The first species of *Lentinula* described from Africa: patterns of genetic divergence and historical biogeography in *Lentinula*

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Abstract

The genus *Lentinula* (Agaricales) is a small lineage in Omphalotaceae with seven described species, including the shiitake mushroom (*L. edodes*), which is the most widely cultivated mushroom in the world. Species of *Lentinula* are distributed throughout Australasia, the neotropics, and the Gulf Coast and Carribean regions of the Americas, but none have been described from Africa. Here, we describe the first species of *Lentinula* from Africa, *Lentinula madagaskarensis* sp. nov., from central Madagascar. This report constitutes a 4000-mile, trans-oceanic range extension for *Lentinula*. The new taxon is strikingly similar to *L. edodes*, but a multi-locus phylogenetic analysis places it as sister to the neotropical *L. aciculospora*. A combination of macro- and micromorphological characters clearly distinguish *L. madagaskarensis* from all other species of the genus. We will discuss the implications of this discovery for the geographic origin of *Lentinula*, as well as a particularly high rate of interspecific sequence divergence in the ITS region detected in the group.

**L. madagaskarensis** sp. nov.

During a survey on edible mushrooms of Madagascar, B. Buyck and V. Hofstetter reported the finding of a species of *Lentinula*. This species was found on both native wood as well as introduced Eucalyptus. The new species closely resembles *L. edodes* but differs in having thick velar material on the cap margin as well as narrower spores and sphaeropedunculate chel icystidia that forms florets. *L. madagaskarensis* is morphologically distinct from its sister species, *L. aciculospora*, with its vinaceous cap color, larger basidiospores, and chelicystidia without lobes. The epithet is derived from the Malagasy term for Madagascar.

**Species phylogeny of Lentinula**

After confirming placement in *Lentinula*, an ITS phylogeny resolves the new species placement as sister to *L. aciculospora*, an America species restricted to Central America and northern South America.

**Placement in Omphalotaceae**

The 28S dataset of Omphalotaceae from Oliveira et al. (2019) was used to test whether the African material represents a new species of *Lentinula*, a new genus, or a member of a different genus. Based on these results, this is clearly a new species of *Lentinula*.

**High interspecific variation in ITS**

New sequences for the African species and an ITS multi-sequence alignment were included in the analyses. A dataset (28S) with 100 species was used to test the new species placement. Initial BLAST results of the ITS sequences of *Lentinula* resulted in ambiguous hits to various members of Omphalotaceae. Genetic distances between species of *Lentinula* outside of the Asian-Australases clade are high.

**Future directions**

It will be important to include this new species in the ongoing *Lentinula* genome project. We plan to use the Oxford Nanopore MinION system to sequence the 2008 material. With this data we can use phylogenomics to resolve relationships in *Lentinula* and test for a biogeographic origin.

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*Figure 1. Lab and field photographs of *Lentinula* madagaskarensis: Chloicystidia; Basidiospores, and Basidia; G) Chelicystidia. Scale bar for drawings equals 20 μm.*