On the Identity of New Acarid Mites in genus *Caloglyphus* Berlese Occurring in Asian Expanse (Pakistan) (Acarina: Acaridae)

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ABSTRACT

During this taxonomical exploration, 2 mites species were recognized and pinpointed from hypopial stage in the genus *Caloglyphus.* Mites were distinguishable morphologically and the new taxa identified were *Caloglyphus bradys* and *C. austerus.* Compared with previously documented species by analyzing 25 taxonomical characters of 10 already known countrywide deutonymphs, and the new taxa showed sufficient dissimilarity to be classified these as separate species. A historical review of the genus completed with already existing species; and traditional description, illustration of main body characters, geographical distribution, host, comparison remarks, matrix showing similarities and differences, and percentage of resemblance for the new species are given. These are followed by a hypopial-based key for recognition of 12 known *Caloglyphus* species identified from countrywide locations together with discussion on faunal relationships of this pest.

Key words: Acaridae, new mite hypopus, chaetotaxy, *Caloglyphus*, taxonomy

INTRODUCTION

Several species of acarid mites in the Acaridae family (Tyroglyphidae) are important as pests of stored foods. The species of genus *Caloglyphus* have been collected from potato tubers, onion bulbs, barley, rice, wheat, flour and chicken feeds (Ostovan and Kamali, 1995). The species belonging to genus *Caloglyphus* are often found in 4 kinds of "sensitive food ingredients" that include poppy, mustards, lettuce and wheat grain (Stejskal *et al*., 2002). These occurrences of stored mites may have serious practical consequences since currently the food safety is one of the most important priorities. Taxonomy provides a framework that enables us to undertake studies on the relationships between living things, so that we are better able to understand and assess biodiversity, and can more efficiently manage it.

Genus *Caloglyphus* in the family Acaridae is recorded as key pest among mites's fauna in many countries of the world. Berlese first proposed and described the genus *Caloglyphus* in 1923 and he marked *Caloglyphus berlesei* Michael, 1903 as its type species for a single species (hypopus). Species of genus *Caloglyphus* have been reported from several regions of the world; Zakhvatkin (1941) reviewed this genus and portrayed 4 new species and re-described 6 species with improved descriptions. Nesbitt (1944, 1949) and Samsinak (1966) supplemented 1, 3, and 1 new species to this genus, respectively. Mahunka (1973, 1974, 1978 and 1979) described 2, 1, 2 and 1 new species, respectively, in this genus *Caloglyphus*. Hughes (1976) prepared an excellent accumulation of knowledge to this genus. Tseng and Hsieh (1976) re-described 1 species with enhanced description. Samsinak (1980) reviewed the tribe *Caloglyphini*, re-established the genus *Caloglyphus* and illustrated 1 new species. Channabasavanna *et al*. (1981), Rao *et al*. (1982) and Ashfaq and Chaudhri (1983) incorporated 1, 1 and 4 new species, respectively in this genus. Samsinak (1988) pointed out 1 new species of the tribe *Caloglyphini*. Zou and Wang (1989), Sevastyanov and Radi (1991), Sher *et al*. (1991), Klimov (1996) and Eraky (1999) supplemented 1, 3, 2, 1 and 1 new species, respectively to this genus. Klimov (2000) reviewed acarid mites of the tribe *Caloglyphini* with description of a new species. Klimov and Oconnor (2003) published phylogeny, historical ecology and systematic of some mites including full descriptions of each taxon, keys and biological information. Sarwar and Ashfaq (2004) and Sarwar *et al*. (2005) in their study recognized and expressed 4 new species reported from this global expanse.

Mites' fauna are rich in species as indicated by their occurrences in agricultural field and rural and urban areas. Accurate identification of the organism concerned in control of pest is the

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first step. Thus, the taxonomy of mites is important in modern agriculture. Such investigation is a tool for precise recognition of species role as pests or predators.

MATERIALS AND METHODS

Bahawalnagar in Punjab and Turbat in Baluchistan provinces were surveyed to explore new taxa and distribution range of mites in the genus *Caloglyphus.* Samples of different stored grain commodities were collected and brought to the laboratory. Mites were separated employing Berlese Funnel Method. Whole mite specimens were cleaned to remove dust and then preserved in 70% alcohol. Each specimen was examined with the aid of compound binocular light microscope. The hypopi were mounted over the glass slide using Hoyer's medium having cover slip. The slide mounted specimens were examined under light microscope with differential interference contrast. All illustrations of body parts were made with the aid of the graph paper using an ocular grid. Measurement of body length, width and other body parts were made with the help of an ocular micrometer. The terms of body parts and idiosomal chaetotaxy follow Griffiths *et al.* (1990); and terms of leg chaetotaxy and solenidiotaxy follow Griffiths (1970). All the measurements are expressed in micrometers (µm) and were taken from whole specimen.

The analysis of the genus *Caloglyphus* Berlese (1923) instigated earlier in Pakistan showed that 10 species within this genus were characterized. Present examinations of acarological collections have further yielded 2 innovative species, which raised a total of 12 species in this genus. In addition, all the other species described in the genus *Caloglyphus* from Pakistan are placed in the key for identification.

RESULTS AND DISCUSSION

Key to Pakistani Species of Genus *Caloglyphus* (Hypopi)

1. Sternum2(*st2*) present……..……2
- Sternum 2 (*st2*) absent……..... 10
2. Apodeme 2 (*ap2*) meeting apodeme 3 (*ap3*)……..… *C. austerus*, n. sp.
- Apodeme 2 (*ap2*) not meeting apodeme 3 (*ap3*)…….... 3
3. Apodeme 3 (*ap3*) meeting apodeme 4 (*ap4*)……. 7
- Apodeme 3 (*ap3*) not meeting apodeme 4 (*ap4*)……..……. 4
4. Gnathosomal lateral margins parallel……..….. 5
- Gnathosomal lateral margins not parallel……..…….. 6
5. Sternum 1 (*st1*) bifid posteriorly; paragenital seta (*pr*) bifid……..*C. multaniensis*, Ashfaq and Chaudhri (1983)
- Sternum 1 (*st1*) not bifid posteriorly; paragenital seta (*pr*) not bifid……..…*C. agrios*, Sarwar *et al.* (2005)
6. Setae *sci* and *sce* forming straight line; coxal discs (*di1*, *di2*) not conoids……..…….... *C. opacatus*, Ashfaq and Chaudhri (1983)
- Setae *sci* and *sce* not forming straight line; coxal discs (*di1*, *di2*) conoids……..*C. trigonellum*, Sher *et al.* (1991)
7. Gnathosoma notched posteriorly……..……..…. 8
- Gnathosoma not notched posteriorly……..……..……..... 9
8. Setae *sci* and *sce* of equal size; apodemes 4 (*ap4*) meeting medially……..*C. merisma*, Ashfaq and Chaudhri (1983)
- Setae *sci* and *sce* not of equal size; apodemes 4 (*ap4*) not meeting medially..... *C. hadros*, Sarwar *et al.* (2005)
9. Hysterosomal shield smooth; sternum 1 (*st1*) not bifid posteriorly; coxal discs (*di1*, *di2*) conoids…….. *C. bradys*, n. sp.

- Hysterosomal shield dotted; sternum 1 (*st1*) bifid posteriorly; coxal discs (*di1, di2*) not conoids ……*C. faisalabadiensis*, Sher *et al.* (1991)

10. Gnathosoma extended beyond the body; apodemes 4 (*ap4*) meeting medially…..… *C. morosus*, Ashfaq and Chaudhri (1983)

- Gnathosoma not extended beyond the body; apodemes 4 (*ap4*) not meeting medially 11

11. Coxal field III open; genital disc (*gdi3*) and suctorial shield with radial striations…….. *C. clemens*, Sarwar and Ashfaq (2004)

- Coxal field III closed; genital disc (*gdi3*) and suctorial shield without radial striation… *C. cingentis*, Sarwar and Ashfaq (2004)

1. *Caloglyphus bradys* (*sp. nov.*)

Hypopus

The main features of the species are following: body brown, ropodosoma strongly reduced and comparatively weakly sclerotized, only a short area hidden under hysterosoma, and major area of propodosoma not covered by hysterosomal shield. All idiosomal setae not well developed, represented by micro setae only.

Dorsal View

Body, is 270 µm long, 188 µm wide and divided into propodosomal and hysterosomal shields (Fig. 1a). Propodosomal shield 65 µm long, 173 µm wide, with rostral projection antero-medially, dotted medially, broken striations antero-laterally, remaining shield smooth; setae *vi, ve, sci, sce* and *scs*, each 1 pair, simple, 17 µm, 7 µm, 7 µm, 14 µm and20 µm long, respectively; *sci-sci* 35 µm, *sce-sce* 76 µm and *sci-sce* 20 µm apart; setae *sci* and *sce* forming a straight line, middle in position. Hysterosomal shield 233 µm long, 188 µm wide; smooth medially, anterior margins with transverse broken striations, lateral margins with longitudinal striations and dots, lateral margins turn towards the ventral surface. Hysterosomal shield setae, 11 pairs, simple, 3 pairs visible pores. Setae *d1* = *d2* = *d3* = *d4* = 6 µm; *hi* = *he* = 6 µm; *la* 6 µm, *lp1* 8 µm, *lp2* 6 µm; *sae* 16 µm, *sai* 8 µm, long; *d1* - *d1* 75 µm, *d2* - *d2* 48 µm, *d3* - *d3* 63 µm, *d4* - *d4* 63 µm; *d1* - *d2* 37 µm, *d2* - *d3* 65 µm, *d3* - *d4* 50 µm and *la* - *la* 145 µm apart. 3 pairs minute, rectangular spots medio-laterally. Hysterosomal shield anterior margin overlapping propodosomal shield posterior margin upto 18 µm, overlapping area with transverse, broken striations.

Ventral View

Gnathosoma fused pedipalpi, broad and rounded at base, slightly tapering anteriorly, lateral margins parallel, 2 segmented, 33 µm long (basal part 22 µm, distal part 11 µm long), 1 pair arista, 32 µm long, 2 pairs small setae (Fig. 1b). Apodeme 1 (*ap1*) Y-shaped, continuing with sternum 1 (*st1*). Sternum 1 (*st1*) 48 µm long, free. Apodeme 2 (*ap2*) free, curved posteriorly. Apodeme 3 (*ap3*) meeting apodeme 4 (*ap4*) and meeting each other forming a slightly convex membranous line. Apodemes 4 (*ap4*) not meeting medially. Apodeme 5 (*ap5*) and apodeme 4 (*ap4*) meeting making broad, rounded tip, not meeting with same structure from other side. One pair metasternal seta (*mts*) encircled in apodeme 5 (*ap5*) and apodeme 4 (*ap4*). Sternum 2 (st2) double-lined, 35 µm long, making a triangular structure with apodeme 5 (*ap5*). Coxal fields II and I open, III and IV closed, I, II and III smooth, and IV dotted. Sternal shield separated from ventral shield. Ventral shield separated from genital shield by a membranous line. Genital shield with longitudinal genital slit, dotted, 2 pairs genital suckers, 1 pair paragenital seta (*pr*) messed to genital disc (*gdi3*). Coxal discs *di1* and *di2* present, *di1* and *di2* conoids, genital disc (*gdi3*) kidney-shaped without radial striations. Seta *hv* 1 pair, 8 µm long. Suctorial shield 56 µm long, 70 µm wide, dotted, anterior margin wavy, narrow pointed postero-medially; posteriorly and laterally with sclerotized piece with pointed ends, anterior suckers 1

pair rounded, anal suckers 1 pair, equal in size to anterior suckers, 1 pair lateral and 1 pair posterior conoids, 2 pairs peripheral vestigial suckers, 1 pair suckers below the shield. Suctorial shield separated from posterior end of body by 24 µm, a distance smaller than suctorial shield length.

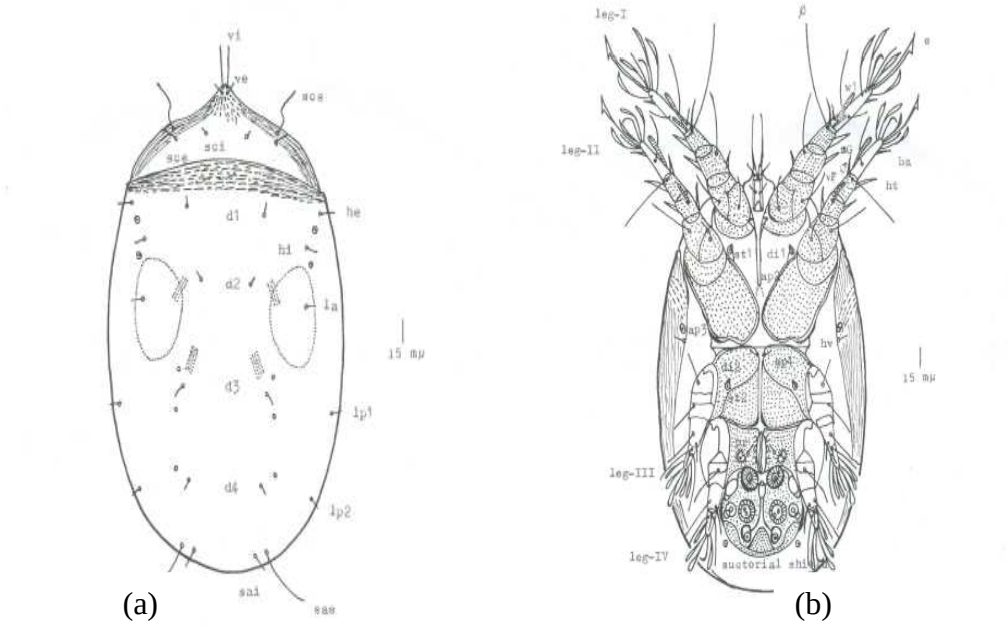

Fig. 1. *C. bradys*, n. sp: (a) dorsal view, and (b) ventral view.

Legs

Well built and stout, length of legs I-IV, 115 µm, 103 µm, 83 µm and 75 µm, respectively (trochanter base to tarsus tip) (Fig.1b). Chaetotaxy and solenidiotaxy of legs: setae and solenidia on legs I-IV segments: coxae 0-0-0-0, trochanters 1-1-1-0, femora 1-1-0-1, genua 3-3-1-0, tibiae 3-3-2-2, tarsi 12-10-7-8. Tarsi I and II 46 µm and 32 µm long, respectively. Seta *vF* on femora I, II and IV 26 µm, 40 µm and 15 µm long, respectively, absent on femur III. Seta *e* on tarsi I-IV measuring 25 µm, 20 µm, 13 µm and 16 µm in length,respectively. Seta *mG* on genu I, a spine 13 µm, on genu II, a spine 12 µm long; *hT* on tibiae I and II lancet-like 22 µm and 14 µm long, respectively. Seta ó on genu I, a simple seta 17 µm long, on genu II, a spine 9 µm long. Tarsi I and II each with a solenidion *w1* 30 µm and 29 µm long, respectively. Tarsi III and IV short and stout. Dorsal seta ö on tibiae I and II 70 µm and 33 µm long, respectively. Seta *ba* on tarsus I 22 µm long. Tarsi I-IV provided with 3 leaf-like + 1 spoon-shaped; 4 leaf-like + 1 spoon-shaped; 3 leaf-like + 1 spoon-shaped; 3 leaf-like+1 spoon-shaped setae, respectively.

Type

The holotype of the genus *Caloglyphus* is known from hypopus collected from Bahawalnagar associated with sorghum (*Sorghum vulgare* P.) on 29.9.1994 (Sarwar). Paratype collected from leaf litter in the same locality. The specimen of the new species has been kept in Acarology Research Laboratory, Department of Agricultural Entomology, University of Agriculture, Faisalabad.

Comparison

This new species looks similar to the other species *Caloglyphus agrios*, Sarwar *et al.* (2005) of this genus but following are the deviating points: (1) Setae *sci* and *sce* forming a semi-circular line and posterior in position in *C. agrios* but forming a straight line and middle in position in this new species; (2) Apodeme 3 (*ap3*) not meeting apodeme 4 (*ap4*) in *C. agrios* but meeting in this new species; (3) Suctorial shield broadly rounded posteriorly in *C. agrios* but narrow posteriorly in this new species; and (4) Tarsus I with 5 leaf-like setae in *C. agrios* but with 3 leaf-like setae in this new species.

This new species can also be separated from *Caloglyphus hadros* (Sarwar *et al.*, 2005) due to the following characters:

(1) Setae *sci* and *sce* forming a semi-circular line and posterior in position in *C. hadros* but forming a straight line and middle in position in this new species; (2) Gnathosoma notched posteriorly in *C. hadros* but not notched in this new species; (3) Suctorial shield broadly rounded posteriorly in *C. hadros* but narrow posteriorly in this new species; and (4) Tarsi I-IV with 4-5-3-4 leaf-like setae, respectively in C. *hardos* but 3-4 -3-3 leaf- like setae, respectively in this new species.

This new species is closely identical with *Caloglyphus faisalabadiensis*, Sher *et al.* (1991) but can be distinguished from it on the basis of following points: (1) Hysterosomal shield dotted in C. faisalabadiensis but smooth in this new species.(2) Setae sce and sci not in straight line in *C. faisalabadiensis* but forming a straight line in this new species. (3) Paragenital seta (pr) antero-medial to genital disc (gdi3) in *C. faisalabadiensis* but messed in this new species.(4) Tarsus I with 5 leaf-like setae in *C. faisalabadiensis* but with 3 leaf-like setae in this new species; and (5) Seta *e* on tarsus III lancet-like in *C. faisalabadiensis* but spoon-shaped in this new species

This new species is also close to *Caloglyphus muscarius* Sevastyanov and Radi but they deviate from each other on the basis of following morphological features: (1). Hysterosomal shield and all the coxal fields smooth in *C. muscarius* but dotted in this new species; (2). Setae *ve* and *hv* absent in *C. muscarius* but present in this new species; (3). Apodemes 3 (*ap3*) meeting from either sides in *C. muscarius* but not meeting in this new species; and (4). No leaf-like setae on tarsi I-IV in *C. muscarius* but leaf-like setae present in this new species.

2. *Caloglyphus austerus* (*sp. nov.*)

Hypopus

The chief facial appearances of the species are following: body chocolate colour, propodosoma robustly condensed and comparatively softly sclerotized, simply a tiny region hidden under hysterosoma, and main area of propodosoma not roofed by hysterosomal shield. The entire idiosomal setae not well developed symbolized by micro setae only.

Dorsal View

Body 300 µm long, 198 µm wide, divided into propodosomal and hysterosomal shields (Fig. 2a). Propodosomal shield with rostral projection antero-medially, 68 µm long, 185 µm wide, dotted antero-medially, broken striations antero-laterally, remaining shield smooth; setae *vi*, *ve*, *sci*, *sce* and

scs, each 1 pair, measuring 25 µm, 6 µm, 7 µm, 15 µm and 28 µm in length, respectively; setae *sci* and *sce* middle in position, forming a straight line; *sci-sci* 35 µm, *sce-sce* 59 µm and *sci-sce* 24 µm apart. Hysterosomal shield 253 µm long, 198 µm wide, smooth, anteriorly, laterally with broken striations, lateral margins turn towards ventral side. Hysterosomal shield with 11 pairs simple setae, 6 pairs visible pores. Setae *d1* = *d2* = *d3* = *d4* = 7 µm; *hi* 9 µm, *he* 14 µm; *la* 5 µm, *lp1* = *lp2* = 11 µm; *sae* 45 µm, *sai* 11 µm, long; *d1* - *d1* 88 µm, *d2* - *d2* 52 µm, *d3* - *d3* 73 µm, *d4* - *d4* 61 µm; *d1* - *d2* 41 µm, *d2* - *d3* 73 µm, *d3* - *d4* 60 µm and *la* - *la* 160 µm apart. Hysterosomal shield anterior margin overlapping propodosomal shield posterior margin by 20 µm, with transverse, broken striations.

Ventral View

Gnathosoma fused pedipalpi, parallel laterally, 35 µm long, 2 segmented (basal part 24 µm, distal part 11 µm), bifurcated anteriorly, 1 pair arista, 33 µm long, 2 pairs small setae. Apodeme 1 (*ap1*) Y-shaped, continuing with sternum 1 (*st1*). Sternum 1 (*st1*) free, 48 µm long, slightly bifid (Fig. 2b). Apodeme 2 (*ap2*) not free, meeting apodeme 3 (*ap3*) making broad, rounded tip. Apodeme 3 (*ap3*) meeting apodeme 4 (*ap4*). Apodemes 4 (*ap4*) not meeting medially from both sides. Apodeme 4 (*ap4*) and apodeme 5 (*ap5*) meeting anteriorly making broad, rounded tip, not meeting with same structure from other side. Sternum 2 (*st2*) double-lined, 32 µm long. Metasternal seta (*mts*) 1 pair, small, each seta in encircled area of apodeme 4 (*ap4*) and apodeme 5 (*ap5*). Seta *hv* 1 pair, 6 µm long. Coxal fields I open, smooth, II, III and IV closed, dotted. Ventral shield separated from genital shield. Genital shield as shown in figure 2-B, dotted, genital slit elongated with 2 pairs genital suckers and 1 pair paragenital seta (*pr*) messed to genital disc (*gdi3*). Coxal discs *di1* and *di2* present, conoids. Genital disc (*gdi3*) kidney-shaped with radial striations. Suctorial shield 66 µm long, 77 µm wide, dotted, concave antero-medially, rounded posteriorly having 2 suckers below; anterior suckers 1 pair, oval with radial striations, anal suckers 1 pair, rounded with radial striations, anal suckers equal in size to anterior suckers, 1 pair lateral and 1 pair posterior conoids, 1 pair clear and 1 pair dotted areas representing the vestigial suckers towards periphery. Suctorial shield separated from posterior body end by 25 µm, a distance smaller than suctorial shield length.

Legs

Legs strong and stout, I-IV measuring 110 µm, 105 µm, 100 µm and 93 µm long, respectively (trochanter base to tarsus tip) (Fig. 2b). Setae and solenidia on legs I-IV segments: coxae 0-0-0-0, trochanters 1-1-1-0, femora 1-1-1-1, genua 3-3-0-0, tibiae 3-3-2-2, tarsi 12-9-8-7. Tarsi I and II 37 µm and 34 µm long, respectively. Seta *vF* on femora I, II, III and IV 42 µm, 45 µm, 28 µm and 26 µm long, respectively. Seta *e* on tarsi I-IV measuring 30 µm, 25 µm, 23 µm and 23µm long, respectively. Seta *mG* on genua I, lancet-like, on II, a spine; *hT* on tibiae I and II lancet-like measuring 12 µm, 15 µm, 15 µm and 16 µm in length, respectively. Seta óon genua I, a seta, on II a solenidion, 30 µm and 7 µm long, respectively. Tarsi I and II each with a solenidion *w1* 27 µm and 29 µm long, respectively. Dorsal seta ö on tibiae I and II 75 µm and 38 µm long, respectively. Seta *ba* on tarsus I 26 µm long. Tarsi I-IV provided with 4 leaf-like + 1 spoon-shaped; 4 leaf-like + 1 spoon- shaped; 4 leaf-like + 1 club-shaped; 3 leaf-like + 1 club-shaped setae, respectively. Seta *d* on leg IV tarsus 50 µm long.

Type

Holotype, hypopus, collected from Turbat from wheat (*Triticum aestivum* L.) on 18.2.1995 (Sarwar), paratype collected from wheat straw and deposited in Acarology Research Laboratory, Department of Agricultural Entomology, University of Agriculture, Faisalabad.

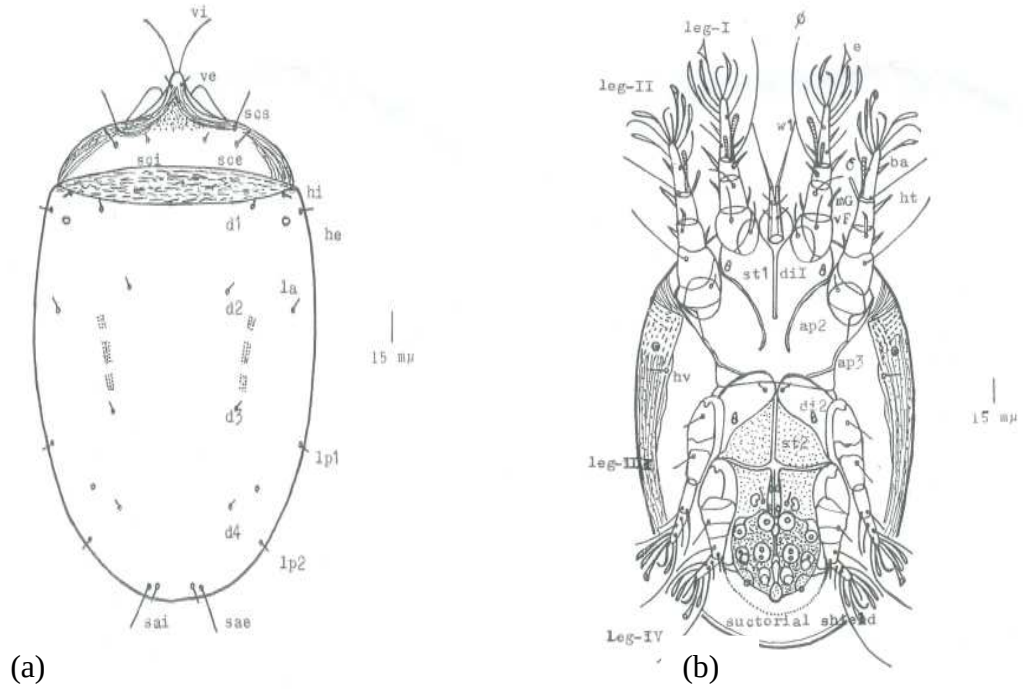

Fig. 2. *C. austerus*, n.sp: (a) dorsal view, and (b) ventral view.

Comparison

This new species has highest similarity with *Caloglyphus bradys*, new species but they show the following different attributes: (1). Hysterosomal shield with 3 pairs of visible pores in *C. bradys* but with 6 pairs visible pores in this new species; (2). Coxal field II opens in *C. bradys* but shut in this new species; (3). Genital disc (*gdi3*) without radial striations in *C. bradys* but with striations in this new species; (4). Tarsi III and I each with 3 leaf-like setae in *C. bradys* but each with 4 leaf-like setae in this new species; and (5). Seta ó on genu II a spine in *C. bradys* but a solenidion in this new species.

This new species is also comparable with *Caloglyphus tshernyshevi* Zakhvatkin on the basis of the following points: (1). Basal joint of gnathosoma twice as long as wide in *C. tshernyshevi* but not so in this new species; (2). Propodosomal shield 4 times shorter than hysterosomal shield in *C. tshernyshevi* but 3 times shorter in this new species; (3). Leg I tarsus with 4 leaf-like setae in *C. tshernyshevi* but with 5 leaf-like setae in this new species; (4). The coxal, genital, posterior and lateral suckers are less fleshy in *C. tshernyshevi* but not so in this new species; and (5). The external seta of genu I is thin and hair-like in *C. tshernyshevi* but not so in this new species.

Analysis of Phenogram

The phenogram categorizes 2 sections having sister groups; which show different relationships at different levels of linkages with one another, a brief discussion pertaining to 12 species is presented here (Fig. 3). The foremost bunch shows the peak communal phenetic affinity of

92% between the species *C. agrios* and *C. hadros* linked in a pair-like format. Both the species have been collected from adjoining sub-mountainous areas of similar ecological niche; their high affinity could thus be attributed to their similar ecological habitats. The second pair in this bunch is a combination of 2 species in which the phenetic resemblance of 88% is exposed between *C. bradys* and *C. austerus* from discrete localities of plains and hilly areas. This pair is bridged to the adjacent first pair at 82 % level of shared affinity. This infers that similarity could be an attribute of genetics. The third pair in this cluster depicts an affinity of 80% between species *C. faisalabadiensis* and *C. trigonellum*, as these two species are the commoners of the same habitat, having the identical hosts, thus it is revealed that affinity of these species could be attributed due to the same ecological zones they dwell. This pair is linked to the former two pairs at 72% level of phenetic affinity. The species *C. multaniensis* and *C. opacatus* are showing an affinity of 66.5 % and 65.5 %, respectively, with the group of *C. agrios, C. hadros, C. bradys, C. austerus, C. faisalabadiensis* and *C. trigonellum* species, thus completing the cluster.

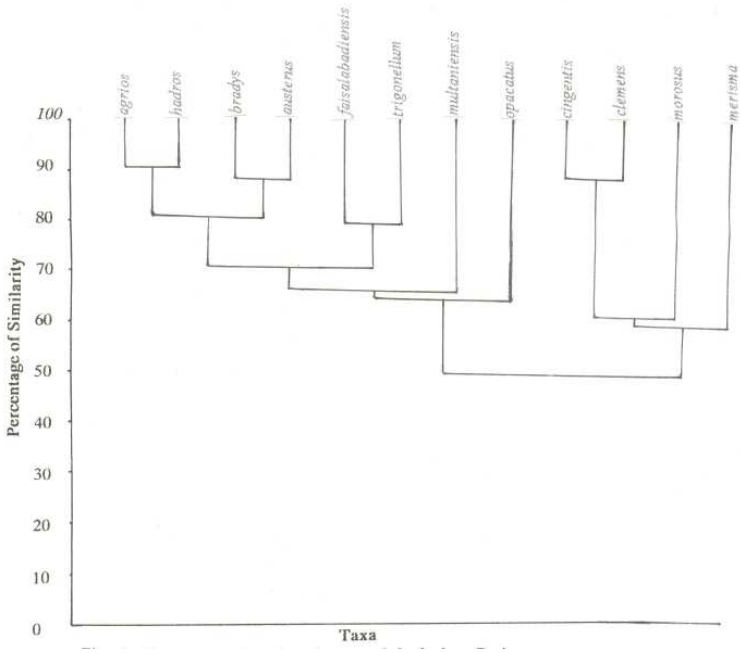

Fig. 3. The phenogram showing relationship between species of genus *Caloglyphus* at different levels of linkages.

Since these species are associated with miscellaneous ecological zones, therefore, the kinship among them may be due to sharing of universal genetic characters rather than ecological relatedness. The characters used for the separation of species inside the genus emerged to be of reliable happening.

The second bunch is a combination of 4 species in which the phenetic affinity of 88 % is exposed between *C. cingentis* and *C. clemens* pair that are the occupiers of varied ecological spots. To this couple, species *C. morosus* and *C. merisma* adhere at 62 % and 50.9 % levels of phenetic affinities. All the species of this second bunch, regardless of the fact that are the dwellers of discrete localities. Their affinity may be due to the consistent characters and instincts which embody the genus. This infers that similarity could be an attribute of genetics. This second cluster is bridged to the first

cluster at 59 % level of shared affinity, thus forming the phenogram in the current study from heterogeneous habitats.

CONCLUSION

The genus *Caloglyphus* has an extensive assortment of sharing in Pakistan. As they have been collected from distinct and diverse biological habitations, this specifies that species have an aptitude to assume diverse ecological territory, and thus can be recognized to have a wider inherent flexibility. It is hoped that the inter-relationships between different species would provide a basis for future phylogenetic work. It can be argued that once a primary biological survey of an area has established baseline data; observing changes in the habitats can monitor changes in the data of regular sampling of *Caloglyphus*. Quantitative mite sampling in such a context is important for the conservation of natural habitations. It is emphasized for a flow of published information and this publication together with identified material could form the foundation of reliable reference for the country of origin.

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