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A new species of *Cheletonella* Womersley (Prostigmata: Cheyletidae) from Iran and a key to the species

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**Original research**

**ABSTRACT**

A new species, *Cheletonella iraniensis* n. sp. (Acariformes: Prostigmata: Cheyletidae) is described based on adult females from Rasht, Guilan Province, Northern Iran. Additionally, a key to the world species (females) of the genus *Cheletonella* Womersley is provided.

**Keywords** Cheletonella; Cheyletidae; Iran; Guilan; key; new species; taxonomy

**Zoobank** http://zoobank.org/39C94FD9-1D1D-42E2-912A-02505D1A864A

**Introduction**

The family Cheyletidae presently includes over 440 species in 75 genera (Zhang *et al*., 2011; Bochkov and Abramov 2016). Cheyletid mites have a cosmopolitan distribution and they occur on all the continents (Gerson *et al*., 1999; Bochkov and Fain, 2001). About 78% of cheyletid species are predators, the remaining species are permanent parasites of mammals and birds. Sometimes they cause allergies and popular dermatitis in humans having close contact with infested pets (Keh *et al*., 1987; Gerson *et al*., 1999; Bochkov and Fain, 2001; Dogan *et al*., 2011). The predatory species occupy a wide variety of habitats including plants, soil-litter, tree bark, stored products and colonies and galleries of insects or ephemeral substrates requiring dispersal by phoresy on insects or vertebrates. Cheyletid mites have also been collected from arthropod and bird nests, caves, and bat roosts in association with beetles, bugs, bees, flies, scorpions, millipedes, lizards (Summers and Price, 1970; Laing, 1973; Hughes, 1976; Fain and Bochkov, 2001; Bochkov and Oconnor 2004; Gerson *et al*., 2003; Krantz and Walter, 2009; Fuangarworn and Lekprayoon, 2010; Skoracki *et al*., 2012). Cheyletid mites are mainly free-living predators that feed on various micro-arthropods, particularly on herbivorous, fungivorous, and saprophagous acaroid mites (Zdarkova, 1979). A few species however can be beneficial as biological control agents controlling acaroid mites (Acarini: Acaridae), which are serious pests damaging agricultural stored food (Gerson and Smiley, 1990; Bochkov and Fain, 2001; Fain and Bochkov, 2001).

The genus *Cheletonella* was established by Womersley in 1941 with *Cheletonella vespertilionis* as the type species. Four species were previously described in this genus, namely, *Cheletonella vespertilionis* Womersley, 1941 from a bat in Australia, *C. caucasica* Volgin, 1955 from a gray hamster and sparrow’s nest in Russia, *C. pilosa* Tseng, 1977 from wheat in Taiwan of China and *C. hoffmannae* Smiley, 1996 from the brown bat’s guano in the USA (Xia *et al*., 1999). Xia *et al*. (1999) described a fifth species *C. juglandis*, collected from the nut, *Juglans regia*, in China. Fain and Bochkov (2001) considered *C. juglandis* as a species inquirenda (requiring further investigation), because presented figure in the paper (Xia *et al*., 1999, page 150, figure 3) represents the anal region of deutonymph (last nymphal stage). *Cheletonella caucasica* described by Volgin (1955) in Russia was also considered a junior synonym of *C.
vespertilionis by Fain and Bochkov (2001). Thus only three valid species of Cheletonella were recognized by Fain and Bochkov (2001) who provided a key based on female specimens. During taxonomic studies of cheyletid mites from Guilan Province, Northern Iran, a fourth new species of Cheletonella was discovered. Herein, we describe C. iraniensis n. sp., and provide an identification key to the known Cheletonella species of the world.

Materials and methods

This study was conducted in Rasht county, Guilan Province, Northern Iran, during the period 2016 – 2017. The mites were extracted from stored materials like rice flakes, barn and barley, by placing them in a Berlese/Tullgren funnel or directly collecting them under a stereomicroscope. Mites were cleared in Nesbitt’s solution and mounted in Hoyer’s medium on microscope slides. The mites were examined under a 1000× magnification of an Olympus BX51 phase contrast and a differential interference contrast microscope (Olympus Optical Co; LTD; Japan). All drawings were prepared with the help of a 1.25X Olympus camera lucida (Olympus Optical Co; LTD; Japan). Body length measurements represent the distance between the anterior tip of the gnathosoma and the posterior margin of idiosoma; width was measured at the broadest point of the idiosoma. Leg measurements are from trochanter to pretarsus. In the description below, the idiosomal setation follows Grandjean (1939) as adapted for Prostigmata by Kethley (1990) and adapted for Cheyletidae by Skvarla et al (2014). The nomenclature for leg setae follows that of Grandjean (1944). All measurements are given in micrometers (μm). Type material were preserved as slide-mounted specimens and will be deposited in Acarology Laboratory, Department of Plant Protection, Faculty of Agricultural Sciences, University of Guilan, Iran. One female paratype will be deposited in the National Collection of Arachnida, Plant Protection Research Institute, Pretoria, South Africa.

Results

Subfamily: Cheyletinae Leach, 1815
Tribe: Cheyletini Leach, 1815
Genus: Cheletonella Womersley 1941

Cheletonella iraniensis n. sp. (Figs 1-3)

Zoobank: 92164C11-8243-4A38-950E-52201E56BAAC

Diagnosis (female) — Dorsal shield with 15 pairs of lanceolate setae; propodosomal shield with one pair of dorsomedian setae x1; genitoanal area with two pairs of genital setae (g1 and g2), three pairs of aggenital setae (ag1, ag2 and ag3) and two pairs of pseudoanal setae, pseudoanal setae ps1 barbed setaceous and ps2 lanceolate barbed; chaetotaxy of coxa I-IV: 2-1-2-2; coxa I and IV each with 2 smooth setaceous setae.

Description. Female (n=5)

Dorsum (Fig. 1A) — Body (including gnathosoma) 560 (480–664) long; gnathosoma 151 (120–160) long, 144 (120–160) wide; idiosoma 450 (380–520) long, 313 (264–360) wide; dorsum of idiosoma with a large propodosomal shield, the rest of dorsum striated. Without hysterosomal shield. Eyes absent. Propodosomal shield squarish as long as wide 120 (100–140). Dorsum of idiosoma with fifteen pairs lanceolate setae, ten pairs marginal, four pairs dorsomedian and one pair humeral. Propodosomal shield with one pair of dorsomedian setae x1 25 (22–32) long, and four pairs rather large marginal setae (vi, ve, sci, x2). Setae hm also
lanceolate situated ventrally. Setae sce 38 (36–42) long, situated off propodosomal shield on dorsal membrane of propodosoma between setae x2 and hm. Hysterosomal membrane bearing three pairs of lanceolate dorsomedian setae c1 24 (22–31) long, d1 26 (24–33), e1 25 (24–33) and three pairs of lanceolate barbed setae (c2, d2, e2) laterally and two pairs of lanceolate barbed setae (f1, h1) situated near posterior margin. Lengths of setae: vi 46 (40–48), ve 37 (34–39), sci 50 (48–52), x1 25 (22–32), x2 37 (32–42), hm 60 (54–63), c2 42 (42–44), d2 38 (34–42), e2 42 (44–48), f1 38 (34–46), h1 36 (34–40). Distances between dorsal setae: vi–vi 93 (80–110), ve–ve 109 (95–120), sci–sci 128 (120–150), x1–x 88 (70–100), x2–x2 91 (85–100), vi–ve 19 (18–20), ve–sci 28 (26–30), sci–x2 79 (75–90), x1–x2 22 (20–26), hm–hm 296 (288–310), sce–sce 172 (160–188), x1–x2 40 (30–55), c1–c1 84 (80–90), d1–d1 79 (75–90), e1–e1 57 (44–75), c2–c2 104 (96–115) d2–d2 135 (120–160), e2–e2 93 (68–120), h1–h1 40 (35–46), f1–f1 70 (55–80), x1–c1 98 (88–104), c1–d1 62 (60–66), d1–e1 69 (66–74), e1–e2 39 (36–44), d1–d2 37 (34–40), e1–e2 34 (34–40), e2–f1 39 (36–44), f1–h1 13 (8–20).

Venter (Fig. 1B) — Ventral surface of idiosoma finely striate, bearing three pairs of setaceous intercoxal setae (ic1, ic3, ic4). Genitoanal area small with two pairs of genital setae (g1 and g2), three pairs of aggenital setae (ag1, ag2 and ag3) and two pairs of pseudoanal setae (ps1 and ps2). All ventral setae setaceous, excluding genital setae g1–g3 barbed, pseudoanal setae ps1 barbed setaceous and ps2 lanceolate barbed. Lengths of setae: ic1 24 (22–26), ic3 26 (24–28), ic4 24 (22–26), g1 14 (12–15), g2 15 (14–17), ag1 23 (20–26), ag2 22 (20–25), ag3 17 (15–19), ps1 17 (14–18), ps2 22 (20–24). Distances between ventral setae: ic1–ic1

Figure 1 Cheletonella iranianensis n. sp. (Adult female): A – Dorsal view of idiosoma; B – ventral view of idiosoma. Scale bar: 100 μm.
Gnathosoma (Figs. 2A–B) — Peritremes M-shaped, composed of nine pairs of fairly strong chambers. Dorsum of gnathosoma with adoral setae ao1 17 (16–20) and pair of very small supracoxal setae elcp (measurement impossible). Venter of gnathosoma bearing subcapitular setae n 60 (56–62) and adoral setae ao2 10 (8–12). Palp 151 (130–200) long; palp femur with equal length and width 78 (60–100); palp setal formula as follows: trochanter without seta; femora with one barbed setaceous dF 80 (76–86) and three smooth setaceous setae v’F 40 (38–44), v”F 32 (30–38), I”F 15 (14–18); genua only with one barbed setaceous seta dG 39 (38–45); tibiae with three smooth setaceous setae dTi 30 (28–32), l’Ti 25 (24–26) l”Ti 29 (28–30); tibial claw 38 (32–46) long and with 2 basal teeth; tarsi with two comb-like eupathidia (acm, sul), outer comb (sul) about as long as claw, with 17 tines distributed throughout inner surface; inner comb (acm) almost straight, with approximately 20 tines, two smooth setaceous setae (ul’, ul”) and one solenidion (ɷ). Distance between ao1–ao1 23 (22–24), ao2–ao2 11 (10–12), ao1–ao2 7 (6–8), n–n 48 (46–50), dF–dF 105 (85–130), dG–dG 144 (120–190), dTi–dTi 146 (110–180), v’F–v”F 124 (110–114), v”F–v”F 124 (110–114), v’F–l”F 18 (20–22), l”F–l”F 180 (150-195), v”F–l”F 42 (38–46), v”F–l”F 34 (36–38), dF–l”F 40 (38–42), I”F–l”F 125 (90–160), l”F–l”F 165 (110–210), l”F–l”F 19 (16–20), dTi–l”F 10 (8–12), dTi–l”F 12 (10–14).

Legs (Figs. 3A–D) — All legs with barbed setaceous setae except dorsal setae on genua and femur III–IV which are lanceolate, barbed, of same structure as those on dorsal shield. Leg I–IV setal formulae: tarsus 9 + solenidion ɷ1 (tc’, tc”, a”, u”, u’, p”, p”, p”, p’, p”, ft, vs) −7 + solenidion ɷ1I (tc’, tc”, a”, u”, u’, p”, p”, p”, p”, vs) −7 + solenidion ɷ1II (tc’, tc”, u”, u’, p”, p”, vs) −7 + solenidion ɷ1III (tc’, tc”, p”, p”, p”, vs) −7 + solenidion ɷ1IV (tc’, tc”, u”, u’, p”, p”, vs) −7; tibia 5 (l’T, l”T, v’T, v”T, dT) −4−4−4 (l’T, dT, v’T, v”T); genu −2−2−2−2 (dG, l’G); femur 2–2–2–1; trochanter 1–1–2–1;
coxa 2–1–2–2 smooth setaceous. Guard setae (ft) of solenidion (ɷI) 28 (26–30) long and about 2 times longer than solenidion 14 (13–16) long. Length of legs I–IV: 282 (260–320); 215 (196–240); 246 (228–280); 272 (248–300).

**Remarks** — The new species belongs to the tribe Cheyletini and genus Cheletonella because of the dorsal idiosoma plating restricted to a large propodosomal shield (Summers and Price, 1970). *Cheletonella iraniensis* can be distinguished from *C. pilosa* Tseng, 1977 by having 1) coxa I and IV each with 2 smooth setaceous setae, coxa formulae 2–1–2–2 (vs. coxa formulae 1–1–2–1; 2) dorsum of idiosoma with 15 pairs setae (vs. dorsum of idiosoma with 12 pairs setae; 3) the presence of three pairs of dorsomedian setae c1, d1 and e1 on hysterosomal membrane (vs. two pairs of dorsomedian setae on hysterosomal membrane; 4) legs with barbed setaceous setae (vs. legs with acicular and smooth setae; 5) pseudoanal setae ps1 barbed setaceous and ps2 lanceolate barbed (vs. pseudoanal setae ps1 and ps2 lanceolate; 6) outer comb of palptarsi with 17 tines and inner comb with approximately 20 tines (vs. outer comb of palptarsi with 15 tines and inner comb with approximately 24 tines; 7) femur of the palp with dorsal seta dF barbed and setaceous (vs. femur of the palp with dorsal seta acicular and smooth. *Cheletonella iraniensis* differs from *Cheletonella vespertilionis* Womersley, 1941 by having 1) dorsal setae of idiosoma lanceolate (vs. dorsal setae of idiosoma fan-shaped; 2) propodosomal shield with a dorsomedian setae x1 (vs. propodosomal shield without a dorsomedian setae; 3)
three pairs of lanceolate dorsomedian setae $c1$, $d1$ and $e1$ on hysterosomal membrane (vs. four pairs of fan-shaped dorsomedian setae on hysterosomal membrane; 4) peritreme M-shaped (vs. peritreme U-shaped; 5) genitoanal area with two pairs of pseudoanal setae, $ps1$ barbed setaceous and $ps2$ lanceolate barbed (vs. genitoanal area with three pairs of pseudoanal setae, two pairs bifurcate distally; 6) peritreme M-shaped (vs. peritreme U-shaped; 7) tibial claw of the palp with 2 basal teeth (vs. tibial claw of the palp with 3 basal teeth; 8) genua I without solenidion $\sigma$ (vs. genua I with solenidion $\sigma$; 9) dorsal setae of palpfemur $dF$ and palpgenua $dG$ are barbed setaceous, differ from dorsal setae of idiosoma (vs. dorsal setae palpfemur $dF$ and palpgenua $dG$ are fan-shape, similar to dorsal setae of idiosoma). *Cheletonella iraniensis* differs from *C. hoffmannae* Smiley, 1996 by having 1) 15 pairs of lanceolate, barbed dorsal setae (vs. dorsum of idiosoma with 13 pairs of fan-shaped setae; 2) propodosomal shield with dorsomedian setae $c1$ (vs. propodosomal shield without dorsomedian setae; 3) propodosomal shield smooth, without striae (vs. propodosomal shield with tuberculate striae; 4) peritreme M-shaped with 9 pairs of chambers (vs. peritreme U-shaped with 11 pairs of chambers; 5) tibial claw of the palp with 2 basal teeth (vs. tibial claw of the palp with 4 basal teeth; 6) outer comb of palptarsi with 17 tines and inner comb with approximately 20 tines (vs. outer comb of palptarsi with 14–18 times and inner comb with approximately 21 tines; 7) palp femur with equal length and width, bearing four setae (vs. palp femur wider than long, bearing three setae; 8) dorsal seta of palpfemur barbed setaceous (vs. dorsal seta of palpfemur fan-shape; 9) palpgenua with a barbed setaceous seta (vs. palpgenua with two lanceolate and two fan-shape setae; 10) tarsus of leg I with 9 setae + solenidion $\omega_{1}$ (vs. tarsus of leg I with 8 setae + solenidion $\omega_{1}$; 11) tibia of leg I with 5 setae, without solenidion (vs. tibia of leg I with 4 setae, with solenidion $\phi_{1}$; 12) genua of leg I with 2 barbed setaceous setae, without solenidion $\sigma$ (vs. genua of leg I with 2 two setae, one lanceolate and one fan-shape setae, with solenidion $\sigma$).

**Etymology** — The species name refers to the country of origin, Iran.

**Type materials** — Holotype and 7 paratype females were collected from samples of stored rice and decayed rice bran; 1 female paratype, decayed plant material; 3 female paratypes, livestock and poultry manure; 1 female paratype, birch and fig leaves; 2 female paratypes, soil; Khomam City (37° 23’ 21” N 49° 39’ 30” E, −17 m), 19 July 2017; 10 female paratypes, stored rice and decayed rice bran; 1 female paratype, livestock and poultry manure; Rasht County (37° 17′ 0″ N, 49° 35′ 0″ E, alt. –7 m), 9 August 2015; 1 June 2016; 3 July 2016; 3 September 2016; 4 March 2017; 7 March 2017; 1 female paratype, livestock and poultry manure; Lashtnesha City (37° 36’ 44” N 49° 85’ 78” E, alt. 24 m), 22 July 2016; 8 August 2017; 1 female paratype, decayed rice bran; Bahstnehesha City (37° 36’ 44” N 49° 85’ 78” E, alt. 24 m), 22 July 2016; 8 August 2017; 1 female paratype, decayed plant material; Khoshkebijar City (37° 28’ 11” N 49° 77’ 32” E, alt. −28 m), 8 August 2017; 2 female paratypes, stored rice and decayed rice bran; 1 female paratype, decayed plant material; 1 female paratype, livestock and poultry manure; Kuchesfahan City (37° 28’ 11” N 49° 77’ 32” E, alt. 0 m), 26 August 2016; 27 October 2016; 8 October 2017; 9 November 2017; 1 female paratype, decayed plant material; Sangar City (37° 10’ 42” N, 49° 41’ 38” E, alt. 31 m), 2 August 2016; 1 female paratype; were collected from bran and dust of rice warehouse; Emamzadeh Hashem Village (37° 01’ 27” N 49° 37’ 32” E, alt. 115 m), 2 November 2016. All specimens were collected by Safoura Salarzehi. The holotype and paratype females are deposited in Acarology Laboratory, Department of Plant Protection, Faculty of Agricultural Sciences, University of Guilan, Iran. One female paratype will be deposited in the National Collection of Arachnida, Plant Protection Research Institute, Pretoria, South Africa.

**Key to the known species of the world**

1. Dorsal idiosomal setae fan-shaped ................................................................. 2
   — Dorsal idiosomal setae lanceolate ......................................................... 3

2. Palpal claw with 3 basal teeth, guard seta ($ft$) more than 1.3 times longer than solenidion $\omega_1$, peritremes with 9 links ........................................ C. *vespertilionis* Womersley, 1941

— Palpal claw with 4 basal teeth, guard seta (ft) more than 2 times shorter than solenidion ɷI, periitremes with 11 links. 

3. Idiosoma with 12 pairs of dorsal setae, coxa I and IV each with 1 smooth setaceous seta, coxal formulae 1−1− 2−1. 

C. pilosa Tseng, 1977

— Idiosoma with 15 pairs of dorsal setae, coxa I and IV each with 2 smooth setaceous setae, coxal formulae 2−1− 2−2. 

C. iraniensis

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