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Species clarification of the most important and cultivated *Auricularia* mushroom "Heimuer": evidence from morphological and molecular data

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Abstract

Phylogenetic analysis of the *Auricularia auricula-judae* complex was carried out using ITS and nLSU ribosomal RNA gene regions, and morphology of the *A. auricula-judae* complex and related species is examined based on 33 wild collections and 10 cultivated samples worldwide. The phylogenetic analysis presented here showed that the wild and cultivated samples previously identified as *A. auricula-judae* in China are different from those from Europe (the type locality). So far no exist name for the most important Chinese *Auricularia* species is available, and thus a new species, *Auricularia heimuer*, is described and illustrated. The new species is characterized by effused-reflexed or substipitate basidiomata with fawn to reddish brown color when fresh and vinaceous gray to dark gray when dry, pilose upper surface usually with a few folds when dry, short abhymenial hairs without branching and measured as 50–150 × 4–6.5 µm, usually presence of medulla, long clavate basidia with oil guttules and measured as 40–67 × 3.0–6.5 µm, and allantoid spores measured as 11–13 × 4–5 µm. *A. auricula-judae* is not found in China, and most probably has a distribution in Europe only. In addition, *A. americana* and *A. villosula* are the first time reported in China. Both *A. heimuer* and *A. villosula* grow on angiosperm wood, while *A. americana* is found on gymnosperm wood exclusively.

Key words: Auriculariales, ITS, nLSU, phylogeny, taxonomy

Introduction

Auricularia Bull. (Auriculariaceae, Auriculariales), typified by *Auricularia mesenterica* (Dickson 1785: 20) Persoon (1822: 97), is macroscopically characterized by gelatinous, resupinate to substipitate basidiomata, dark yellow to brown or reddish brown upper surface with distinguished hairs; pallid or rosy to dark brown or black lower surface with smooth, rugulose to merulioid, glabrous to pruinose configuration (Lowy 1951, Kobayasi 1981, Montoya-Alvarez *et al.* 2011). Microscopically, it has cylindrical to clavate and transversely three-septate basidia with oil guttules and slender sterigmata, and its basidiospores are hyaline, thin-walled and allantoid (Lowy 1952, Montoya-Alvarez *et al.* 2011).

Simpleness of distinct morphological features for the genus resulted in a number of names registered under *Auricularia*. For instance, MycoBank database (http://www.mycobank.org) has 175 specific or infraspecific records in *Auricularia*, while the number in Index Fungorum (http://www.indexfungorum.org) is 165. However, many records are synonyms or have been transferred to other genera. Till 2013, about 75 names are recognized to be legitimate in the genus worldwide (Wu *et al.* 2014).

Recently, molecular studies employing multi-gene datasets have helped to clarify the relationships among *Auricularia* and related fungi (Montoya-Alvarez *et al.* 2011, Looney *et al.* 2013). On the basis of the phylogeny inferred from the internal transcribed spacer sequences of nuclear ribosomal DNA (ITS), Montoya-Alvarez *et al.* (2011) demonstrated that five *Auricularia* species [*A. mesenterica*, *Auricularia delicata* (Montagne ex Fries in Schlechtendal 1830: 533) Hennings in Wilhelm-Engelmann (1893: 492), *Auricularia fuscosuccinea* (Montagne in Milne-Edwards 1842: 125) Hennings, *Auricularia auricula-judae* (Bulliard 1789: 427) Quélet (1886: 207) and

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latter is lack of medulla in cross-section (Malysheva & Bulakh 2014) and has very short abhymenial hairs [(40–80(–90) × 4.5–6.0 µm measured in present study; 30–70 × 5.0–6.0 µm in Malysheva & Bulakh (2014)](Table 2). In the dry basidiomata, *A. heimuer* has vinaceous gray to dark gray lower surface, while it is pale brown to dark brown in *A. villosula*. In addition, *A. villosula* has a wider geographic distribution in China, occurring from boreal to tropic areas, while *A. heimuer* distributes in boreal and temperate areas only.

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