

# Three *Lactarius* (Russulaceae) species from Taiwan

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(Accepted: August 8, 2011)

## ABSTRACT

This paper described and illustrated three ectomycorrhizal *Lactarius* species (Basidiomycetes), *Lactarius piperatus*, *L. deliciosus*, and *L. chrysorrheus* collected from a mixed-forest of *Abies kawakamii*, *Tsuga chinensis*, and *Yushania niitakayamensis* in Mt. He-Huan in Nantou County, Taiwan. *Lactarius chrysorrheus* is new reported from Taiwan.

**Keywords:** ectomycorrhizal fungi, *Lactarius chrysorrheus*, Mt. He-Huan.

## Introduction

*Lactarius* (Russulaceae) is a very diverse genus in Basidiomycetes. It closely related to the genus *Russula*, traditionally separated base on latex producing in the hymenium when wounded. Most species of *Lactarius* are known to be ectomycorrhizae (Geml *et al.*, 2009). It contains 1,370 taxonomic name (Index Fungorum, 2011). About 500 *Lactarius* species have been described in the world, but only 19 species were reported in Taiwan at present (Shao *et al.*, 2008; Wang, 2008). There is few studies and descriptions about *Lactarius* in Taiwan. The studies of *Lactarius* are relative rich in Europe, North America, Japan, and South East China (Miller *et al.*, 2006; Nuytinck *et al.*, 2006; Nuytinck and Verbeken, 2005). Many *Lactarius* species had strong habitat preference in different vegetation types in temperate Europe and North

America (Geml *et al.*, 2009; Miller *et al.*, 2006; Nuytinck and Verbeken, 2005).

Due to the highly diverse forest flora in Taiwan, there may also be a high diversity of *Lactarius* flora in Taiwan. Mt. He-Huan area is located at the center of Taiwan and covered with coniferous forests. In this study, we report three species of *Lactarius* reported at 3,000 m altitude of Mt. He-Huan alpine area. The dominant vegetations of the area are *Tsuga chinensis*, *Abies kawakamii*, and *Yushania niitakayamensis*. *Lactarius chrysorrheus* is a new record in Taiwan. *Lactarius deliciosus* and *L. piperatus* had been reported by Sawada (1959) Yu-Shan, but not been describrd.

## Materials and Methods

Specimens were collected during July to October in 2009 and 2010. Fresh fruiting bodies

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were collected and examined. They were subsequently dried in warm air and deposited in the mycological laboratory of Tunghai University. The fruiting bodies were sliced by hand and soaked in drops of the 1% aqueous phloxine solution, and then mounted in drops of 3% KOH solution for microscopic examination. Spore size and shape were observed and measured in side view in Melzer's reagent and exclude the ornamentation (Melzer, 1924).

## Description

*Lactarius chrysorrhoeus* Fr., Epicr. Syst. Mycol.: 342 (1838). (Fig. 1)

Cap 2.4–4.5 cm across, depressed in the center stick on the surface, with pale orange color ring; margin with colorless radial fringe. Lamellae 1–3 mm wide, free to adnate, patched, pale yellow color, latex yellow. Stipe 2–4 × 0.5–1 cm, cylindrical, hollow, equal, central; surface smooth, pale orange color. Basidia clavate, (30–)37.5–45(–52.5) × 10–10.5(–12.5) μm, 3 to 4-sterigmata, sterigmata 5–7.5 μm, clamp connection on the basal. Basidiospores 7.5–10 × 5–7.5 μm, Q = (1.0–)1.33–1.82, Q = 1.25 ± 0.24, ellipsoid to long ellipsoid, consisting of ornamentation, often confluent, incompletely connected with each other to form a fragmentary network. Cystidia thick and obvious, spindle, 45–100 × 5–12.5 μm, tip sharp.

**Specimen examined.** Taiwan. Nantou: Mt. He-Huan, Taroko National Park, alt. 3,005 m, on soil, under coniferous forest, 9 October, 2010, 1010HT7, collected by Ming-Hsiu Kao, *ibid.*, 18 September, 2010, 1009HT3 and 1009HT11, collected by M.H. Kao.

**Habitat.** Interspersed on soil under mixed-forest of *Abies kawakamii*, *Tsuga chinensis*, and

*Yushania niitakayamensis*; fruiting from September to October.

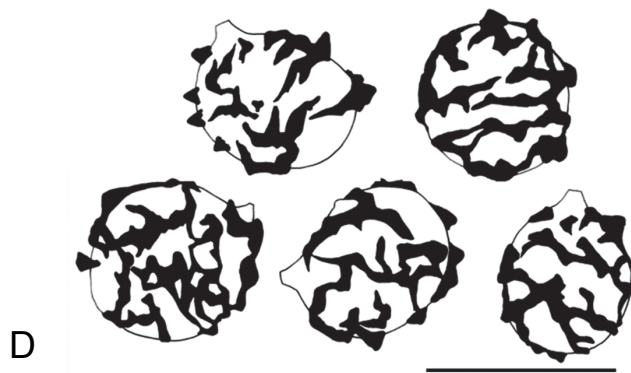
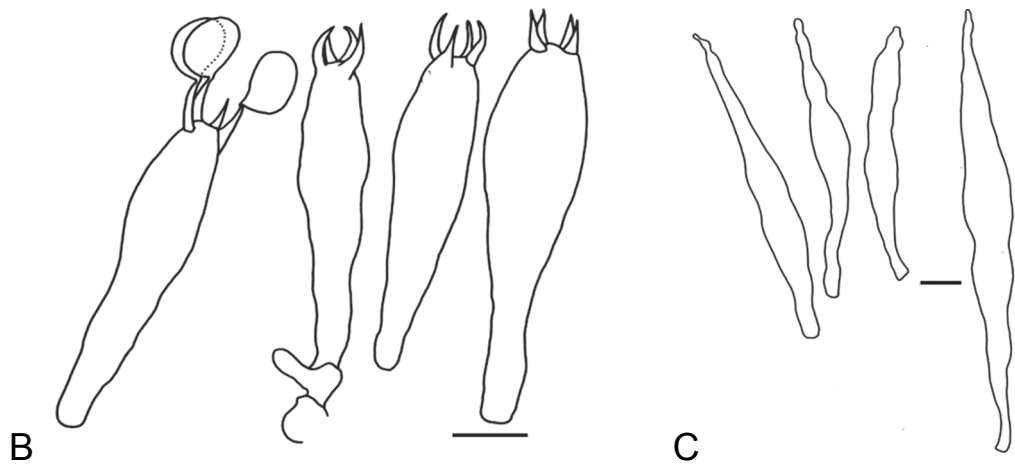
**Distribution.** Taiwan, Japan, North America, Europe, East Africa, the United Kingdom, and temperate regions of north hemisphere.

*Lactarius deliciosus* (L.) Gray, Nat. Arr. Brit. Pl. (London) 1: 624 (1821). (Fig. 2)

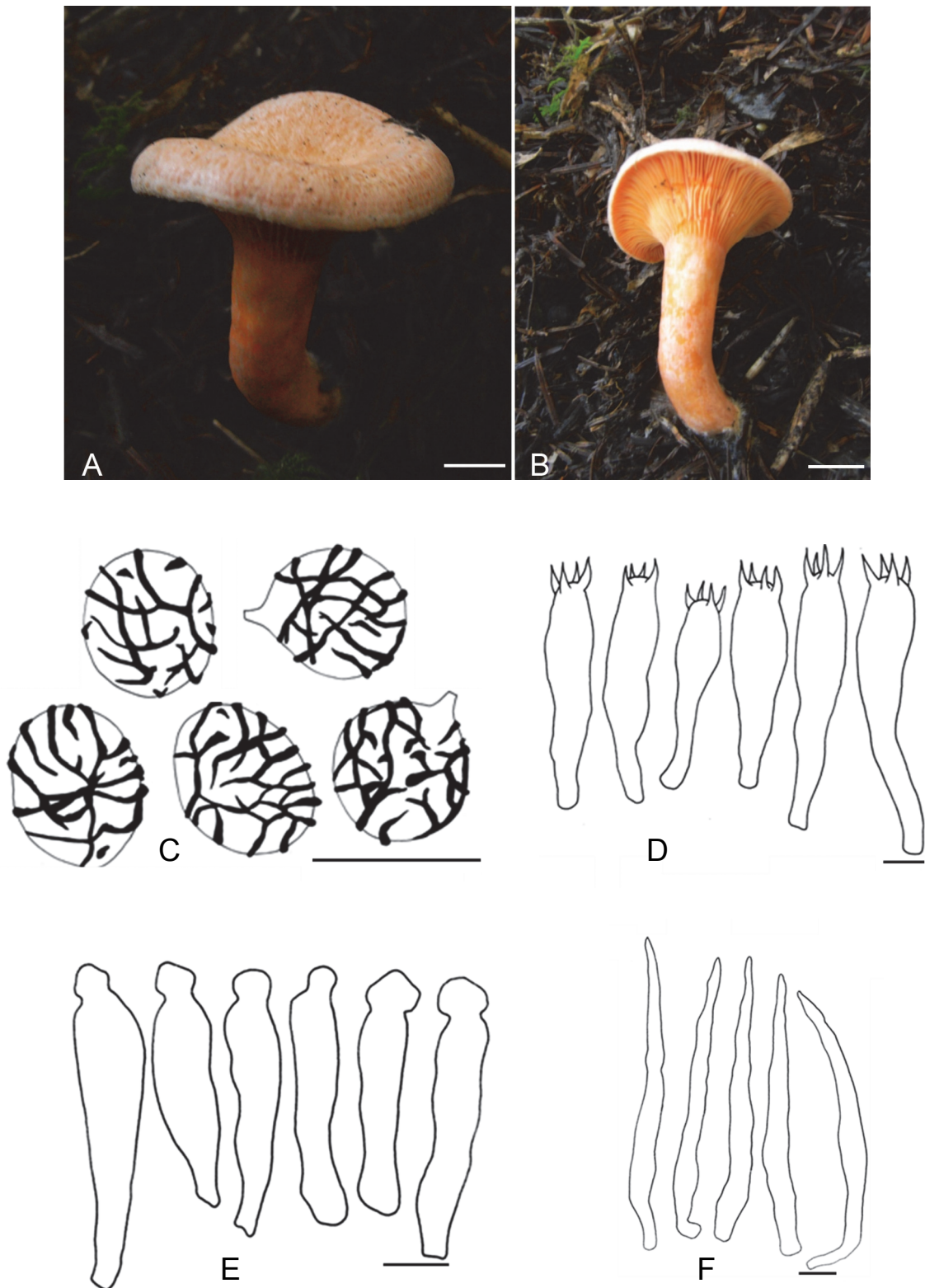
Cap 2.8–5 cm across, depressed in the center, concentric circles on the surface, orange color with white spot, margin smooth. Lamellae 0.7–3.0 mm wide, adnate, patched, many forks, orange color, latex is orange. Stipe 2.8–6.5 × 0.3–1.0 cm, cylindrical, central, hollow, fibrous, white color, cover with orange ornamentation on the surface. Hymenium composed abundance 2.5–7.5 μm filamentous hypha; sphaero-cyte rare, 20.5–62.5 × 15–42.5 μm. Basidia 50–70 × 10–13.75 μm, 4-sterigmata, sterigmata 6.25–7.50 μm. Basidiospores 7.5–10.0 × 7.5–8.75 μm, Q = 1.0–1.33, Q = 1.175 ± 0.148, globose, broadly ellipsoid, or ellipsoid consisting of ornamentation; ornamentation 0.16–0.60 μm high, often connected with each other to form a fragmentary network. Cystidia fusiform, clavate or short cylinder, 40–90 × 6.25–10.0 μm. Pileipellis composed periclinal hyphae or globose mycelium, some yellow color, or colorless.

**Specimen examined.** Taiwan. Nantou: Mt. He-Huan, Taroko National Park, alt. 3,005 m, on soil, under coniferous forest, 17 August, 2010, 1008HT12, 17 September, 2010, 1009HA3, and 9 October, 2010, 1010HA5, collected by Ming-Hsiu Kao.

**Habitat.** Interspersed on soil under mixed-forest of *Abies kawakamii*, *Tsuga chinensis*, and *Yushania niitakayamensis*; fruiting from August to October.



**Fig. 1.** *Lactarius chrysorrheus*. A. Basidiocarps and habitat. Scale bar = 0.7 cm. B. Basidia. Scale bar = 10  $\mu$ m. C. Cystidia. Scale bar = 10  $\mu$ m. D. Basidiospores. Scale bar = 10  $\mu$ m.



**Fig 2.** *Lactarius deliciosus*. A. & B. Basidiocarps and habitat. Scale bar = 1 cm. C. Basidiospores. Scale bar = 10  $\mu$ m. D. Basidia. Scale bar = 10  $\mu$ m. E. & F. Cystidia. Scale bar = 10  $\mu$ m.

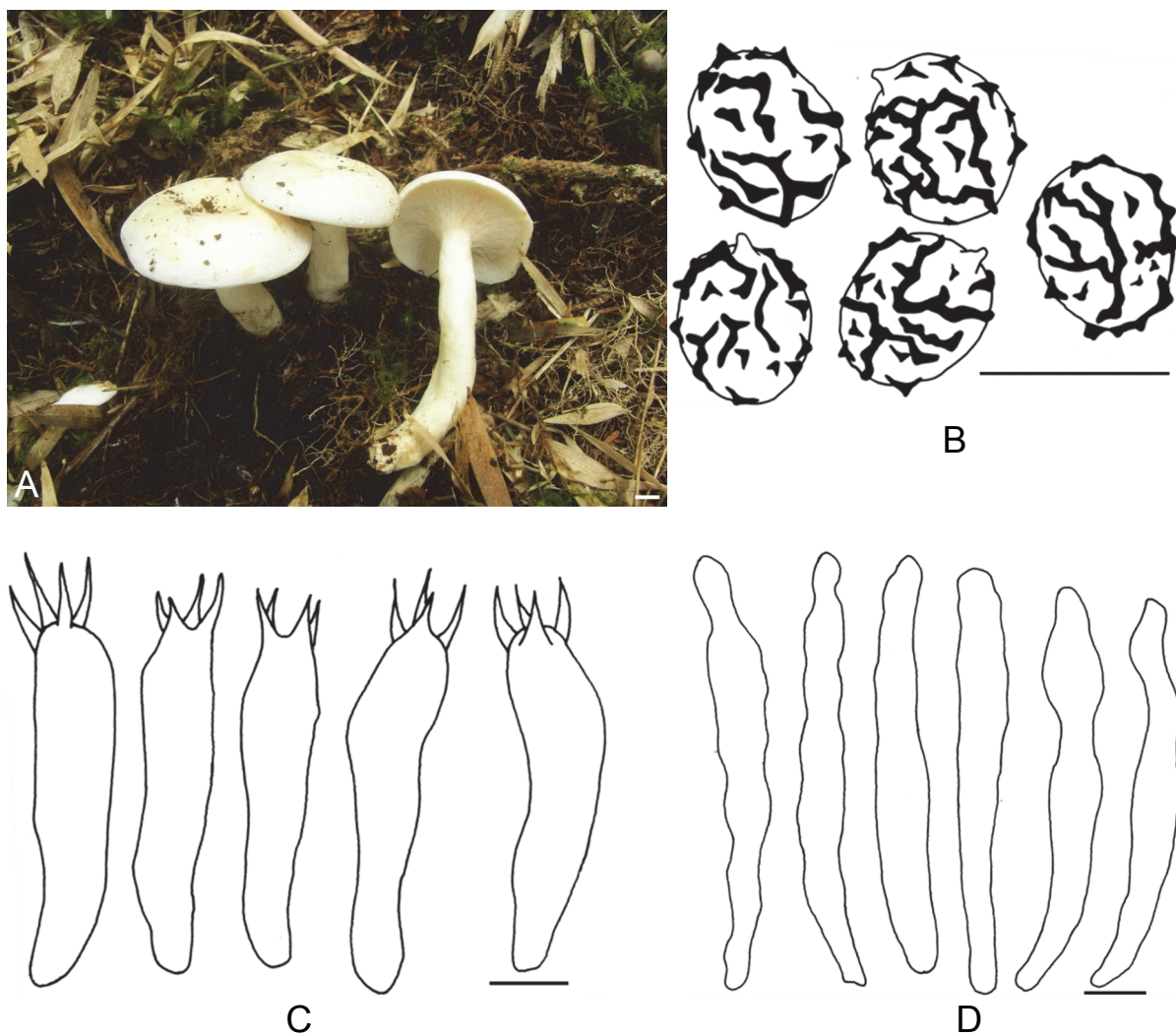
**Distribution.** Taiwan, China, Japan, Korea, Canada, the United States, Sweden, and Europe.

**Note.** Previous descriptions show *Lactarius deliciosus* cystidia abundance are the same with basidium (Nuytinck *et al.*, 2006; Wang, 2008). Taiwan material confirms to the description of *L. deliciosus* by Nuytinck *et al.* 2006 and Wang 2008 but shows that cystidia abundance are less than basidium. *Lactarius deliciosus* had been reported from Taiwan by Sawada (1959) in Yu-Shan (alt, 2,700–2,800 m). *Lactarius deliciosus*

is ectomycorrhizal fungi of *Abies kawakamii* and *Tsuga chinensis* in Mt. He-Huan, Taiwan.

***Lactarius piperatus*** (L.: Fr.) Pers., Tent. Disp. Meth. Fung.: 64 (1797). (Fig. 3)

Cap 5.5–9.0 cm across, depressed in the center, smooth on the surface, white to beige color, margin smooth. Lamellae 2 mm wide, adnate, patched, white color, latex is white. Stipe 6–10 × 1 cm, cylindrical, surface smooth, white or beige color. Basidia 42.5–47.5 × 7.5–10 μm, 4-



**Fig 3.** *Lactarius piperatus*. A. Basidiocarps and habitat. Scale bar = 1 cm. B. Basidiospores. Scale bar = 10 μm. C. Basidia. Scale bar = 10 μm. D. Cystidia. Scale bar = 10 μm.

sterigmata, sterigmata 7.50–8.75  $\mu\text{m}$ . Basidiospores 7.5–8.75  $\times$  6.25–7.5  $\mu\text{m}$ , Q = 1.0–1.2, Q = 1.075  $\pm$  0.095, globose, or broadly ellipsoid consisting of ornamentation; ornamentation 0.5–0.8  $\mu\text{m}$  high. Cystidia fusiform, cylinder or clavate 65–75  $\times$  5–7.5  $\mu\text{m}$ . Pileipellis composed 2.5–3.75  $\mu\text{m}$  filamentous hypha, spherocyte abundance, 25–62.5  $\times$  12.5–30  $\mu\text{m}$ .

**Specimen examined.** Taiwan. Nantou: Mt. He-Huan, Taroko National Park, alt. 3,005 m, on soil, under coniferous forest, 23 August, 2009, *0908HA27*, 18 August, 2010, *1008HT18*, *ibid.*, 18 September, 2009, *0909HA12*, collected by Ming-Hsiu Kao.

**Habitat.** Interspersed on soil under mixed-forest of *Abies kawakamii*, *Tsuga chinensis*, and *Yushania niitakayamensis*; fruiting from August to September.

**Distribution.** Taiwan, China, Japan, Canada, the United States, and Sweden.

**Note.** *Lactarius piperatus* was collected in Yu-Shan (alt. 2700–2,800 m) and reported by Sawada (1959). *Lactarius piperatus* is an ectomycorrhizal fungus of *Abies kawakamii* and *Tsuga chinensis* in Mt. He-Huan, Taiwan.

## Acknowledgments

We thanks for Dr. F.C. Tschen of National Hsinchu University of Education who made helpful suggestion and comments. This project was supported by the Taroko National Park, Taiwan, Republic of China.

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## 臺灣的三種乳菇屬真菌

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### 摘 要

本文描述採集自位於南投縣合歡山臺灣鐵杉及臺灣冷杉混合林的三種乳菇屬 (*Lactarius*) 真菌：辣乳菇 (*Lactarius piperatus*)、松乳菇 (*L. deliciosus*) 及黃汁乳菇 (*L. chrysorrheus*)，其中黃汁乳菇為新記錄種，此三種都為外生菌根真菌。

**關鍵詞：**外生菌根真菌、合歡山、黃汁乳菇。