

Pseudotulostoma japonicum, Comb. nov. (= *Battarrea japonica*),
A Species of the Eurotiales, Ascomycota

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Abstract Although *Battarrea japonica* (Kawamura) Otani has tentatively been treated as a species of the Battarreaceae, Tulostomatales of Gasteromycetes, Basidiomycota, we found this species has saccate asci at the younger, volva stage of the fruit-bodies of *Battarrea japonica*. The fruit-bodies, asci and ascospores show the characteristics for the Elaphomycetaceae of the Eurotiales in the Ascomycota. Since *Battarrea japonica* is closely related to *Pseudotulostoma volvata* in morphology of the fruit-bodies as well as in the DNA sequence data suggested by Masuya & Asai (2004), we propose a new combination name *Pseudotulostoma japonicum* (Kawamura) Asai *et al.* for this species. A neotype specimen for the species is designated in this paper, as the holotype specimen of *Dictyocephalos japonicus* Kawamura, the basionym of *Battarrea japonica*, had surely been lost.

Key words: *Battarrea japonica*, *Pseudotulostoma*, Ascomycota, Kobo-fude, Elaphomycetaceae, Eurotiales, Basidiomycota, Tulostomatales

Battarrea japonica (Kawamura) Otani, known as “Kobo-fude” in Japanese, was first described as *Dictyocephalos japonicus* Kawamura (Kawamura, 1954), and was later transferred to *Battarrea japonica* by Otani (1960). This species has been classified in the Tulostomatales of the Basidiomycota. However, both Kawamura (1954) and Otani (1960) were unable to determine its accurate taxonomical position, because they found basidiospore-like spherical spores but they did not find its basidia.

Recently we found that the species had saccate asci only in the younger, unopened volva (egg) stage fruit-bodies under ground. According to the parsimony analyses of the partial sequences of ribosomal DNA study to speculate its taxonomical position by Masuya and Asai (2004), this species should be placed in the Elaphomycetaceae of the Eurotiales. In this paper we report its morphological characteristics especially its asci and ascospores. As Masuya and Asai (2004) had pointed out, this species is closely related to *Pseudotu-*

lostoma volvata O.K.Miller & T.Henkel in their phylogenetic analysis and our morphological comparison. Accordingly, this species should be named *Pseudotulostoma japonicum* Asai, H. Sato & Nara, as a new combination for *Dictyocephalos japonica* Kawamura. Although ascospores and general appearance of fruit-bodies of *P. japonicum* are similar to those of *P. volvata*, the former species can be separated from the latter in much larger size of fruit-bodies and gray-colored stipes of the former species.

Because the holotype specimen of *Dictyocephalos japonicus*, the basionym of *Pseudotulostoma japonicum*, had surely been lost, a neotype specimen is designated in this paper.

Pseudotulostoma japonica (Kawamura) Asai, H. Sato & Nara, comb. nov. (Figs. 1–19)

≡ *Dictyocephalos japonicus* Kawamura, *Icones of Japanese Fungi* (=S. Kawamura’s Genshoku Nihon Kinrui Zukan) 7: 723–725, 1954.

= *Battarrea japonicum* (Kawamura) Otani, *Trans. Mycol. Soc. Jpn* 2 (15): 11–13, 1960.



Fig. 1



Fig. 2



Fig. 3



Fig. 4



Fig. 5



Fig. 6

Pseudotulostoma japonicum (Kawamura) Asai, H.Sato & Nara.

Fig. 1. Dried specimens of mature fruit-bodies. Fig. 2. Habit of mature fruit-bodies. Fig. 3. Habit of young fruit-body. Fig. 4. Fertile head of matured fruit-body. Fig. 5 & 6. Volva in longitudinal section.



Fig.7



Fig.8

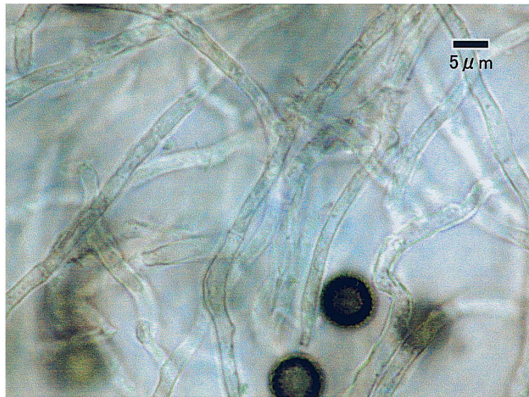


Fig.9

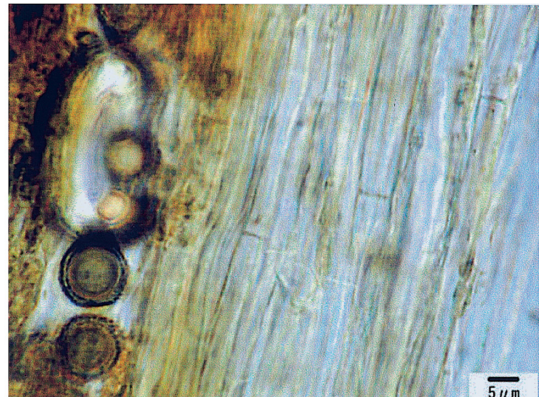


Fig.10

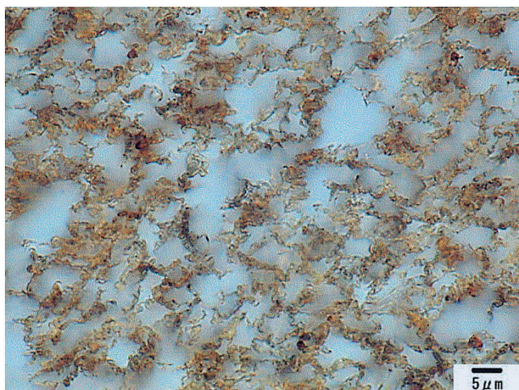


Fig.11

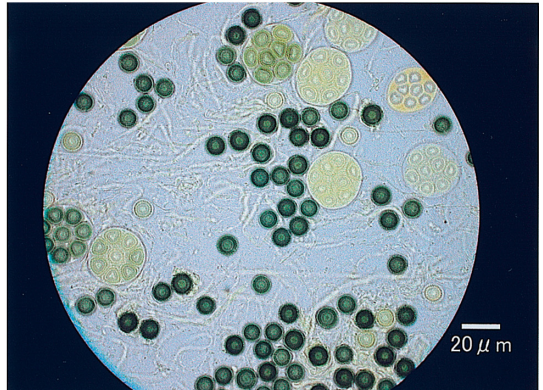


Fig.12

Pseudotulostoma japonicum (Kawamura) Asai, H.Sato & Nara

Fig. 7. Mature fruit-bodies in longitudinal section. Fig. 8. Basal portion of dried mature fruit-body in longitudinal section. Fig. 9. Hyphae of gleba. Fig. 10. Tissue of stipe in longitudinal section. Fig. 11. Tissue of stipe in transverse section. Fig. 12. Asci and ascospores.

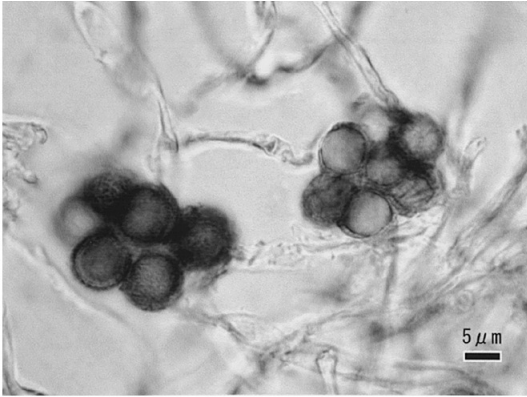


Fig.13

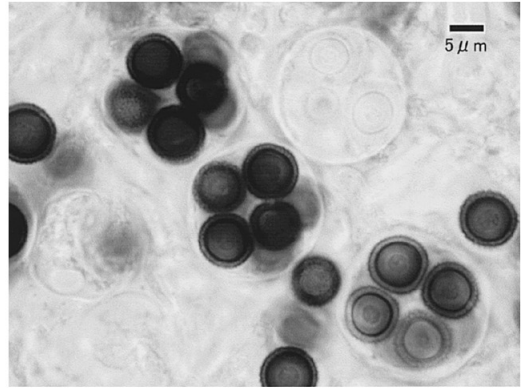


Fig.14

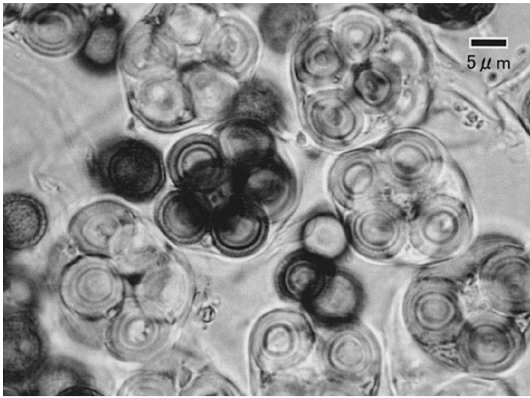


Fig.15

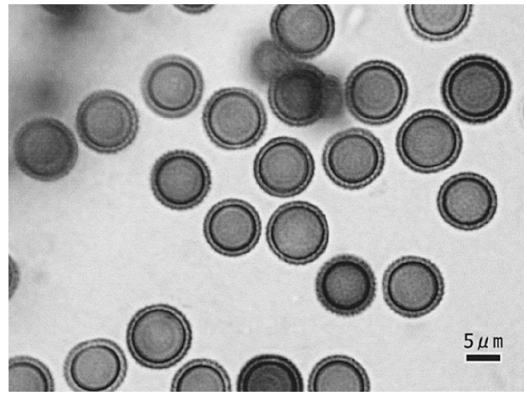


Fig.16

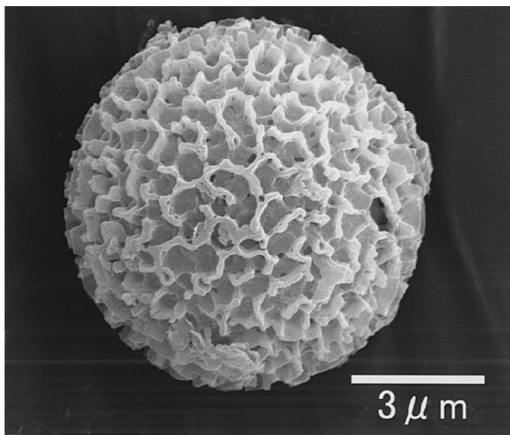


Fig.17

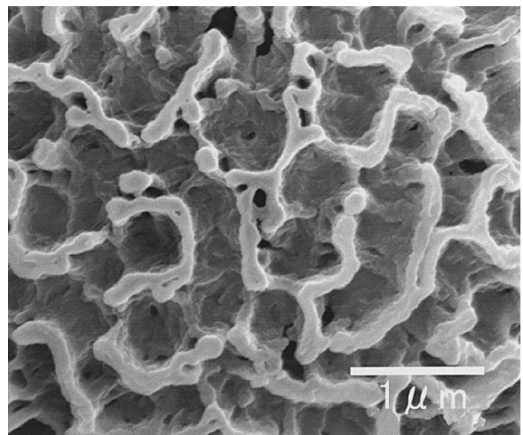


Fig.18

Pseudotulostoma japonicum (Kawamura) Asai, H.Sato & Nara

Fig. 13. Aggregated ascospores remaining the shape of Asci. Fig. 14 & 15. Asci. Fig. 16. Ascospores. Fig. 17. SEM micrograph of ascospore. Fig. 18. SEM micrograph of ascospore surface.

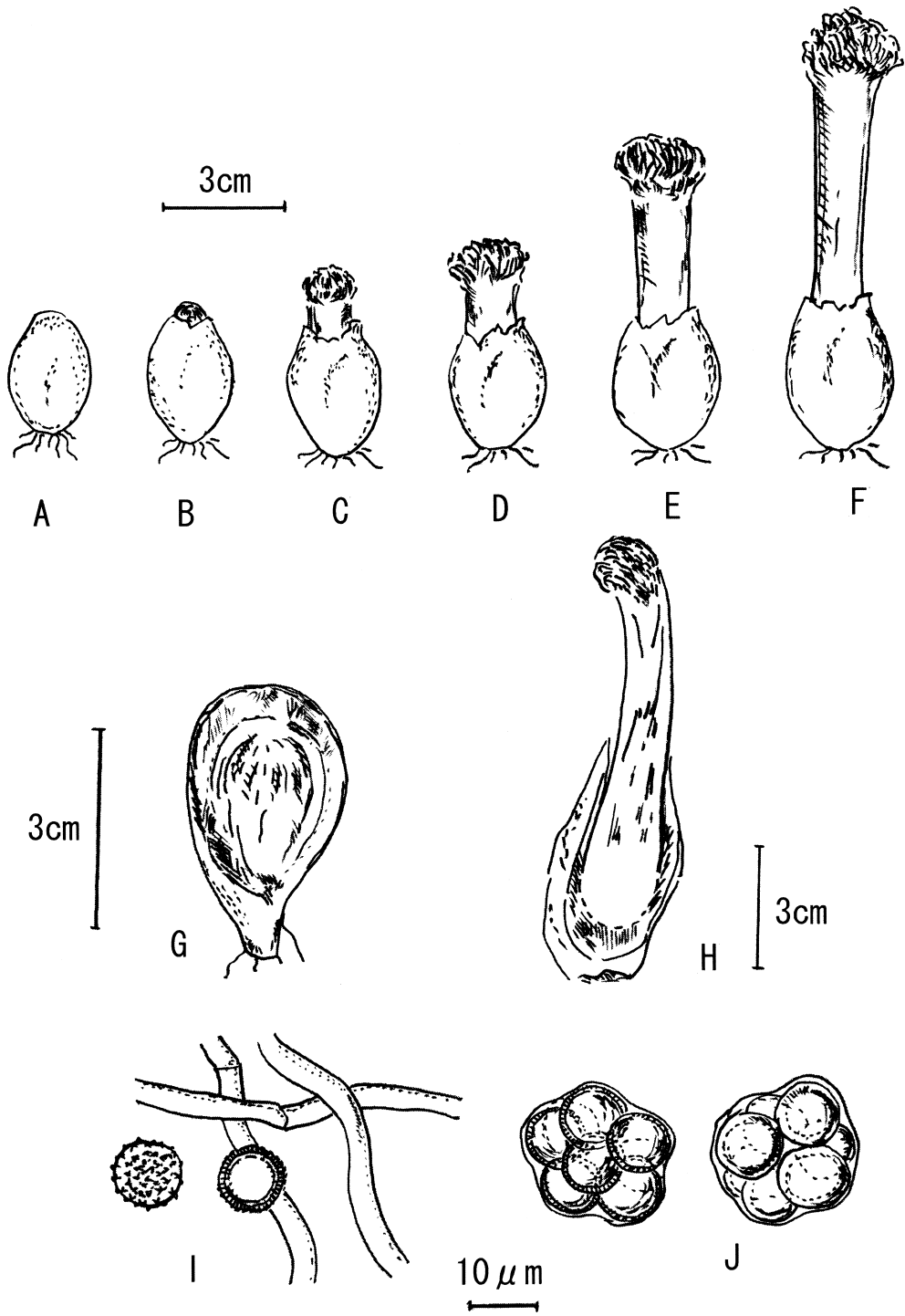


Fig. 19. *Pseudotulostoma japonicum* (Kawamura) Asai, H.Sato & Nara

A. Young volva. B–E. Growth of stipe and apical head. F. Mature fruit-body. G. Young volva in longitudinal section. H. Mature fruit-body in longitudinal section. I. Pseudocapillitia with Ascospores. J. Asci and ascospores.

Fruit-body composed of volva at the base, stipe elongated from the volva and fertile head at the apex of the stipe, totally 60–160 mm high, 15–25 mm wide.

Volva pale yellow-ochre, 35–60 mm high, 25–35 mm wide. In younger stage volva obovate or narrowly obovate, hypogeous or its upper portion sometimes epigeal, pale grayish ochre or pale yellowish ochre, 25–50 mm high, 20–35 mm wide, later the apex of volva opened, producing stipe and fertile apical head. The volva composed of thin exoperidium, thick endoperidium and meso-peridium, with a bundle of short mycelial strands from the basal portion. The exoperidium of volva composed of compactly interwoven hyphae; hyphae thin-walled, hyaline to pale yellow-colored with 3% KOH solution, not branched, 3–5.5(–8) μm in diam. Endoperidium of volva composed of *textura prismatica*, hyaline, thin-walled, becoming pale green-gray in 3% KOH solution, 3.5–6(–10) μm in diam. Meso-peridium thin, composed of *textura intricata*, hyphae not branched, thin-walled, pale yellow with 3% KOH solution, 3–5.5 μm in diam.

Stipe grayish blue, cylindrical, longitudinally striate, smooth, becoming wider toward the base, dark green-blue, ligneous, farctate, subsisting for a few year after maturation on the ground, 60–90 mm high, 7–12 mm wide with a fertile apical head. Surface of stipe composed of compacted and longitudinally parallel hyphae 5–7 μm in diam. Inner tissue of stipe composed of longitudinally elongated bundle of parallel hyphae, 4.5–7.5 μm in diam.

Apical head darker blue-green, 12–18 mm high, 15–25 mm wide. The exoperidium of apical head irregularly eroded and forming a brush-like mazaedium at first, then becoming irregular fragments of mazaedia and hanging down from the head.

Tissue covering apical head composed of *t. intricata*, hyphae of the tissue thinn-walled, flexuous, sometimes produced septa, rarely branched, 2.5–5.5(–7) μm in diam.

Asci present only in the younger volva under the ground, evanescent, thin-walled, hyaline, glo-

bose, 22–30 μm diam., 8-ascospored.

Ascospores globose, hyaline at first, then becoming ferruginous when matured, 9–10(–13) μm in diam. Wall of ascospore composed of 3 layers under compound microscope; the exosporium covered with warts 0.8–1.4 μm in diam.

Habitat. On the ground under forests composed of *Quercus* spp., etc., forming a fairy ring.

Distribution: Found only from Japan: from Fukushima Pref. and Ibaraki Pref. to Miyazaki Pref. and Kumamoto Pref.

Neotype (designated here): On the ground under the forest of broad-leaved trees such as *Quercus serrata* Thunb., *Q. acutissima* Carruth., Kawauchi-mura, Futaba-gun, Fukushima Pref., Japan, Sept. 21, 2003, Coll. Hiroshi Sato, in Herb. I. Asai 55331=TNS-F-11152.

Other specimens examined: Miyakawamura, Taki-gun, Mie Pref., Japan, Sept. 26, 2003, Coll. M. Taniguchi, TNS-F-11151 (in ethanol solution); Kawauchi-mura, Futaba-gun, Fukushima Pref., Oct. 14, 2002, Coll. I. Asai in Herb. I. Asai 5531 a=TNS-F-11158; Shioya-machi, Shioya-gun, Tochigi Pref., Oct. 5, 2003, I. Asai, Herb. I. Asai 55333=TNS-F-11159; Oganomachi, Chichibu-gun, Saitama Pref., Oct. 4, 2003, H. Sakamoto, in Herb. I. Asai 55401=TNS-F-11160.

Notes. 1. The asci of the present fungus were found in the younger volva of the neotype specimen and also of the specimen TNS-F-11158. In order to find the asci of the present species, we had to trace the place where the fruit-bodies grew in 2002, and recorded the exact growing points. In 2003 we dug carefully around a little outside of the fairy rings recorded in 2002. Then we found the younger volva under the ground. We can find the asci only in the younger volva under ground.

Those asci are evanescent, soon melted away when fruit-bodies were matured or when dry; asci are not found in the dried specimens of the volva of the younger stage. In the matured mazaedia, only ascospores are observed. According to Miller *et al.* (2001), the asci of *Pseudotlostoma volvata* were also not observed in the

mazaedium of matured fruitbodies.

2. According to the bereaved family of Dr. Seiichi Kawamura, almost all fungal specimens of S. Kawamura collection had been kept in formalin solution at their home. After S. Kawamura's death those specimens including the holotype of *Dictyocephalos japonicus* were abandoned because the formalin solution smelled over their home. In the same manner, the holotype specimen of *Lampteromyces japonicus* Kawam. etc. had been also abandoned.

3. Kawamura (1954) classified this species in the Tulostomataceae. His description of this species was based only on well-matured fruitbodies so that he was not able to observe its asci.

4. In the description of the generic characteristics of *Pseudotulostoma*, Miller *et al.* (2001) delimited the size of head, stipe (stalk) and volva. Compared those characteristics of *P. volvata* with *P. japonicum*, those of the latter species are far larger than those of the former species. The generic characteristics delimited by Miller *et al.* should be emended.

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