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FULL PAPER

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Two new species of *Amanita* from Japan

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Abstract Two new species from Japan, *Amanita areolata* and *Amanita griseoturcosa*, are described. The former, found in a broad-leaved forest in Aichi Prefecture, is a medium- to large-sized mushroom characterized by an areolate, brownish pileus, a nonstriate and appendiculate margin of the pileus, and amyloid basidiospores. The latter, found in forests with Fagaceae or Pinaceae in Tokyo, Chiba Prefecture, and Miyagi Prefecture, is a medium-sized mushroom characterized by a grayish-turquoise pileus, a nonstriate margin of the pileus, a saccate volva, an apical membranous annulus, and amyloid basidiospores.

Key words Agaricales · *Amanita areolata* · *Amanita griseoturcosa* · Aomidori-tamago-tengutake · Hibiware-tengutake

Two undescribed *Amanita* species were found in Japan. Here, these are described as new species. Colors in the descriptions are according to Kornerup and Wanscher (1978). Specimens examined are deposited in the CBM (Natural History Museum and Institute, Chiba, Japan).

Amanita areolata T. Oda, C. Tanaka & Tsuda, sp. nov. Figs. 1–10

Pileus 4.5–9.4 cm latus, initio hemisphaericus, deinde convexus vel planus; superficies cinereo-brunnea, brunneolo-cinerea vel brunneolo-aurantiaca, areolata; trama alba; margo non striatus, appendiculatus. Lamellae liberae, confertae, 3–8 mm latae, aurantiaco-albae vel -cineraceae. Stipes 6.4–15.0 cm longus, 1.0–1.7 cm latus, fere cylindricus, albus, pulverulentus, floccosus vel squamosus, solidus; basis 2.4–6.0 cm longa, 1.1–1.9 cm lata, ellipsoidea, fusiformis vel paulo radiciformis, squamis appressis albis vel brunneo-griseis et circulis fasciariis paucis praedita. Annulus pruinosus vel floccosus, fugax. Basidia 4-sporigera, interdum 2-sporigera. Sporae (8.0–) 8.4–11.2 (–12.4) × 6.0–8.0 (–8.8) μm, late ellipsoideae vel ellipsoideae, amyloideae, hyalinae, laeves.

Holotypus: Ikegane-cho, Okazaki-shi, Aichi Prefecture, Sept. 28, 2000, S. Honda, FB-30251 (CBM).

Etymology: areolatus, "areolata," is named after the areolate surface of pileus. Pileus 4.5–9.4 cm wide, at first hemispherical, then convex to plane, 0.4–1.0 cm thick at the center; surface slightly viscid when moist, floccose-subfelted, grayish-brown, brownish-gray to brownish-orange (5C–F2–3), as mature splitting into moderately thick areolae between which a white layer is showing; volval remnants as floccose patches or warts on the center of each areola, white in outer part, grayish in inner part, deciduous, often covered with sand; margin nonstriate, appendiculate. Flesh white. Lamellae free, 3–8 mm broad, orange-white to orange-gray (5A–B2), crowded; lamellulae truncate to subtruncate in 1–5 ranks. Stipe 6.4–15.0 cm long, 1.0–1.7 cm wide, almost cylindrical, stuffed; white, at upper part pulverulent to floccose, at lower part often with appressed large white to brownish-gray scales; annulus apical, white, pulverulent to floccose, fugacious and appearing absent in mature specimens, often adherent to margin of pileus; base 2.4–6.0 cm long, 1.1–1.9 cm wide, ellipsoid, fusiform or slightly rooting, about lower half buried in the ground.

Lamella trama bilateral. Mediostratum (~70–80 μm wide) and lateral strata consisting of cylindrical, cylindro-clavate, clavate, fusiform to subfusiform inflated cells 40–130 × 15–26 μm, mixed with abundant branching hyphae 3–8 μm wide; vascular hyphae rare or absent. Subhymenium ~30–70 μm thick, inflated-ramose to cellular, usually with 2–3 layers of globose, subglobose, broadly ellipsoid, ellipsoid, oblong, doliiform, pyriform to clavate inflated cells 10–40 × 7–18 μm. Basidia 36–63 × 9–15 μm, clavate, 4-spored, sometimes 2-spored; sterigmata 2–7 μm long; no basal clamp. Basidiospores [60 spores measured from three specimens from one collection: (8.0–) 8.4–11.2 (–12.4) × 6.0–

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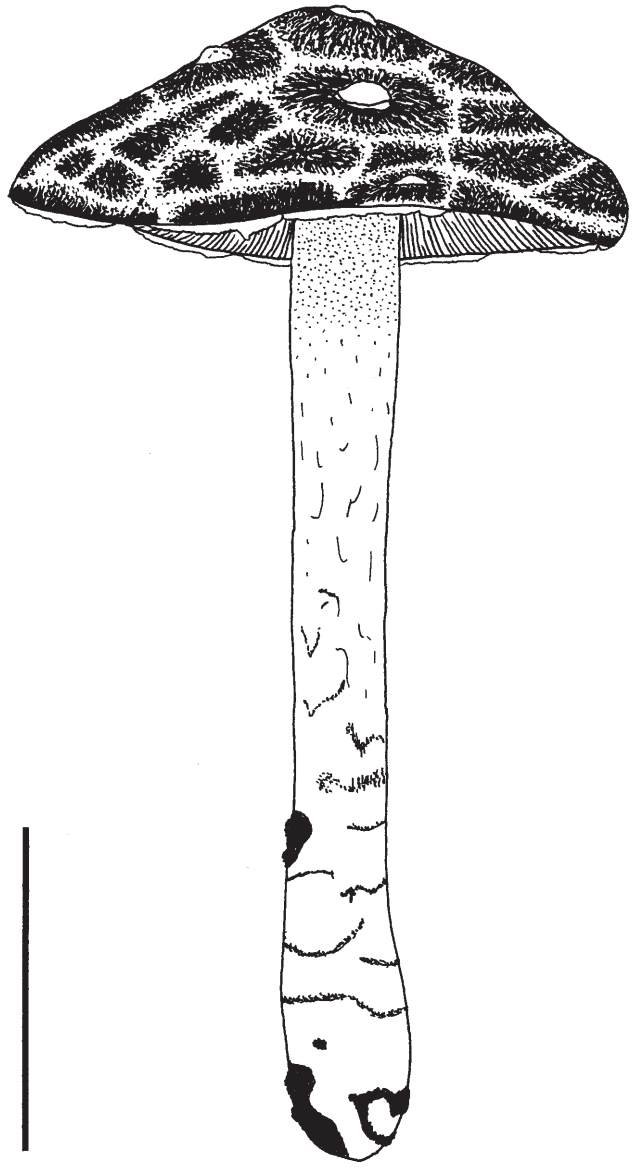
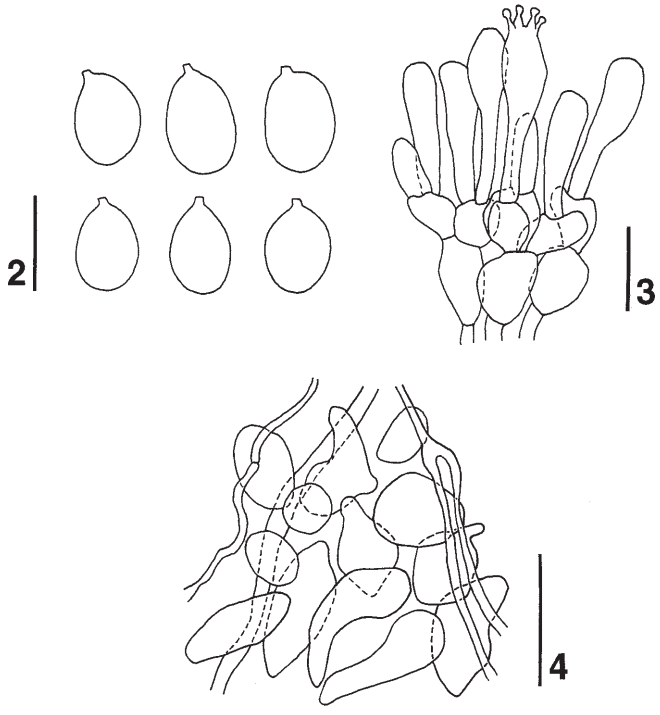
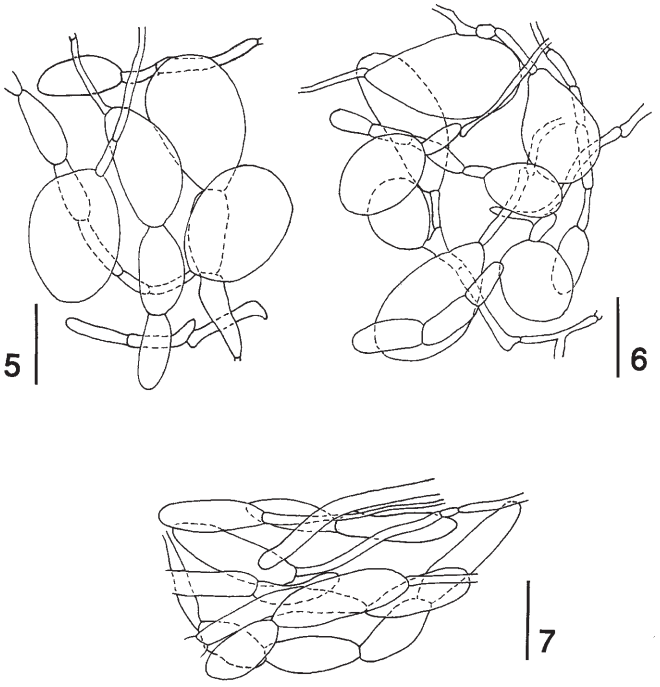


Fig. 1. Mature fruit body of *Amanita areolata* (holotype). Bar 5 cm



Figs. 2–4. *A. areolata* (holotype). **2** Basidiospores. **3** Hymenium and subhymenium. **4** Crushed elements of tissues remained on surface of upper part of stipe. *Bars* **2** 10 μm; **3** 25 μm; **4** 50 μm



Figs. 5–7. *A. areolata* (holotype). **5** Elements of the outer white part of volval remnants on the pileus. **6** Elements of the inner grayish part of volval remnants on the pileus. **7** Elements of the areolate brownish layer on the pileus surface. *Bars* 50 μm

8.0 (–8.8) μm; Q (length/width ratio) = (1.21–) 1.24–1.59 (–1.67); $\bar{Q}$ = 1.41 ± 0.11], broadly ellipsoid to ellipsoid, sometimes elongate, amyloid, hyaline, smooth. Volval remnants on pileus mainly consisting of irregularly disposed globose, subglobose, broadly ellipsoid, ellipsoid to fusiform, colorless to slightly grayish inflated cells 22–100 × 20–60 μm, terminal or in short rows on abundant colorless to slightly grayish, nonclamped hyphae 4–10 μm wide; vascular hyphae rare. The grayish-brown areolae of pileus surface, mainly consisting of interwoven rows of cylindrical, cylindro-clavate, clavate to fusiform, brownish cells 36–180 × 15–55 μm, mixed with brownish, non-clamped hyphae 3–13 μm wide; the white layer between areolae, which is difficult to delimit from pileus trama, mainly consisting of irregularly disposed to subparallel, colorless, nonclamped hyphae 2–7 μm wide and cylindro-clavate to cylindrical terminal cells 36–50 × 10–12 μm. Stipe trama consisting of

Fig. 8. Fruit bodies of *A. areolata* (holotype). *Bar* 5 cm

Fig. 9. Upper part of stipe and underside of pileus of *A. areolata* (holotype). *Bar* 2 cm

longitudinally arranged, cylindrical, cylindro-clavate to clavate cells 100–360 × 15–60 μm, terminal on hyphae 2–20 μm wide; vascular hyphae rare or absent. Surface elements on upper part of stipe mainly consisting of variably inflated cells 15–80 × 7–30 μm, single or partly in rows, mixed with nonclamped hyphae 1–5 μm wide; vascular hyphae rare.

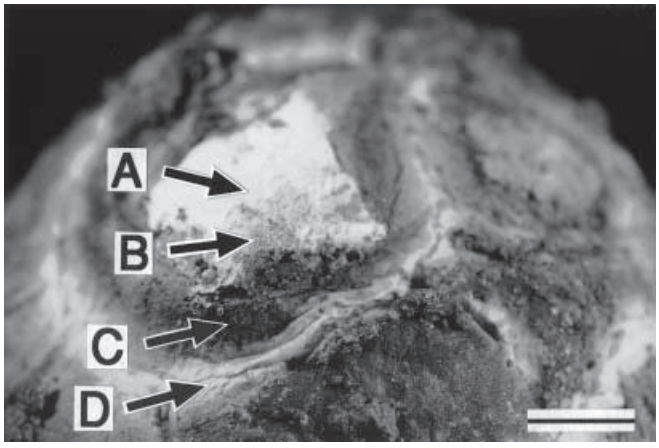


Fig. 10. Part of the pileus surface of *A. areolata* (holotype). *A*, Outer white part of a volval remnant; *B*, inner grayish part of a volval remnant; *C*, grayish brown areola; *D*, white layer between areolae. *Bar* 5 mm

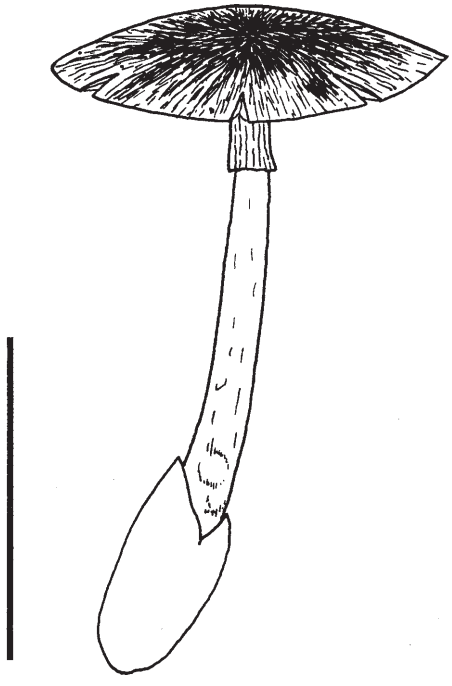


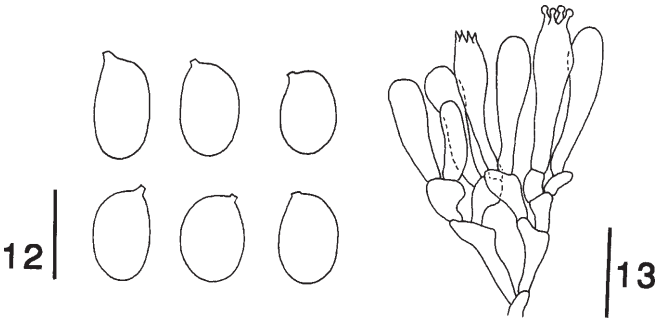
Fig. 11. Mature fruit body of *Amanita griseoturcosa* (holotype). *Bar* 5 cm

Japanese name: Hibiware-tengutake

Specimens examined: Japan: Ikegane-cho, Okazaki-shi, Aichi Prefecture, in a broad-leaved forest with *Castanopsis cuspidata* (Thunb. ex Murray) Schottky var. *sieboldii* (Makino) Nakai and *Quercus serrata* Thunb. ex Murray, Sept. 28, 2000, S. Honda FB-30251 (Holotype, CBM).

Distribution: Aichi (Japan).

Remarks: Volval remnants on the pileus are present as floccose patches or warts, white outside and grayish inside (Fig. 10). It is difficult to determine whether the areolae are volval remnants or pileipellis tissue. However, its microscopic characters differ from those of floccose volval



Figs. 12, 13. *A. griseoturcosa* (holotype). **12** Basidiospores. **13** Hymenium and subhymenium. *Bars* **12** 10 μm; **13** 25 μm

Fig. 14. Mature fruit body of *A. griseoturcosa* (FB-30282) in its habitat. *Bar* 2 cm

remnants (Figs. 5–7). Moreover, the elements of the basal part of the areolae and the upper part of the lower white layer are intermingled. Therefore, the areolate grayish-brown layer may be considered as disrupted pileipellis rather than volval remnants. This species belongs to section *Lepidella* of subgenus *Lepidella*. It closely resembles *A. hesleri* Bas. However, *A. hesleri* differs from *A. areolata* in having longer basidiospores (10.5–12.5 × 5.5–7.0 μm, Q = 1.5–2.0, $\bar{Q}$ = 1.8–1.9) (Bas 1969).

Amanita griseoturcosa T. Oda, C. Tanaka & Tsuda, sp. nov. Figs. 11–14.

Pileus 4.0–6.0 cm latus, initio hemisphaericus, deinde convexus vel planus, griseo-turcosus, laevis; trama alba; margo non striatus. Lamellae liberae, confertae, 3–4 mm latae, albae. Stipes 5.0–8.0 cm longus, 0.4–0.7 cm latus, cylindricus vel sursum leviter attenuatus, albus, laevis vel leviter squamosus, solidus vel leviter fistulosus; basis fusiformis; volva saccata, membranacea, 1.5–2.0 cm longa, 0.7–1.3 cm lata. Annulus superior, albus, membranaceus. Basidia 4-sporigera. Sporae (8.0–) 8.4–12.0 (–13.2) × (5.2–) 5.6–7.6 (–8.0) μm, late ellipsoideae, ellipsoideae vel elongatae, amyloideae, hyalinae, laeves.

Holotypus: Izumi-Shizenkouen, Noro-cho, Wakaba-ku, Chiba-shi, Chiba Prefecture, Oct. 1, 2000, unknown members of Chiba Mycological Club, FB-30253 (CBM).

Etymology: griseus + turcosus; "griseoturcosa" is named after the grayish-turquoise pileus.

Pileus 4.0–6.0 cm wide, at first hemispherical, then convex to plane, 0.2–0.3 cm thick at the center; surface grayish-turquoise, turquoise-gray to dark turquoise (24C–F2–4), smooth, often finely innate-fibrillose; trama white; margin nonstriate. Lamellae free, 3–4 mm broad, white, crowded; lamellulae truncate to subtruncate, in 1–3 ranks. Stipe 5.0–8.0 cm long, 0.4–0.7 cm wide, cylindrical to slightly tapering upward, white, smooth to slightly scaly, stuffed to slightly hollow; base fusiform; volva saccate, membranous, 1.5–2.0 cm long, 0.7–1.3 cm wide, often adherent to stipe. Annulus apical, white, membranous.

Lamella trama bilateral. Lateral strata consisting of cylindrical, cylindro-clavate, clavate, fusiform to subfusiform inflated cells 23–100 × 10–40 μm, mixed with abundant branching hyphae 2–6 μm wide; mediostratum ~20–60 μm wide, mainly consisting of branching hyphae 1–10 μm wide; vascular hyphae absent. Subhymenium ~25–50 μm thick, inflated-ramose, usually with 2–3 layers of mainly globose, subglobose, broadly ellipsoid, ellipsoid, pyriform, clavate to fusiform cells 10–32 × 7–20 μm. Basidia 34–50 × 8–12 μm, clavate, 4-spored; sterigmata 2–6 μm long; no basal clamp. Basidiospores [100 spores measured from five specimens from four collections: (8.0–) 8.4–12.0 (–13.2) × (5.2–) 5.6–7.6 (–8.0) μm, Q = (1.25–) 1.29–1.69 (–1.83), $\bar{Q}$ = 1.50 ± 0.13], broadly ellipsoid, ellipsoid to elongate, amyloid, hyaline, smooth. Pileipellis ~80–140 μm thick, 3-layered: upper layer (~20–40 μm thick) consisting of interwoven, gelatinized, colorless hyphae 1–5 μm wide; middle layer (~30–60 μm thick) mainly consisting of slightly grayish-turquoise, subradial to interwoven hyphae 2–10 μm wide; lower layer (~30–60 μm thick) consisting of subradial to interwoven rows of cylindrical, cylindro-clavate to clavate inflated cells, 60–100 × 15–20 μm, mixed with colorless hyphae 2–7 μm wide; in each layer, hyphae nonclamped, vascular hyphae 2–10 μm wide, frequent to rare. Stipe trama consisting of longitudinally arranged, cylindrical, cylindro-clavate to clavate cells 105–300 × 16–25 μm, terminal on 1–10 μm wide hyphae; vascular hyphae rare or absent. Annulus consisting of abundant, globose, subglobose, broadly ellipsoid, ovate, clavate, pyriform, fusiform, subfusiform to sphaeropedunculate cells 15–50 × 11–30 μm, terminal or in rows on branching, interwoven, non-clamped hyphae 1–6 μm wide; globose, subglobose, broadly ellipsoid, ellipsoid, elongate to cylindrical, smaller inflated cells 3–20 × 2–5 μm, single or in short rows, absent to locally fairly abundant between other elements; vascular hyphae rare. Volva at stipe base mainly consisting of branching, interwoven to subparallel, colorless, nonclamped hyphae 1–7 μm wide, mixed with colorless, variably inflated cells 15–85 × 13–55 μm, terminal or sometimes in short rows; vascular hyphae occasional, 2–10 μm wide.

Japanese name: Aomidori-tamago-tengutake

Specimens examined: Japan: Banzan, Aoba-ku, Sendai-shi, Miyagi Prefecture, in a forest of *Abies firma* Siebold et Zucc. mixed with *Pinus densiflora* Siebold et Zucc. and *Quercus serrata* Thunb. ex Murray, Sept. 15, 1999, Y. Ando, FB-30252 (CBM); Sept. 23, 2000, Y. Ando, FB-30282

(CBM); Mt. Tsukiyomi, Okutama-cho, Nishitama-gun, Tokyo, in a broad-leaved forest of *Q. mongolica* Fisch. ex Ledeb. var. *grosseserrata* Rehder et E.H. Wilson mixed with *Fagus crenata* Blume and *Castanea crenata* Siebold et Zucc., Aug. 3, 2001, K. Maruyama, FB-30738 (CBM); Izumi-Shizenkouen, Noro-cho, Wakaba-ku, Chiba-shi, Chiba Prefecture, Oct. 1, 2000, unknown members of Chiba Mycological Club, FB-30253 (holotype, CBM).

Distribution: Tokyo, Chiba, Miyagi (Japan).

Remarks: This species is characterized by the grayish-turquoise pileus, nonstriate margin of the pileus, the saccate volva, the apical membranous annulus, and the amyloid basidiospores. This species belongs to section *Phalloideae* of subgenus *Lepidella* according to Yang (1997). It closely resembles *A. fuliginea* Hongo. However, *A. fuliginea* differs from *A. griseoturcosa* in having globose basidiospores and a fuliginous pileus (Hongo 1953; Imazeki and Hongo 1987).

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