright brownish and oblique ; width of interocular space at level of hind ocelli equal one time and two- thirds of ocellar area width ; compound eyes black yellowish; eye height slightly less double eye width , width equal of height malar space; postorbitals carinae not clear , preorbital carinae not present; scrobe obovata ,deep and smooth, extended to front ocellus ;inter antennal projection elongated triangle ; fronto genal suture distinct ,gena immensity and extend below orbit ; clypeal sulcus deep ; mandible bidentate; antennae completely orange – reddish ,thick and short; scape smooth, less one- half of flagellum length and unequal thickness; pedicel semi-rounded ; anellus small ,flagellum increased in width parts and covered with small yellow hairs ; funicle 8 segments , 1stflagellomerewidth equal length, each rest segments width slightly more length ,club 2 segments and large of other funicle segments.

Thorax: Strong, glazy with silver short hairs and densely punctured, width equal one-sixth of length and elevated with curve; pronotum reduced and planer concave ; parapsidal furrows shallow ; scutum bell shaped ; scutellum with two lobes and convex laterally; propodeum

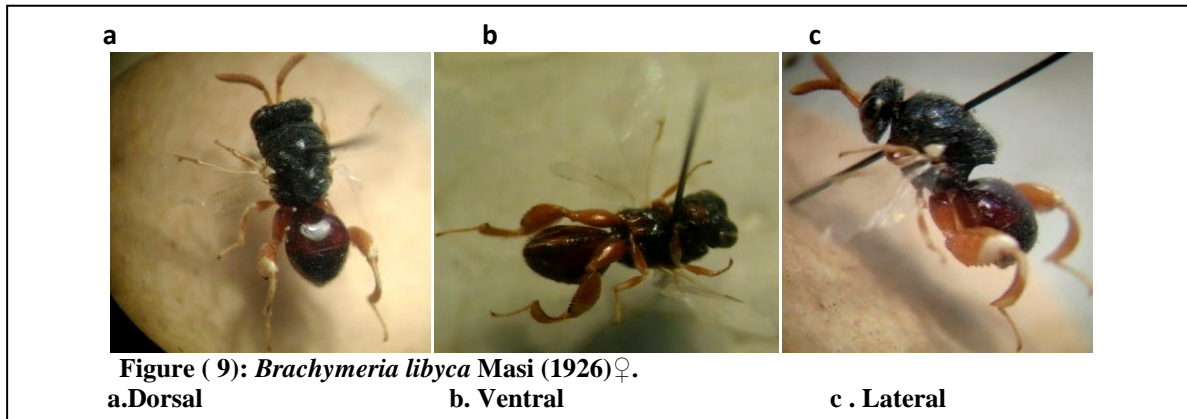
sculptured with laterally into acute teeth ; tegula whitish yellow and triangular shaped ;wings hyaline ,veins yellowish orange forewing length equal two times of hind wing length and width equal 3 times of hind wing width ; submarginal vein equal three times of marginal, marginal vein equal two times of post marginal. legs some parts whitish yellow , orange and others copper color ;third legs strong and large , hind femur enlarged , length slightly less two times of width , with few fine hairy, punctures , first two-thirds orange and last third yellowish-white cream , ventral orange with teeth , inner margin with small tooth and external with nine black teeth, equal in size , first three closed together; hind tibia curved , strong , equal hind femur length, color orange, with pale yellow stripes, margin lower black and more wide near the tarsus, tarsus margins uneven ; tarsi yellowish with pubescence; 5 segments, and not equal in size , spur with two orange and short seta; claws dark brownish.

Abdomen: Oval shaped , approximately conical reddish black , shiny and smooth ; with small white protuberances and whitish bristle ,tip blunt; equal thorax width and height; dorsal reddish black; last four segments depression ; ventral copper blackish; 1st tergite large ,smooth; 2nd tergite with punctures on laterally; tergites 3-6 with row bristles and punctures on laterally; 6th tergite coarsely and gently pressed with dense punctures .

Specimens examined: ♀, Cairo, 3.6.2014.

Geographical zone: Lower Egypt.

Distribution: Libya and Syria.



2.10. *Brachymeria minuta* Linnaeus, 1767 (*Brachymeria puttorensis* Joseph, Narendran and Joy, 1971) (Figure,10):

Body: Length 3.5 - 6 mm, black, streamlined shape, shiny and half-shiny, covered with grayish white pubescence.

Head: Pitted with carinate, except scrobe; ocelli rounded, yellowish, width of ocellar area equal 0.67 wide of interocular space at level of hind ocelli; compound eyes enlarged, glabrous; convex; black light brownish; compound eyes high equal one-third of width; preorbital and postorbital carinae distinct; right mandible with two blunt teeth; antennae black, brave, club long and equal two segments of flagellum, slightly reddened; antennae of male narrow apically.

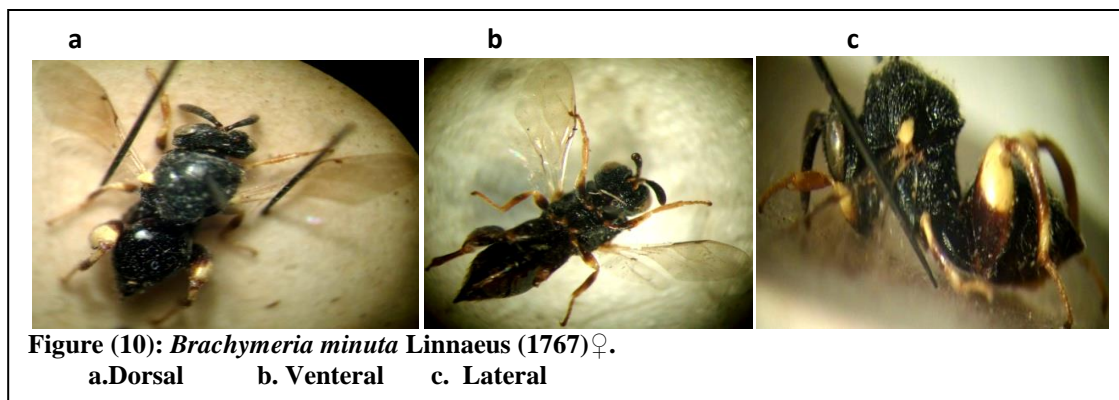
Thorax: Inflected, with long silver erect hairs, with shallow pitted dorsally and interspaces pits carinate; scutum wide equal 1.2 times of long; Parapsidal furrows distinct; scutellum apically extending outward in flat form and fold back, rough and consisting of two lobes; propodeum distinctly incline downward posterior. with one hurt indistinct tooth behind spiracles at sides. Forewing length

equal 2.5 times of wide; veins brownish; hind femur oval, enlarged, length equal 1.77 times of width, punctate, pubescent punctures on inner side, with small blunt tooth at inner ventral side near base and usually 12 brownish teeth on outer ventral margin. *Abdomen* point posterior, 1st tergite shiny; tergites 2-5 with distinct microsculpture except apical, on ventrolateral parts and basal 2nd tergite; tergite 6 weakly pitted pipygium compressed from sides; ovipositor sheath visible dorsally, with weakly dense punctate and thick hairs.

Specimens examined:. Alexandria 13.7. 2013 ; ♀, Baharia Oasis, 20.3.2017 ; ♀, Cairo, 3 .2014 ; ♀, Giza, 5.5. 2014 ; ♂, Giza 8.6.2014 Watermelons ; ♀, Giza, 17.11.2013 maize ; ♀, Matrouh, 28.9.2017 and ♀, Zigazig, 4. 2014 .

Geographical zone: Costal stripes, Lower Egypt and Upper Egypt.

Distribution: Australia, Europe, India, Iran, Japan, Kazakhstan, Malaysia, Moldova, Montenegro, Netherlands (Gijswijt, 2003), Papua New Guinea, Russia, Syria, Thailand, Turkey, Uzbekistan (Sychevskaya, 1964) and Vietnam.



2.11. *Brachymeria somalica* Masi, 1929

(Figure, 11):

Body: Black, length 3.7 – 5 mm, male length less female, covered with white hairs, pubescence and punctate, some areas glassy and smooth.

Head: Strongly; with dense and small punctures; vertex scarcely round; ocelli rounded, bright brownish and gleaming; distance between median and lateral ocelli equal twice distance between compound eyes and lateral ocellus; occiput sloping steeply behind eyes; eyes convex and brownish; face covered with fine velvet hairs and pitted, genae sculpture distinct; fronto-genal suture quite distinct; preorbital carina visible, postorbital carinae absent; scrope not deep, glazy, nearly reaching front ocellus; scape length equal 0.33 of flagellum; malar space expands above the temple; epistomal groove sides indeterminate; clypeus punctate producing hair numerous enough impressed; genal temporal margin incomplete prominent; antennae blackish, pedicel more wide; flagellum cylindrical, length equal 0.8 of head breadth, in male thicker; first to third funicle segments elongate, 2nd square; 4th-6th segment slightly wide; 7th trifle abbreviate; club black brownish, equal 1.7 times of preceding segment.

Thorax: Higher than abdomen and head; curved dorsally; mobilized and expanded; short coarse areas and other

shiny and reticulate; from dorsal with regular shallow and dense punctures; pronotum angled with distinct produced lateral carinae, interrupted medially with upper edge, looks like planoconcave; parapsidal furrows marked; scutum width larger than length; scutellum semi-circular with long silver hairs, high laterally, length equal width, edges not crenulated, apical edge complete; metathorax protuberant laterally; propodeum glazy and coarsely sculptured; tegulae yellow and triangular shape; wings hyaline, fore wing with marginal vein less half submarginal vein, and increase twice postmarginal veins; stigma equal one-third of postmarginal vein; hind legs strong; hind coxae black and glazy, with fine punctures ventrally; trochanters reddish; hind femur enlarged, width equal three-fifth length, black with small yellow space near tibiae; clear with dense and finely punctured, ventral margin with ten black triangular teeth, different in thickness and interfaces, first lateral significantly greater, last four apical teeth very close to each other; hind tibia yellowish, equal femur in length; tarsi yellow with trifle brown, five tarsomeres and last long, ended with brown black claws.

Abdomen: Short, ovate, curved, less thorax length, with pointed end, 1st tergite, large, shiny, finely and densely pitted, carinate laterally and bristle; 2nd

tergite finely and coarsely punctured, sculpture with bristles at lateral or piliferous ; tergites (3-6) coarsely punctured and bristled at upper half, sternite pitted producing hair; ovipositor sheath short , invisible from top ; male

abdomen reddish laterally, male genitalia yellow with taper end.

Specimens examined: ♀, Cairo , 18.10.2014; ♀, Giza , 29.10. 2014; ♂, Giza, 5.12.2014 on halfa **Geographical zone:** Lower Egypt

Distribution: Somalia (Masi ,1929).

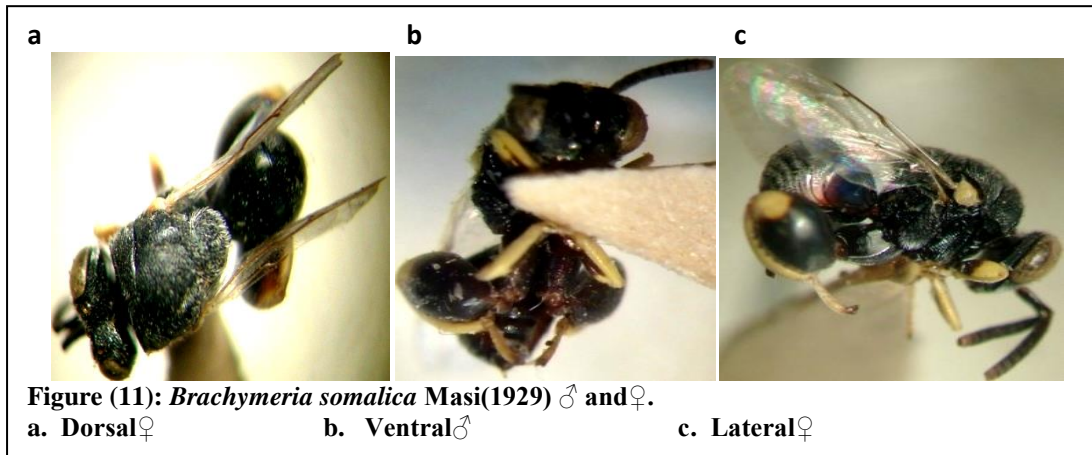


Figure (11): *Brachymeria somalica* Masi(1929) ♂ and♀.

a. Dorsal♀

b. Ventral♂

c. Lateral♀

2.12. *Brachymeria vicina* Walker, 1834

(*Chalcis obtusata* Foerster, 1859) (Figure, 12):

Body: Black, length 4-5 mm, shiny, punctuate and hairy.

Head: Heart shape; ocelli yellowish; distance between each compound eye and lateral ocellus equal distance between median and lateral ocellus; eyes brown; fronto-genal suture distinct; pre and postorbital carinae existent; malar area triangular shape,; scrobe smooth; interantennal projection elongate; mandible red brownish with black teeth; antennae black brown, short, thick and width increasing at apex; pedicel brownish and rounded; flagellum with short soft hairs.

Thorax: Black ; shiny, shallow densely and coarsely pitted .Pronotum scapular; scutellum flatten and slopin posteriorly ;metanotum lateral blunted ; propodeum coarsely sculptured; tegula yellow and triangular shaped ; wings hyaline; in forewing submarginal vein equal more two times of marginal vein, marginal vein length equal twice of postmarginal vein

;legs black brownish and yellow ; hind coxae large with densely punctured and silver hairs; hind femora elongate , shiny , with one big reddish patch, followed by apical yellowish ring ; length equal one and half times of broad ,with 12 black teeth closed apically; hind tibiae arched ;black with different spots, tarsi 6 segments , white red ; claw and arolium black brownish .

Abdomen: Oval and elongate; 1st tergite smooth ; 2nd tergite smooth with fine punctures and bristles laterally; tergites 3-5 punctured with bristles apically; 6th tergite with coarse dense punctures and covered with bristles; 7th tergite compressed laterally and with coarsely punctured .

Specimens examined: ♀, Giza ,24.10.2013; ♀,Ismailia , 10.10.2018.

Geographical zone.: Lower Egypt.

Distribution : Austria, Europe , Iran, Iraq, Japan, Moldova, North Africa , Palestine, Turkey and Turkmenistan.

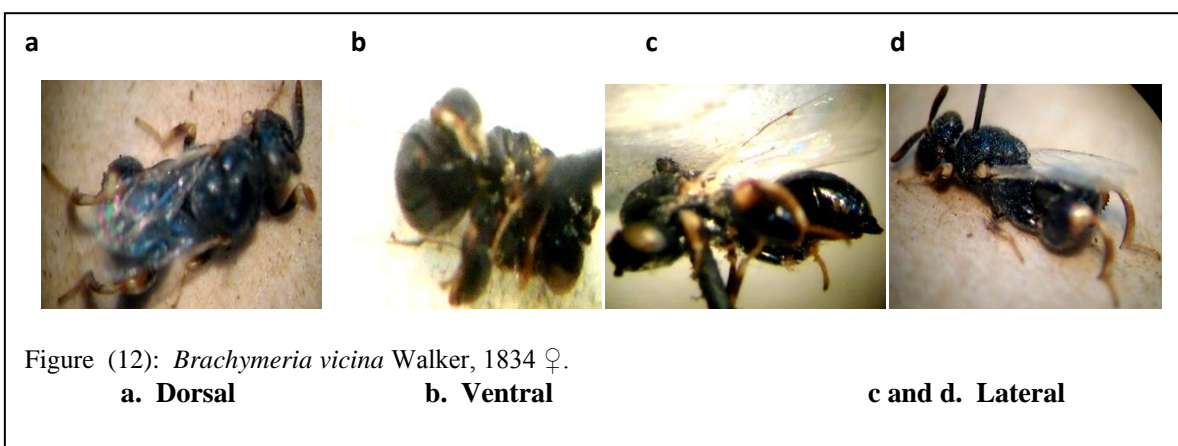


Figure (12): *Brachymeria vicina* Walker, 1834 ♀.

a. Dorsal

b. Ventral

c and d. Lateral

Remarks:

B. ancilla Masi with weak elongate posterior femur, provided with a small long and acute inner tooth; nearly the whole basal two-thirds of the femora red; hind tibia some parts yellow and middle part brownish red. *B. femorata* Panzer and *B. minuta* Linnaeus is a very divers or extremely variable species with variations in colouration of hind femora in , the nature of punctuation on the thorax and size especially *B. minuta* and are known as a common species in Mediterranean region as pupal parasitoid of various Lepidoptera. *B. kassalensis* Kirby features in having ,a tooth (not very prominent) on the inner ventral side of hind coxa in female ; the lateral ridges of scrobe only faintly produced in front of the annal toruli ; frist tergite shagreened ; abdomen of female trifle longer than pronotum, mesosctum and scutum combined seems to be related to *B. albicrus* Klug, but *B. kassalensis* differs from *B. albicrus* in having the postorbital carina present and lateral ridges of scrobe distinctly produced in front of the antennal toruli. *B. libyca* Masi claws of the first pair of legs differ from those of the *B. minute* to have the distal tooth obtuse at the apex, and not truncated, and the other teeth, in number of three acute

instead of four. *B. minuta* Linnaeus is very close resemblance with *B. fonscolombei* in structure especially in femora, The typical form with reddish femora is easily recognizable, but the hind femora sometimes turn into black even in the female, being very often black in the male. in this case the identification is more or less difficult, but *B. fonscolombei* Dufour hind femora narrow, more than or at least 1.80-2.00 times as long as wide, with apical patch; hind tibia red, with subbasal and apical patches. In typically form this apical patch of the hind femora and the subbasal and apical patches of the hind tibia are whitish in *B. minuta* hind femora not more than 1.80 times as long as wide, mostly black, apical yellow; hind tibia mostly black. Apical and prebasal part yellow or brownish-yellow. *B. minuta* , *B. fonsclombei* and *B. vicin* presence of only two teeth in each mandible, the antennal flagellum fusiform, ; the posterior femur with tubercle on the inner side, at the base; the median dorsal part of the fourth targite smooth. Right mandible of *B. excarinara* Gahan with three teeth at apex; fronto-genal sutures completely carinate; genae flat below compound eyes; basal area of hind tibia black.

3.Genetics study and discussion:

The DNA extraction of *Brachymeria* parasitoid in Egypt was diagnostic by PCR in detecting and identifying parasitoids. The DNA sequences of *B. femorata* was obtained included 327 nucleotide (Figure,13) . The amino acid Guanine was the most amino acid found and followed by Adenine, Cytosine and Thymine, respectively. The DNA appeared with amino acid Guanine and ended with amino acid Adenine. The amino acid was arrangement within the DNA in the form of bundles and consisting of 10 amino acids. The information of the sequences was used of congeneric species in GenBank to made relative evaluation of these data. The DNA sequences of *B. femorata* were similar to the available corresponding sequences of congeneric species and the sequence similarity was 99% with *Brachymeria* sp. alignments .The DNA sequences of *Cheiropachus quadrum* , *eupelmus* sp., *Platynochilus cuprifrons*, *Nasonia vitripennis*, *Epitranus* sp., *Neochrysocharis formosa*, *Nasonia vitripennis* and *Pteromalus* sp. were also some different (98% sequence similarity) (Table,1) , According Greenstone (2006) determined that the problem of insect parasitism rates was due to the small size and difficult of distinguishing morphological characters for many parasitoid taxa.To solve this problem, entomologists have employed one of four general methods to detect parasitoid protein or nucleic acid markers: serological assay; random amplified polymorphic DNA–polymerase chain

reaction (RAPD-PCR). Traugott *et al.* (2006) established the parasitoids key of lepidopteran pests by multiplex PCR. The use of diagnostic polymerase chain reaction (PCR) avaluable approach to study the host–parasitoid interactions. The inherent problems of rearing parasitoids from the collected hosts was a new idea to identify parasitoid and hosts by molecular markers. The useful identify of the host based on multiplex PCR , and screening of field-collected caterpillars. Also they found the *Pl. xylostella*, *P. brassicae*, and *P. rapae* parasitism rates of 33.4% by *D. semiclausum*, 52% by *C. glomerata*, and 53.4% by *C. rubecula*, respectively. Garipey *et al.* (2007) recorded that the PCR-based techniques today with applications in medical, veterinary, forensic and botanical sciences. Molecular techniques had generally used for insect identification and systematic; however, PCR-based techniques were increasingly becoming recognized as valuable tools in ecological studies. Munro *et al.* (2011) studied a molecular phylogeny of the Chalcidoidea (Hymenoptera).

Either Mymarommatoidea or Diaprioidea were the sister group of Chalcidoidea depending on the analysis. Likelihood analyses place Rotoitidae as the sister group of the remaining Chalcidoidea after Mymaridae. Jenkins *et al.* (2012) use molecular techniques for the detection and differentiation of host and parasitoid species of the implications for fruit fly management, Parasitoid rate and identification was a necessary step in the

development and implementation of fruit fly in biological control strategies which employing parasitoid augmentive release. Molecular techniques was also

considerable advantage over traditional morphological methods of fruit fly and parasitoid discrimination as well as within-host parasitoid identification

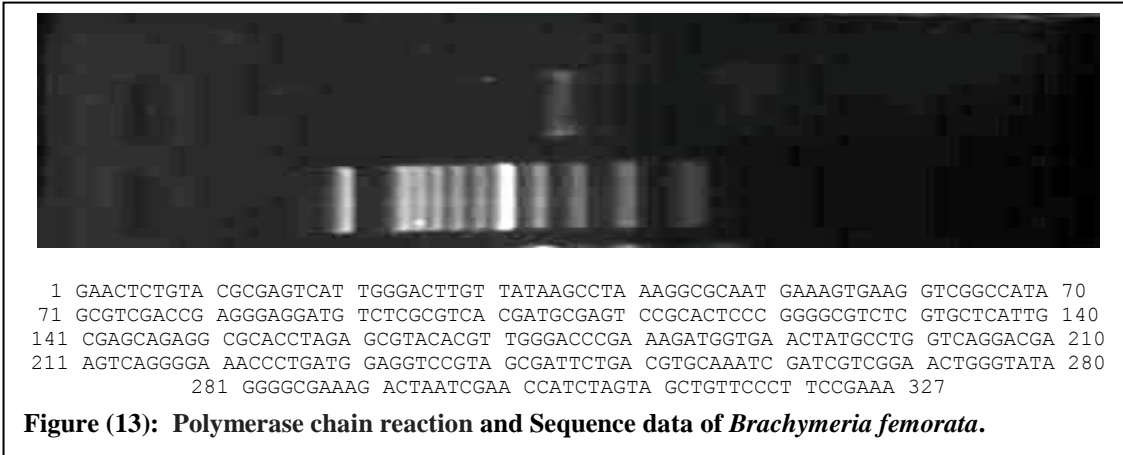


Figure (13): Polymerase chain reaction and Sequence data of *Brachymeria femorata*.

Table (1): Sequences producing significant alignments in Egypt.

Description	Max score	Total score	Query cover	Ident	E value	Accession
<i>Brachymeria</i> sp.	520 - 503	520 - 503	100%	99%	8e-144	JN623581.1
<i>Cheiopachus quadrum</i>	501	501	100%	98%	3e-138	JN624260.1
<i>Epitranus</i> sp.	496	496	100%	98%	1e-136	JN623602.1
<i>Eupelmus</i> sp.	501	501	100%	98%	3e-138	AY599307.1
<i>Nasonia vitripennis</i>	496	496	100%	98%	1e-136	JN623821.1
<i>Neochrysocharis formosa</i>	496	496	100%	98%	1e-136	HM364979.1
<i>Platynocheilus cuprifrons</i>	496	496	100%	98%	1e-136	JN623838.1
<i>Pteromalus</i> sp.	492	492	98%	98%	2e-135	AY552170.1

It is concluded that many species of this genus spread in different places in Egypt and are mostly primary parasitoids in pupae of holometabolous insects, especially of Lepidoptera, but some species attack Diptera, Which contain many of the pests that are harmful to humans, Therefore the precise determination species concerned is highly important in any host –parasite study for biological control. The previous studies cleared that the molecular diagnostic tools had earned their place in taxonomy and biological control research. The last few years

had seen a tremendous increase in the number of studies by using diagnostic molecular markers for parasitoid. the diagnostic molecular markers had been used to identify morphologically similar parasitoid species.

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