

On the genus *Carvaka* Distant from China (Hemiptera: Cicadellidae: Drabescini) with description of two new species

Lin LU, Yalin ZHANG^①

Key Laboratory of Plant Protection Resources and Pest Management, Ministry of Education, College of Plant Protection, Northwest A & F University, Yangling, Shaanxi 712100, China

Abstract: Two new species, *Carvaka jiangkouensis* **sp. nov.** from Guangdong and Guizhou, and *Carvaka emeiensis* **sp. nov.** from Sichuan, China, are described and illustrated. These species are placed within *Carvaka pruthii* group recognized by Viraktamath (1998). The group is characterized by the absence of an intermediate sclerite (often produced to form a basal process) between aedeagus and connective and by the apical process of the aedeagus. A checklist and key to species of *Carvaka* from China are provided.

Key words: Auchenorrhyncha; Deltocephalinae; Paraboloponina; classification; key

中国卡叶蝉属分类并述二新种（半翅目：叶蝉科：胫槽叶蝉族）

吕林, 张雅林^①

西北农林科技大学植保资源与病虫害治理教育部重点实验室, 植物保护学院, 昆虫博物馆, 陕西 杨凌 712100

摘要: 记述采自中国的卡叶蝉属 2 新种: 江口卡叶蝉 *Carvaka jiangkouensis* **sp. nov.** (广东、贵州) 和峨眉卡叶蝉 *Carvaka emeiensis* **sp. nov.** (四川)。基于阳茎和连索间缺失的骨片 (很多情况下形成阳茎基突) 和阳茎具有成对的端突, 该 2 新种归类于 *Carvaka pruthii* group。本文还提供了中国种的检索表和名录。

关键词: 头喙亚目; 角顶叶蝉亚科; 脊翅叶蝉亚族; 分类; 检索表

Introduction

The leafhopper genus *Carvaka* belongs to the subtribe Paraboloponina and most species of the genus are in the Oriental Region and a few in the Australian region (Zhang & Webb 1996; Viraktamath 1998; Fletcher & Semeraro 2007). The genus *Carvaka* was originally established with the type species *Carvaka picturata* Distant, 1918 and additional three species *C. thoracica*, *C. modesta*, and *C. ochrophara* all from India (Distant, 1918). This genus was revised including the previously known species and additional four species: *C. brunneus* Singh-Pruthi, *C. contempta* (Kirkaldy), *C. dolens* (Melichar) and *C. formosana* (Matsumura) by Zhang & Webb (1996). Subsequently, 15 species of this genus were revised by Viraktamath (1998) including 11 new species from the Indian subcontinent, namely *C. clava*,

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① Corresponding author, E-mail: yalinzh@nwsuaf.edu.cn

C. compressa, *C. confusa*, *C. elongata*, *C. girijae*, *C. kumari*, *C. nielsoni*, *C. pruthii*, *C. sinuata*, *C. synavei*, *C. wellingtoni* and he recognized three species groups based on the characters of type of articulation between aedeagus and connective. Cen & Cai (2002) added a species *C. bigeminatus* from China (Zhejiang). Fletcher & Semeraro (2007) reviewed Australian *Carvaka* and added three species, *C. flava*, *C. maculata*, *C. mouldsorum* and treated *Exitianellus* Evans as a junior synonym of *Carvaka* and all three species were recognized in the definition of Viraktamath's species groups. Zhang & Webb (1996), Viraktamath (1998) and Fletcher & Semeraro (2007) suggested that this genus resembles *Hybrasil* Kirkaldy, 1907, *Divus* Distant, 1908 and *Canopyana* Viraktamath & Srinivasa, 2006.

Here, two new species *Carvaka jiangkouensis* **sp. nov.** from Guangdong and Guizhou, and *C. emeiensis* **sp. nov.** from Sichuan, China, are described and placed within *C. pruthii* species group (Viraktamath, 1998). A checklist and key to species of *Carvaka* are also provided.

Material and methods

Specimens were observed under stereomicroscopes (Leica Zoom 2000; Discovery V20 and AxioCam ICc5, Zeiss). Both holotypes of *Carvaka jiangkouensis* and *Carvaka emeiensis* are deposited in the Entomology Museum of Northwest A&F University, China (NWAUFU). Paratype specimens of *Carvaka jiangkouensis* from Guizhou were loaned and deposited in the Institute of Zoology, Chinese Academy of Science, Beijing (IZCAS).

Taxonomy

Genus *Carvaka* Distant, 1918

Carvaka Distant, 1918: 40. Type species: *Carvaka picturata* Distant, 1918, by original designation.

Exitianellus Evans, 1966: 229 (Type species: *Exitianellus elegantula* Evans, 1966).

Diagnosis. Body stramineous. Head slightly broader than pronotum; anterior margin thick in profile, fore margin weakly bicarinate with a few fine transverse striations. Crown produced forward, longer medially than next to eyes, mid-length slightly less than width of eye, slightly depressed behind anterior margin anteriorly, surface obliquely finely striate; coronal suture prominent. Ocelli large, on fore margin close to corresponding eye, placed approximately a distance equal to own diameter or less from adjacent eye. Face with lateral frontal sutures divergent dorsad of antennal pits, extended to ocelli; frontoclypeus not tumid; clypeal suture; anteclypeus with lateral margins concave, apex expanded; lora broader than basal width of anteclypeus; gena emarginate below eyes; antenna longer than half body length; antennal pits situated near upper corners of eyes, encroaching onto clypeus; antennal ledges weakly carinate. Pronotum slightly produced between eyes, hind margin slightly concave; lateral margin short, carinate; disc with transverse striations except near anterior margin having some fine oblique striations; mesonotum and scutellum shagreen in basal half, together slightly broader than long; scuto-scutellar suture slightly arcuate. Forewing with four apical and three subapical cells, inner subapical cell open; appendix broad. Fore femur with AM1 stout and long, AV1 fine and long. Fore tibia with dorsal setal arrangement on row AD and PD 1+4. Hind femur with distal macrosetae 2+2+1.

Male genitalia. Pygofer lobe produced rounded, with ventral margin straight or rounded, posterior margin rounded without process, with lateral lobe several rows of macrosetae subapically. Valve broad triangular or pentagonal. Subgenital plate, elongate, triangular with lateral margin concave in middle without macrosetae. Style apophysis digitate transversely striate. Connective Y-shaped, with stem slightly longer than arms, articulated with aedeagus either directly or through a sclerite between them, or with basal process of aedeagus. Aedeagus with dorsal apodeme present, shaft curved dorsad, with one or two pairs of apical processes, gonopore apical.

Distribution. China; Korea; Japan; India; Thailand; Sri Lanka; Philippines; Singapore; Indonesia; Australia; Egypt; Madagascar.

Remarks. Viraktamath (1998) grouped the species of *Carvaka* into three species group: *C. picturata* group, *C. clava* group and *C. pruthii* group including all valid known species at that time. Four Distant's (1918) from India were placed within *C. picturata* group defined by having a sclerite (process) between the connective and the aedeagus, and *C. contempta* was tentatively assigned to this group (Viraktamath 1998). Four species were placed in *C. clava* group characterized by aedeagus having a ventral process. Later, Flechter & Semerano (2007) placed the Australian species *C. elegantula* in this group. The remaining species belonged to the third *C. pruthii* group recognized by the character of aedeagus directly articulated with connective without intervening sclerite or the aedeagal basal process. Genus *Carvaka* is similar to *Hybrasil* and *Divus* but differs from the former by the characters of crown with transverse striations rather than two distinct carinae, the male pygofer ventral margin rounded to apex rather than tapered to apex and the dorsoatrium of the aedeagus well-developed rather than vestigial. It can be distinguished from genus *Divus* in lacking a pair of basal aedeagal processes (Viraktamath 1998). This genus resembles *Canopyana* in external characters especially in having fine transverse corrugations on anterior margin of the head but can be differentiated from the latter by the absence of a cross vein between the claval veins of the forewing, the male pygofer not having a ventral process.

Checklist of the genus *Carvaka* from China

- C. bigeminata* Cen & Cai, 2002: 116 — China (Zhejiang).
C. contemptus (Kirkaldy, 1906: 332) — China (Taiwan, Hainan); Korea; Japan; India; Thailand; Sri Lanka; Philippines; Singapore; Indonesia; Australia; Egypt; Madagascar.
C. emeiensis **sp. nov.** — China (Sichuan).
C. formosana (Matsumura, 1914: 238–239) — China (Hunan, Fujian, Taiwan, Guangdong, Hainan).
C. jiangkouensis **sp. nov.** — China (Guangdong, Guizhou).

Key to species China (♂)

1. Connective with posterior elongate unpaired process (Zhang & Webb 1996, figs 157, 158) *C. contemptus*
- Connective without such a process 2
2. Aedeagus with two pairs of apical processes or with one pair of forked processes (Figs 2M, 2N) 3
- Aedeagus with one pair of apical processes (Figs 1O, 1P) *C. jiangkouensis* **sp. nov.**
3. Aedeagus with one pair of process, each process forked a short distance distad of base, longer process about ¼ as long as shorter process (Figs 2J, 2M) *C. emineienssi* **sp. nov.**

- . Aedeagus with processes or branches subequal or equal in length4
- 4. Aedeagus apical processes directed basad (Zhang & Webb 1996, figs 152, 155)*C. formosana*
- . Aedeagus with one pair directed anterodorsally and the other pair basad (Cen & Cai 2002, fig. 7)
.....*C. bigeminata*

1. *Carvaka jiangkouensis* sp. nov. (Fig. 1)

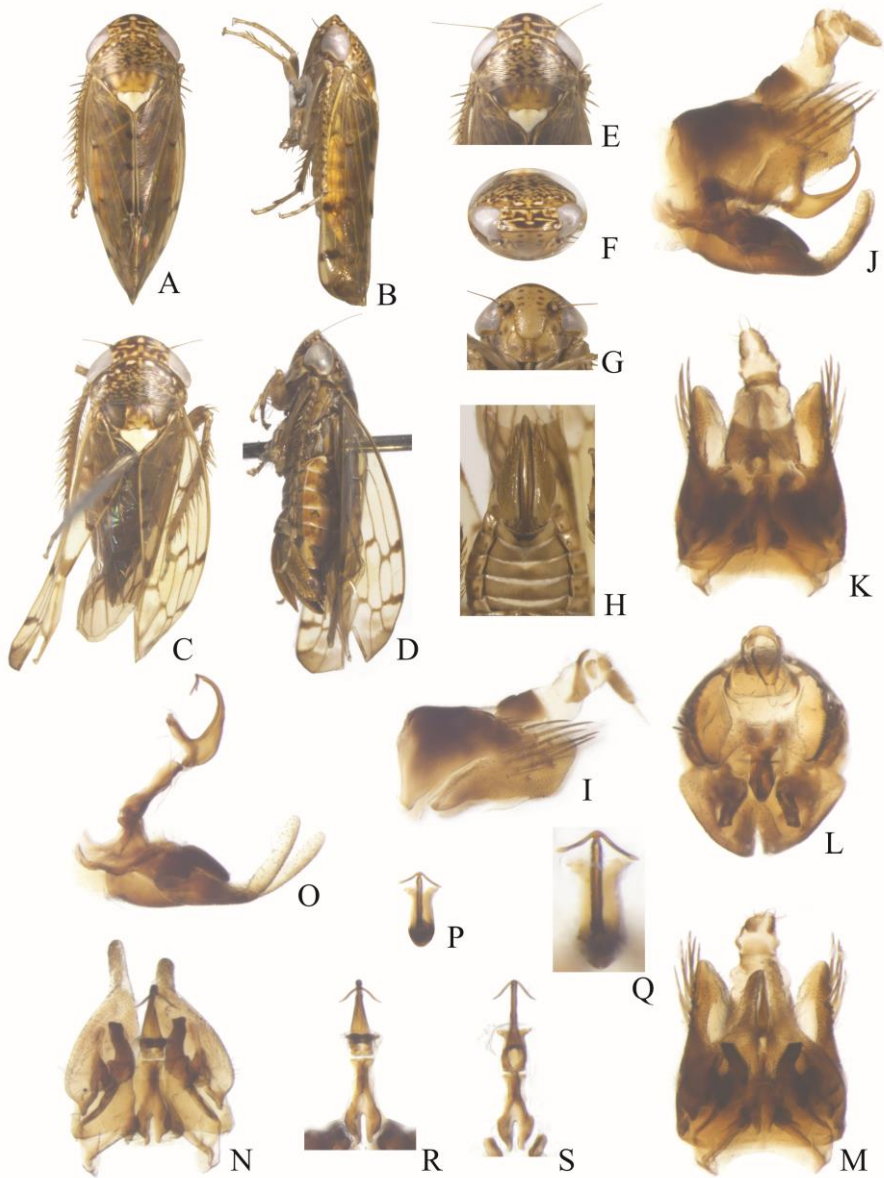


Figure 1. *Carvaka jiangkouensis* sp. nov. A, B. Male, dorsal and lateral views; C, D. Female, dorsal and lateral views; E, F. Head, dorsal and anterodorsal views; G. Face; H. Female sternite VII, ventral view; I. Pygofer lobe; J, M. Male genitalia, lateral, dorsal, caudal and ventral views; N, O. Valve, subgenital plates, styli, connective and aedeagus, dorsal and lateral views; P, Q. Aedeagus and amplification, caudal view; R, S. Aedeagus and connective, dorsal and ventral views.

Description. Length: male 6.0–6.5 mm, female 6.0–7.0 mm.

Coloration. Body brownish marked with dark brown. Crown with irregular symmetrical brown markings along anterior margin, medial and posterior margin between ocelli. Pronotum with symmetrical variable dark markings. Mesonotum with basal triangles dark brown and median stripe and posterior marginal transverse band dark brown; scutellum milky white. Face with narrow brown band at dorsal margin and transverse brownish bands laterally on frontoclypeus; gena, anteclypeus and lora pale brownish with one spot on lower half dark brown. Antennal pedicel and pits brownish. Forewing hyaline, with small brown irroration and crossveins brownish.

Fore femur IC with about 14 fine setae (male) and 12 fine setae (female) in anterior view. Male genitalia. Pygofer lobe produced, posteriorly rounded, with ventral margin straight, without process, lateral lobe with several rows of macrosetae subapically. Valve broad triangular. Subgenital plate, elongate, triangular with lateral margin concave in middle without macrosetae. Style apophysis flattish, of uniform width, apex truncate and lateral angle produced with surface sculptured, and with preapical lobe posteriorly extended about $\frac{3}{4}$ as long as apophysis in dorsal view. Connective Y-shaped, with stem longer than arms, directly articulated with the base of aedeagus. Aedeagus with dorsal apodeme well-developed with apex bilobed, shaft simple, broad in basal region and tapered distally in lateral view, curved dorsad, with one pair of unbranched, short laterally directed apical processes, gonopore apical.

Female genitalia. Sternite VII with posterior margin slightly concave with marginal median dark brown markings (Fig. 1S).

Holotype. ♂, China, Guangdong, Zhongshan, Wuguishan, 22°26'13"N, 113°26'32"E, 11–26-V-2021, MT-8 (NWAUFU). **Paratypes.** 1♂1♀, same data as holotype (IZCAS); 1♂, Guangdong, Zhaoqing, Dinghushan, 23°9'30"N; 112°32'27"E, 09-VIII–09-IX-2021, MT-5 (NWAUFU); 2♂1♀, Guangdong, Zhongshan, Wuguishan, 22°26'13"N; 113°26'32"E, 10–25-VII-2021, MT-8 (NWAUFU); 2♂1♀, **China**, Guizhou, Jiangkou, Kaima, 27°84'27"N; 108°77'49"E, 540 m, 02-VIII-2014, fogging, coll. Xianjin PENG (IZCAS).

Etymology. The species is named after “Jiangkou” county where it was collected.

Remarks. This species belongs to the *C. pruthi* species group as the aedeagus articulates directly with the connective and also has one pair of processes. It differs from other species of the group in having distinctly different coloration on head and thorax.

2. *Carvaka emeiensis* sp. nov. (Fig. 2)

Description. Length: male 6.5 mm.

Coloration. Body stramineous. Crown with irregular symmetrical pale brown markings. Ocelli dorsally and laterally margined by pale brown. Face with narrow brownish band at dorsal margin transverse brownish bands on frontoclypeus. Pronotum with paired anteromedial, medial and posterolateral symmetrical irregular brown markings. Mesonotum and scutellum each with pair of brown markings and longitudinal pale brown in middle. Forewing hyaline, with small brown irroration and crossveins brownish.

Fore femur IC with series of 12 fine setae.

Male genitalia. Pygofer produced, posteriorly narrowly rounded, lateral lobe with several rows of macrosetae subapically without process. Segment X moderately long, well sclerotized

dorsally and laterally. Valve pentagonal. Subgenital plate, triangular with lateral margin concave in middle without macrosetae. Style with lateral apical angle of apophysis beak-like, preapical lobe well-developed. Connective Y-shaped, with stem longer than arms, articulated with the base of aedeagus. Aedeagus with dorsal apodeme well-developed, shaft simple with base slightly expanded and then of uniform to apex in lateral view, curved dorsad, one pair of apical process directed anterodorsad, each process with a short fork distance distad of base about 1/4 as long as long process; gonopore apical.

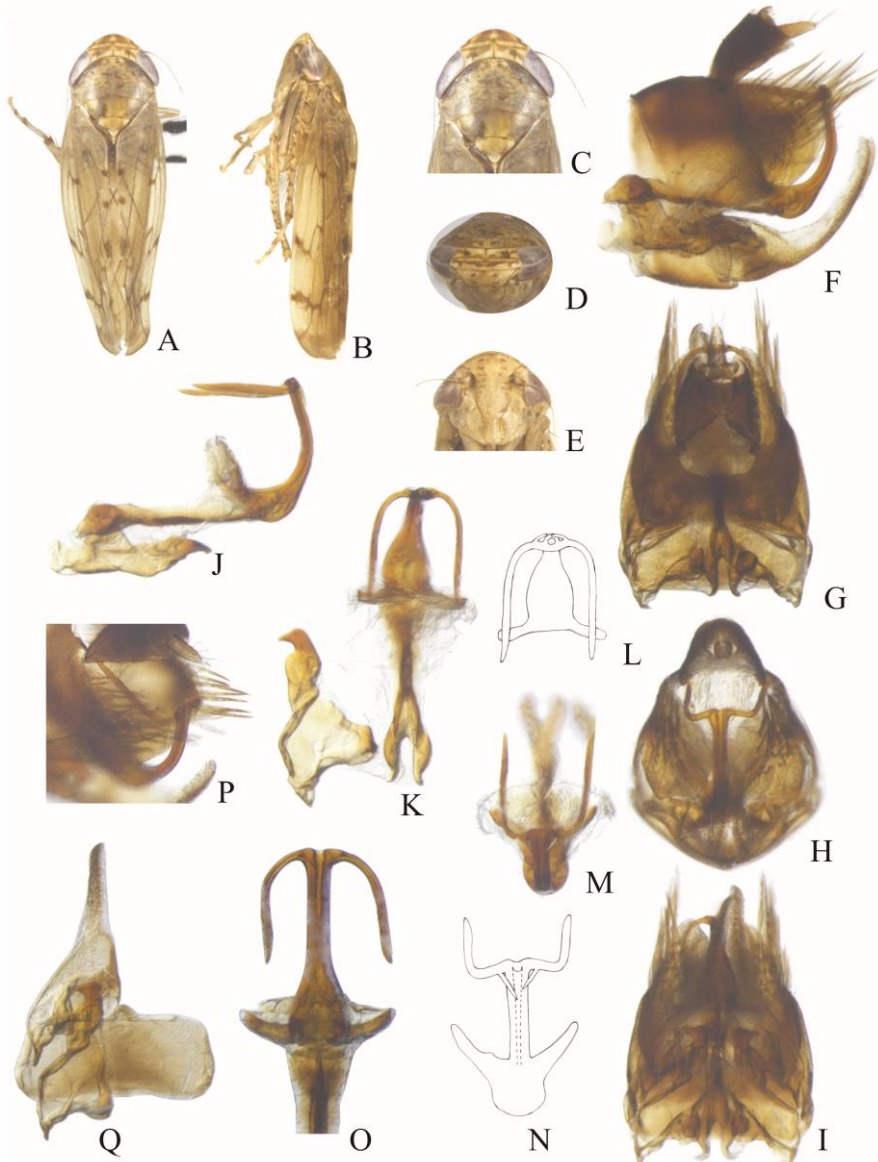


Figure 2. *Carvaka emeiensis* sp. nov. A, B. Male, dorsal and lateral views; C, D. Head, dorsal and anterodorsal views; E. Face; F–I. Pygofer, lateral, dorsal, caudal and ventral views; J, K, M. Style, connective and aedeagus, lateral, dorsal and ventral views; L–O. Aedeagus, dorsal, caudal caudoventral and ventral views; P. Apex of pygofer, laterocaudal view; Q. Valve, subgenital plate and style, ventral view.

Holotype. ♂, **China**, Sichuan, Emei mountains, 1300 m, 27-VII-2013, landside, light trap, coll. Qingquan XUE (NWAUFU).

Etymology. The species is named after its type locality “Emei” mountains.

Remarks. This species differs from other species of *Carvaka* in having a short fork slightly distad of base which is about 1/4 as long as the longer fork.

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