



An undescribed mite of genus *Caloglyphus* Berlese (Acarina: Acaridae) collected from oriental region, Pakistan

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Abstract

A survey of genus *Caloglyphus* Berlese in the family Acaridae Ewing and Nesbitt was conducted from different ecosystems and altitudes within Pakistan. The materials on acarid mites taken from natural habitat have yielded one species *Caloglyphus taraxis* yet unknown from this locality and identified as new species (or ecotype) to the fauna of Acari. The newly recorded species has enough distinctive traits like variable type of setae, gnathosoma, apodemes, sternum, and ventral and suctorial shields that have been lacking in any other species of genus *Caloglyphus*. This suite of features associated is unknown in any other population of *Caloglyphus* to suggest that it might constitute an innovative taxon. Results are compared to data collected earlier on population of *Caloglyphus* from the countrywide areas. The comprehensive analyses of *C. taraxis* were performed, and then systematic status is discussed and assessed based on these comparisons.

Key words: *Caloglyphus*, Acaridae, New mite species, Hypopus, Taxonomy

1. Introduction

Different species of mites often infest stored foodstuffs and various drugs, and cause losses in food and drug products, especially in humid and warm areas. They are small creatures of about half a millimeter in body size and creamy white in color, proving difficult to be detected from drugs and food products (Li *et al.*, 2003). Acaroid mites including *Caloglyphus* can survive in many environments such as the storehouse, and human and animal bodies. Its infestation in human can cause acaridiasis in several organs together with the lung, intestine and urinary tract (Boquete *et al.*, 2000).

Recognition of taxonomic diversity within genus *Caloglyphus* of the family Acaridae (Tyroglyphidae) from geographical areas of world actually began when Berlese initially proposed and described the genus *Caloglyphus* in 1923 and selected *Caloglyphus berlesei* Michael, 1903 as its type species for a single species (hypopus). Among others; Zakhvatkin (1941) prepared a comprehensive review of this genus and portrayed 4 new species and redescribed 6 species with improved descriptions of this taxa. Nesbitt (1944 and 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 from his area of study. Hughes (1976) prepared an excellent accumulation of knowledge to this genus. Tseng and Hsieh (1976) redescribed 1 species with improved depiction. Samsinak (1980) amended 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. Oconnor (2003) listed two species of genus *Caloglyphus* (= *Sancassania*) phoretic on other species of arthropods. Klimov and Oconnor (2003) have reported phylogeny, historical ecology and systematic of some mites including full descriptions of each taxon, keys and biological information. Sarwar and Ashfaq (2004, 2006, 2010), and Sarwar *et al.*, (2005, 2009) in their studies recognized and expressed 5 new species reported from this global area and also gave their distribution record in Pakistan. Undeniably, the mite fauna of Pakistan is rich and diverse, but remains very poorly studied in

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contrast to those from other zoogeographical regions of the world. The aim of this study was to explore the species composition of genus *Caloglyphus* in the family Acaridae within the country.

2. Materials and methods

2.1. Mites collection and preparation of permanent slides

Different localities were surveyed expansively for the collection of *Caloglyphus* mites in different regions of the Pakistan. The method used for the collection of mites comprised Berlese's funnel method. The samples of various stored commodities were brought in the laboratory and then these materials were placed in the funnels having the source of light on top for at least 24 hours. The mites moving away from light source fell downward into the beaker containing 70% alcohol with a few drops of glycerin. These mites were stored in small glass vials and labeled. The specimens were prepared for closer study by clearing their bodies in 10% KOH for 15-30 minutes by examining under a compound microscope. For preparation of permanent slides the Hoyer's medium was used.

2.2. Analysis of Morphology

All collected individuals of the genus *Caloglyphus* were examined under a phase contrast microscope to identify external morphological features that might vary among geographical populations or between morphs. These preparations were compared to specimens previously deposited in Department of Agricultural Entomology, and by going through the literature collections made earlier. All illustrations of body parts were made with the aid of the graph paper using an ocular grid. Measurements of body length, width and other body parts were made with the help of an ocular micrometer. All the measurements were articulated in micrometers (μm) taken from the entire parts of body. New species in the present investigations was described following the terms of body parts and idiosomal chaetotaxy proposed by Griffiths *et al.*, (1990), and terms of leg chaetotaxy and solenidiotaxy projected by Griffiths (1970).

3. Results

Key to Species of Genus *Caloglyphus* (Hypopi)

1 Sternum 2 (<i>st2</i>) present	2
- Sternum 2 (<i>st2</i>) absent	28
2 Sternum 2 (<i>st2</i>) meeting genital shield posteriorly	3
- Sternum 2 (<i>st2</i>) not meeting genital shield posteriorly	20
3 Apodeme 2 (<i>ap2</i>) meeting apodeme 3 (<i>ap3</i>)	4
- Apodeme 2 (<i>ap2</i>) not meeting apodeme 3 (<i>ap3</i>)	7
4 Dorsum dotted; sternum 1 (<i>st1</i>) bifid posteriorly..... <i>C. captus</i> Sarwar and Ashfaq	
- Dorsum not dotted; sternum 1 (<i>st1</i>) not bifid posteriorly	5
5 Propodosomal setae (<i>sci, sce</i>) forming a straight line..... <i>C. austerus</i> Sarwar <i>et al.</i>	
- Propodosomal setae (<i>sci, sce</i>) not forming a straight line	6
6 Apodeme 2 (<i>ap2</i>) meeting apodeme 4 (<i>ap4</i>); metasternal seta (<i>mts</i>) present..... <i>C. spinipes</i> Mahunka	
- Apodeme 2 (<i>ap2</i>) not meeting apodeme 4 (<i>ap4</i>); metasternal seta (<i>mts</i>) absent..... <i>C. rodionovi</i> A. Z.	
7 Apodeme 3 (<i>ap3</i>) meeting apodeme 4 (<i>ap4</i>)	13
- Apodeme 3 (<i>ap3</i>) not meeting apodeme 4 (<i>ap4</i>)	8
8 Gnathosomal lateral margins parallel	9
- Gnathosomal lateral margins not parallel	11
9 Sternum 1 (<i>st1</i>) bifid posteriorly; paragenital seta (<i>pr</i>) bifid..... <i>C. multaniensis</i> Ashfaq and Chaudhri	
- Sternum 1 (<i>st1</i>) not bifid posteriorly; paragenital seta (<i>pr</i>) not bifid	10
10 Tarsus I with 4 leaf-like setae; external ventral seta of genu II simple..... <i>C. tshernyshevi</i> Zakhvatkin	
- Tarsus I with 5 leaf-like setae; external ventral seta of genu II spine-like..... <i>C. agrios</i> Sarwar <i>et al.</i>	
11 Setae <i>sci</i> and <i>sce</i> forming straight line; apodemes 4 (<i>ap4</i>) not meeting medially..... <i>C. opacatus</i> Ashfaq and Chaudhri	
- Setae <i>sci</i> and <i>sce</i> not forming straight line; coxal discs (<i>di1, di2</i>) conoids	12
12. Apodemes 4 (<i>ap4</i>) not meeting medially; paragenital seta (<i>pr</i>) antero-medial to genital disc (<i>gdi3</i>); suctorial shield with radial striations posteriorly..... <i>C. verto</i> Sarwar and Ashfaq	
- Setae <i>sci</i> and <i>sce</i> not forming straight line; apodemes 4 (<i>ap4</i>) meeting medially..... <i>C. trigonellum</i> Sher <i>et al.</i>	
13 Gnathosoma notched posteriorly	14
- Gnathosoma not notched posteriorly	15
14 Setae <i>sci</i> and <i>sce</i> of equal size; apodemes 4 (<i>ap4</i>) meeting medially..... <i>C. merisma</i> Ashfaq and Chaudhri	
- Setae <i>sci</i> and <i>sce</i> not of equal size; apodemes 4 (<i>ap4</i>) not meeting medially..... <i>C. hadros</i> Sarwar <i>et al.</i>	
15 Dorsal body setae simple	16
- Dorsal body setae serrated..... <i>C. oviformis</i> Mahunka	
16 Gnathosoma much below the anterior margin of propodosoma; coxal field III open..... <i>C. moniezi</i> A.Z.	

- Gnathosoma not much below the anterior margin of propodosoma; coxal field III not open	17
17 Gnathosoma parallel laterally; distal fork separated from basal joint	19
- Gnathosoma not parallel laterally; distal fork not separated from basal joint	18
18 Hysterosomal shield smooth; trochanter I without seta; \acute{o} on genu II spine-like.... <i>C. muscarius</i> Sevastyanov and Radi	
- Hysterosomal shield dotted; trochanter I with 1 seta; \acute{o} on genu II a solenidion..... <i>C. kenos</i> Sarwar and Ashfaq.	
19 Hysterosomal shield smooth; sternum 1 (<i>st1</i>) not bifid posteriorly; coxal discs (<i>di1</i> , <i>di2</i>) conoids	
..... <i>C. bradys</i> Sarwar <i>et al.</i>	
- Hysterosomal shield dotted; sternum 1 (<i>st1</i>) bifid posteriorly; coxal discs (<i>di1</i> , <i>di2</i>) not conoids	
..... <i>C. faisalabadiensis</i> Sher, Asfaq and Parvez	
20 Ventral shield separated from genital shield	24
- Ventral shield not separated from genital shield	21
21 Apodemes 4 (<i>ap4</i>) meeting medially..... <i>C. polyphyllae</i> Zakhvatkin	
- Apodemes 4 (<i>ap4</i>) not meeting medially	22
22 Hysterosomal shield with 5 pairs visible pores..... <i>C. taraxis</i> , n. sp.	
- Hysterosomal shield not with 5 pairs visible pores	23
23 Suctorial shield rounded..... <i>C. mandzhur</i> Zakhvatkin	
- Suctorial shield longer than wide..... <i>C. rhizoglyphoides</i> Zakhvatkin	
24 Gnathosoma with 1 pair small setae	25
- Gnathosoma not with 1 pair small setae	27
25 Coxal disc (<i>di1</i>) replaced by a seta..... <i>C. mycophagus</i> Megnin	
- Coxal disc (<i>di1</i>) not replaced by a seta	26
26 Sternum 2 (<i>st2</i>) free from either sides; coxal field III open..... <i>C. baloghi</i> Mahunka	
- Sternum 2 (<i>st2</i>) free posteriorly; coxal field III closed..... <i>C. conus</i> Mahunka	
27 Apodeme 2 (<i>ap2</i>) meeting apodeme 3 (<i>ap3</i>); suctorial shield with radial striations posteriorly <i>C. bifurcatus</i> Mahunka	
- Apodeme 2 (<i>ap2</i>) not meeting apodeme 3 (<i>ap3</i>); suctorial shield without radial striations posteriorly <i>C. forficularis</i> Sevastyanov and Radi	
28 Gnathosoma extended beyond the body	29
- Gnathosoma not extended beyond the body	30
29 Apodemes 4 (<i>ap4</i>) meeting medially, metasternal seta (<i>mts</i>), paragenital seta (<i>pr</i>) and seta <i>hv</i> present. <i>C. morosus</i> Ashfaq and Chaudhri	
- Apodemes 4 (<i>ap4</i>) not meeting medially; metasternal seta (<i>mts</i>), paragenital seta (<i>pr</i>) and seta <i>hv</i> not present <i>C. berlesei</i> Michael	
30 Apodeme 3 (<i>ap3</i>) meeting apodeme (<i>ap4</i>)	33
- Apodeme 3 (<i>ap3</i>) not meeting apodeme (<i>ap4</i>)	31
31 Gnathosoma reduced; coxal field III opened..... <i>C. caroli</i> Channabasavanna <i>et al.</i>	
- Gnathosoma well developed; coxal field III closed	32
32 Coxal field II open; legs strong and stout..... <i>C. geotruporum</i> Zakhvatkin	
- Coxal field II closed; legs fat and small..... <i>C. spinitarsus</i> Hermann	
33 Coxal field III open; genital disc (<i>gdi3</i>) and suctorial shield with radial striation. <i>C. clemens</i> Sarwar and Ashfaq	
-Coxal field III closed; genital disc (<i>gdi3</i>) and suctorial shield without radial striation <i>C. cingentis</i> Sarwar and Ashfaq	

Caloglyphus taraxis (sp. nov.)

Description: Description of new *Caloglyphus* mite is presented for Hypopus, while the female and that of male are not known at this stage.

Dorsal outlook: Body 330 μ m long, 218 μ m wide, divided into propodosomal and hysterosomal shields. Propodosomal shield 80 μ m long, 188 μ m wide, dotted medially, antero-lateral margins with broken striations, remaining shield smooth; setae *vi*, *ve*, *sci*, *sce* and *scs*, each 1 pair, simple, 21 μ m, minute, 10 μ m, 17 μ m and 26 μ m long, respectively; *sci-sci* 38 μ m, *sce-sce* 90 μ m and *sci-sce* 25 μ m apart; setae *sci* and *sce* forming a semi-circular line, middle in position. Hysterosomal shield 270 μ m long, 218 μ m wide, smooth, anterior margins straight having dots and broken striations, lateral margins smooth. Hysterosomal shield setae, 11 pairs, 5 pairs visible pores. Setae *d1* = *d2* = *d3* = *d4* = 11 μ m; *hi* = *he* = 15 μ m; *la* 14 μ m, *lp1* 14 μ m, *lp2* 12 μ m; *sae* 38 μ m, *sai* 12 μ m, long; *d1* - *d1* 94 μ m, *d2* - *d2* 70 μ m, *d3* - *d3* 53 μ m, *d4* - *d4* 88 μ m; *d1* - *d2* 45 μ m, *d2* - *d3* 65 μ m, *d3* - *d4* 75 μ m and *la* - *la* 128 μ m apart. Hysterosomal shield anterior margin overlapping propodosomal shield posterior margin upto 20 μ m, overlapping area straight, dotted with transverse, broken striations (Figure 1).

Ventral outlook: Gnathosoma fused pedipalpi, 2 segmented, slightly tapering anteriorly, 30 μ m long (basal part simple, distal part bifurcated), 1 pair arista, 42 μ m long, 3 pairs small setae (Figure 3 upper). Apodeme 1 (*ap1*) largely Y-shaped, continuing with sternum 1 (*st1*). Sternum 1 (*st1*) 51 μ m long, free. Apodeme 2 (*ap2*) free, curved at tip. Apodeme 3 (*ap3*) meeting apodeme 4 (*ap4*). Apodemes 4 (*ap4*) not meeting medially. Apodeme 4 (*ap4*) and apodeme 5 (*ap5*) meeting making broad, rounded tip anteriorly, not meeting with same structure from other side.

Metasternal seta (*mts*) 1 pair, within encircled area of apodeme 4 (*ap4*) and apodeme 5 (*ap5*). Sternum 2 (*st2*) 30 μ m long, not meeting the genital shield. Coxal fields II and I open, dotted, III closed, dotted, IV open, smooth. Sternal shield separated from ventral shield. Ventral shield not separated from genital shield. Genital shield with longitudinal genital slit, smooth, 2 pairs genital suckers, 1 pair paragenital seta (*pr*) antero-medial to genital disc (*gdi3*) (Figure 3 middle). Coxal discs *d11* and *d12* present, conoids, genital disc (*gdi3*) with radial striations. Seta *hv* 1 pair, 5 μ m long. Suctorial shield 63 μ m long, 95 μ m wide, dotted, concave antero-medially, convex medio-posteriorly with 2 suckers below; posteriorly and laterally with sclerotized piece with pointed ends, anterior suckers 1 pair rounded, dotted in-between, anal suckers 1 pair, larger than all other suckers, 1 pair lateral and 1 pair posterior conoids, 2 pairs vestigial peripheral suckers (Figure 3 lower). Suctorial shield separated from posterior body end by a distance smaller than suctorial shield length (Figure 2).

Legs chaetotaxy: Strong and stout, I-IV measuring 125 μ m, 118 μ m, 83 μ m, 100 μ m and 108 μ m in length, respectively (trochanter base to tarsus tip). Setae and solenidia on legs I-IV segments: coxae 0-0-0-0, trochanters 1-1-1-0, femora 1-1-0-0, genua 4-3-1-1, tibiae 3-3-2-2, tarsi 11-9-9-7. Tarsi I and II 39 μ m and 35 μ m long, respectively. Seta *vF* on femora I and II each 40 μ m long, absent on femora III and IV. Seta *e* on tarsi I-IV measuring 35 μ m, 30 μ m, 28 μ m and 23 μ m in length, respectively. Seta *mG* on genua I and II lancet-like; *hT* on tibiae I and II each lancet-like, 19 μ m, 20 μ m, 14 μ m and 20 μ m long, respectively. Seta *o* on genu I, a simple seta, on genu II, a solenidion 35 μ m and 13 μ m long, respectively. Tarsi I and II each with a solenidion *w1* each 25 μ m long. Tarsi III and IV short and stout. Seta *d* on tarsus IV 62 μ m long. Dorsal seta *o* on tibiae I and II 70 μ m and 52 μ m long, respectively. Seta *ba* on tarsus I, 25 μ m long. Tarsi I-IV provided with 1 spoon-shaped + 4 leaf-like; 1 spoon-shaped + 5 leaf-like; 1 spoon-shaped + 4 leaf-like; 1 spoon-shaped + 3 leaf-like setae, respectively (Figure 2).

TYPE: Holotype, hypopus, collected from Karachi from rice (*Oryza sativa* L.) on 19.9.1994 (Sarwar) and deposited in Acarology Research Laboratory, Department of Agricultural Entomology, University of Agriculture, Faisalabad. Its 1 Paratype collected from decaying leaf litter in the same locality.

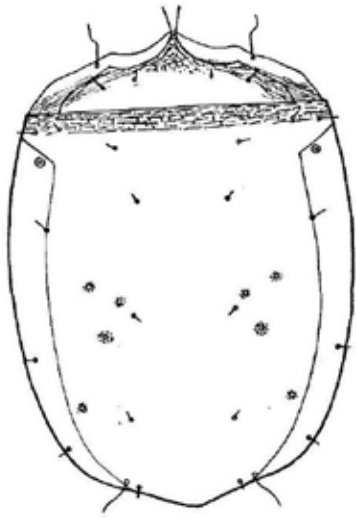
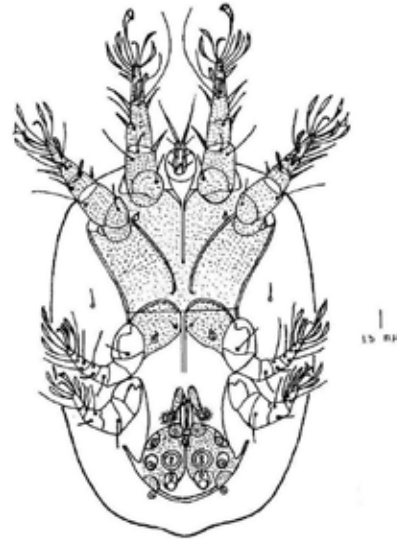
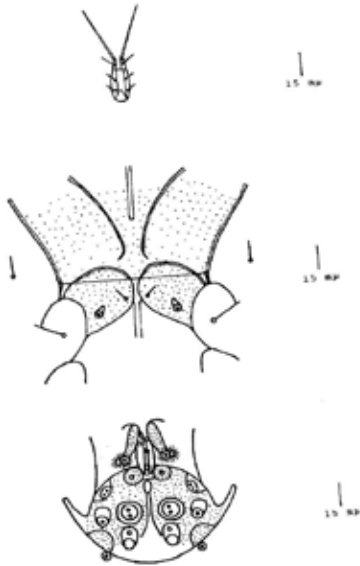
REMARKS: This new species appears to be closely allied to *Caloglyphus merisma* Ashfaq and Chaudhri but the following are different points in them:

1. Setae *sci* and *sce* of equal size in *C. merisma* but not equal in this new species.
2. Apodemes 4 (*ap4*) meeting medially in *C. merisma* but not meeting in this new species.
3. Ventral shield separated from genital shield in *C. merisma* but not separated in this new species.
4. Genital disc (*gdi3*) without radial striations all around in *C. merisma* but with radial striations in this new species.
5. Suctorial shield not rounded posteriorly in *C. merisma* but rounded posteriorly in this new species.

4. Conclusions

Systematics work published to date on the mite of genus *Caloglyphus* related to different commodities in Pakistan is represented by 12 new species, at this occasion; the present authors have collected and described further 1 new species. Like most of other acaroid mites that are generalist foragers, species *Caloglyphus* are organisms of agricultural importance worldwide and they show a wide range of peculiar morphological characteristics. They might occur in much more pervasive localities to utilize many hosts. However, host records are not yet sufficiently comprehensive to exhibit any clear phylogenetic signal. Certainly, the current and previous results clearly showed that ecotype of genus *Caloglyphus* might be collected over a wide geographical range in Pakistan. The newly recorded species has enough distinctive traits like variable type of setae, gnathosoma, apodemes, sternum, and ventral and suctorial shields that have been lacking in any other species of *Caloglyphus*. This suite of features associated is unknown in any other population of *Caloglyphus* to suggest that it might constitute an innovative taxon. However, earlier results just as emphatically placed, there is little resemblance between *C. merisma* and the new species.

First, the earlier sampling of the genus *Caloglyphus* from distinct and diverse biological habitations in Pakistan specifies that species have a tendency to assume a miscellaneous ecological territory, and thus can be recognized to have a wider inherent flexibility. The second conclusion is that acoustically defined species such as *C. merisma* and *C. taraxis* are not necessarily homogeneous in their external appearance. Again, the polymorphic nature of several species within *Caloglyphus* has already been recognized and described, but that was when many different forms were still included within a monolithic sampling of *Caloglyphus*. Further remarkably, the present study showed that *C. taraxis* is tremendously variable in its morphology from other populations encountered earlier in the genus. Therefore, it is no longer acceptable to assign all other species alike with *C. taraxis*. More detailed studies of the taxonomic traits of several specimens could be successful to reveal any uniquely different character affirm that could be of auxiliary systematic use. It is expected that the inter-relationships between different species would offer a basis for future phylogenetic work, after any other work can be done.

Figure 1. Dorsal view of *C. taraxis*, n. sp.Figure 2. Ventral view of *C. taraxis* n. sp.Figure 3. Gnathosoma (upper), Coxal apodemes (middle), Suctorial shield (lower) of *C. taraxis* n. sp.

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