
Ectomycorrhizal mushrooms of Central India-III : *Amanita*

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Five species of *Amanita*, namely *A. caesaria* (Scop.) Pers., *A. citrina* (Schoeff.) Pers., *A. virosa* (Fr.) Beñtill, *A. pantherina* (Dc.) Krombh. and *A. vaginata* (Bull.) Lam. are described and illustrated. These grow as ectomycorrhizal association with sal (*Shorea robusta* Gaerten. F.)

Key words: Ectomycorrhizal mushrooms, Central India, *Amanita*, *Shorea*

INTRODUCTION

The distribution of Indian ectomycorrhizal mushrooms is poorly studied. The Amanitas often considered the most highly evolved of the Agaricales, are ideally suited to a distribution study. These mushrooms are large and conspicuous, and most are readily identifiable in the field by macroscopic characteristics. Within the family Amanitaceae, *Amanita* is recognized for species having ring and volva. It includes about a dozen species, worldwide, although the taxonomy at species level is still unsettled. During mushroom forays of Central India (2003-2007), five species of *Amanita*, namely, *A. caesarea*, *A. citrina*, *A. pantherina*, *A. vaginata*, *A. virosa* have been found. These are being described and discussed in this paper.

MATERIALS AND METHODS

The morphological features, such as shape, size and colour of the basidiocarps were described from fresh specimens. The measurements were made from fresh and dried specimens. The spores were studied from the spore prints as well as from the dried materials. The dried material was revived in 3% potassium hydroxide solution and microscopic examinations were made on lactophenol-cotton blue mounts of gills using NIKON ECLIPSE E800 microscope at varying magnifications and microphotographs were taken with NIKON H-II camera attached to the microscope. The specimens

have been deposited at Mycological Research Laboratory, Department of Biological Sciences, R. D. University, Jabalpur. Authoritative monographs, papers and books were consulted/referred for correct identification. The following literature were consulted, Singer (1986), Purkayastha and Chandra (1985), Wilkinson and Buczaki (1982), Findlay (1977), Flück, (2002), Rayner (1979), Mancinelli and Mancinelli (1974), Lincoff (1981) and Keizer (1998), Review of literature (Jamaluddin *et al.*, 2003; Bilgrami *et al.*, 1991) shows that *A. citrina* and *A. virosa* are new records for India, yet we do not claim new record as these are not so rare in forest and must be left in the compilation. However, these have been found to form ectomycorrhiza with *Shorea robusta*, when their root systems were studied microscopically.

DESCRIPTIONS

***Amanita caesarea* (Scop.) Pers., Syn. meth. fung. (Gottingen) 2 : 252, 1801.**

Pileus 8-18 cm, ovoid or hemispheric, then flat or convex, finally expanded and sometimes somewhat depressed, margin striated by light grooves in the direction of the gills, colour yellowish-orange, cuticle usually without remains of the universal veil, smooth, shining, somewhat viscid in humid weather, easily separable from the cap; *Stipe* 8-15 × 2-3 cm, narrowing at the top, hollow when mature, with yellow falling ring, slightly swollen at the base, cylindrical, thick; *Gills* close, broad, free from the



Fig. 1 : Sporocarps of Ectomycorrhizal Mushrooms—Amanitaceae.

a. *Amanita caesarea*, b. *A. citrina*, c. *A. pantherina*, d. *A. vaginata*, e. *A. virosa* (when mature), f. *A. virosa* (when young).

stem, yellow; *Volva* large, white, lobate, free from the base; *Flesh* firm, white, yellow under the cuticle of the cap; *Ring* large, pendulous, killlike, yellow, sometimes, striate from the top down; *Spores* white, 8-14 × 5-8.5 μm, ellipsoid, smooth; *Habit & Habitat* : terrestrial, solitary, *Ecology* : grows under sal forests, *Edibility* : non-edible, may be poisonous, *Accession Number* : FGCCA 2010, *Place of collection* : Mandha, Karanjia, Bajag, Mawai. *Distribution* : Baroda (Moses, 1948), Khasi Hill, Assam (Berkeley, 1856), Madhya Pradesh (Rajak *et al.*, 2003), Fig. 1a.

***Amanita citrina* (Schaeff.) Pers., *Tent. disp. meth. Fung.* : 70, 1797.**

Pileus 6-9 cm in diameter, convex or hemispherical to plane and flat, lemon yellow, often rather pale, smooth and shining when dry, sometimes with pale to dull ochre yellow warts or patches which are the remains of veil; *Gills* closely spaced and narrow, white, adnexed or semi-free, sometimes with a yellowish edge, unequal; *Stipe* 5-8 × 1-1.5 cm, white, tapering upwards and striate above the membranous ring which is attached well above the middle on the surface which was in contact with the gills, base of the stem bulbous with a narrow edge or ridge running round the upper portion of the bulb, cylindrical, with a bulblike base, spheric or compressed, stuffed, then soon hollow, white tinted with yellow above the ring, often shows the striae imprinted by the gills, *Ring* striate and white on the upper surface and yellowish below; *Volva* adhering to the base with which it forms a bulb with even, flattened margin, whitish here and there cracked and brownish; *Flesh* white, slightly yellow under the cuticle; *Spores* white. *Habit & Habitat* : terrestrial, solitary, *Ecology*: grows under sal forests, *Edibility*: non-edible, may be poisonous, *Accession Number* : FGCCA 3012 *Place of collection*: Baiyar, Mandha, Chilpighati, Fig. 1b.

***Amanita pantherina* (DC.) Krombh., *Naturgetr. Abbild. Beschr. Schwamme (Prague)* : 29, 1846.**

Pileus 6-7 cm, hemispherical then flat, brown, ochraceous brown, grayish brown or dull smoky brown, darker towards the centre, very faded, covered with numerous small, often pointed, white, pyramidal warts on upper surface, short lived, margin clearly striate; *Gills* white, crowded, free;

Ring halfway down, smooth on its upper surface, often obliquely attached and tending membranous rings; *Stipe* 6-12 × 0.5-2 cm, tapering toward the top, with membranous white ring with striate surface towards the gills and basal bulb with a marginate volva, cylindrical; *Volva* often split into 2-3 rings; *Flesh* white, not very firm; *Spores* white, ovoid, smooth, 10-12 × 7-8 μm, thin walled, smooth, 4-spored. *Habit & Habitat* : terrestrial, solitary, *Ecology*: grows under sal forest, *Edibility* : non-edible, may be poisonous, *Accession Number*: FGCCA 2012, *Place of collection*: Mandha, Gopalpur, Mawai, Baiyar, *Distribution*: Sarband, Kashmir (Watling and Gregory, 1980), Solan-Himachal Pradesh (Sodhi *et al.*, 1964), Lucknow-Uttar Pradesh (Ghosh *et al.*, 1974), Nagpur, Maharashtra (Trivedi, 1972), Madhya Pradesh (Rajak *et al.*, 2003), Fig. 1c.

***Amanita vaginata* (Bull.) Lam., *Encycl. Meth. Bot. (Paris)* 1 : 109, 1783**

Pileus 10-16 cm in diameter, campanulate, then expanded, umbonate, more rarely with a small depression at the center, moist, glossy, margin initially striate in the direction of the gills, then grooved, silvery white, sometimes a part of universal veil remains adhering to the cap like a large, thick, whitish wart, margin sulcate; *Stipe* slender, central, cylindrical, rather narrow at the top, white or the same colour as the cap but paler or with streaks of that colour, soft, hollow; *Volva* tall, detached from the base of the stem, with lobed margin, sometimes appearing as a narrow ring or concentric rings around the bulb of the stipe which is usually rather abrupt and well formed, warts or pustules than in broad smooth flakes; *Gills* sometimes very close, generally broad, sometimes adnexed, white or whitish; *Spores* white, not globose, 10-12 × 7-8 μm, thin walled, smooth, 4-spored. *Habit & Habitat*: terrestrial, solitary, *Ecology*: grows under sal forests, *Edibility*: non-edible, may be poisonous, *Accession Number*: FGCCA 2012, *Place of collection*: Mandha, Gopalpur, Mawai, Baiyar, *Distribution*: Sarband, Kashmir (Watling and Gregory, 1980), Solan, Himachal Pradesh (Sodhi *et al.*, 1964), Lucknow, Uttar Pradesh (Ghosh *et al.*, 1974), Nagpur, Maharashtra (Trivedi, 1972), Madhya Pradesh (Rajak *et al.*, 2003), Uppangala forest, Karnataka (Natarajan *et al.*, 2005), Fig. 1d.

***Amanita virosa* (Fr.) Bertill., 1866.**

Pileus 4-10 cm, conical to bell shaped, finally expanded, but almost never totally, white, often with yellowish cream shades, viscid in humid weather, margin striate, detachable, margin smooth; *Gills* white with velvety edges, crowded, free, with numerous intermediate lamellulae; *Stipe* slender, tapering upward, bulbous, white with a fibrous pith, then hollow, 8-15 × 1.2-5 cm with woody fibrillose surface ring incomplete and fragile; *Volva* membranous, white, enveloping the bulbous base and narrowing above it; *Flesh* soft, thin, white; *Ring* malformed, thin, cottony, fragile, white, transient; *Spores* white, round, smooth, 9-12 µm in diam; *Habit & Habitat*: terrestrial, solitary or scattered, found in sandy soil, *Ecology*: grows under sal forests, *Edibility*: non-edible, may be poisonous, *Accession Number*: FGCCA 2013, *Place of collection*: Mandha, Chada, Bajag, Fig. 1e.

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REFERENCES

- Berkely M.J. 1856. Decades of fungi 1-62 Nos. 1-620. In: Hooker's. *J. Bot.* **3-8**: 1844-1856.
- Bilgrami, K. S., Jamaluddin S. and Rizwi, M.A. 1991. *Fungi of India*, list and references. Today and Tomorrow's Printers and Publishers, New Delhi, pp. 798.
- Findlay, W.P.K. 1977. *Mushrooms, toadstools and other common fungi*. Frederic Warne Publishers Ltd., London, pp 184.
- Flück, M. 2002. *Kosmos naturführer: welcher pilz ist das? Erkennen, sammeln, verwenden*. Franckh-Kosmos Verlags-GmbH and Co., stuttgart, pp-447.
- Ghosh, R. N., Pathak, N. C. and Singh, R. B. 1974. Studies on Indian Agaricales II. *Proc. Nat. Acad. Sci. India.* **44(13)**, 125-128.
- Jamaluddin, S., Goswami, M. G. and Ojha, B. M. 2003. *Fungi of India 1989-2001*, list and references. Sci Publishers, Jodhpur, pp. 326.
- Keizer, G.J. 1998. *The complete encyclopedia of mushrooms* Rebo International b.v., Lisse, The Netherlands, pp 286.
- Lincoff, G. 1981. *Guide to mushrooms*. Translation of Funghi by G Pacioni. Simon's and Schuster, New York, pp 511.
- Mancinelli, I. and Mancinelli, A. 1974. *The complete book of mushrooms*. Translation of L'Atlante dei Funghi by A Rinaldi, V Tyndalo. Grown Publishers, Inc. Italy, pp 310.
- Moses, S. T. 1948. A preliminary report on the mushrooms of Baroda. Department of Fisheries, Baroda State, Bulletin No. **XIV**, 1-3.
- Purkayastha, R. P. and Chandra, A. 1985. *Manual of Indian Edible mushrooms*. Today and Tomorrow's Printers and Publishers, New Delhi, pp 267.
- Rajak, R.C. Rahi D, Shukla, K. and Pandey, A. K. 2003. Diversity and systematics of Agaricales of Central India. In: *Frontiers of fungal diversity in India* (Ed: G.P. Rao, C. Manoharachri, D. J. Bhat, R. C. Rajak, T. N. Lakhanpal). International Book Distributing Co. Lucknow, India. pp 297-311.
- Rayner, R. 1979. *Hamlyn nature guides: mushrooms and toadstools*. The Hamlyn Publishing Group Ltd. pp 128.
- Sathe, A. V. and Sasangam, K.C. 1977. Agaricales from South West India-III. *Biovigyanam* **3**: 119-121.
- Singer, R. 1986. The agaricales in modern taxonomy. Bishen Singh Mahendra Pal Singh Publishers, New Delhi, pp 981.
- Sodhi, H. S., Kumar, S. And Seth, P. K. 1964. Some interesting fleshy fungi from Himachal Pradesh. *Indian Phytopath.* **17**: 317-322.
- Trivedi, T. K. 1972. Agaricales of Nagpur-I. *The Botanique (Nagpur)*. **3(1)**, 53-59.
- Watling R. and Gregory, N. M. 1980. Larger fungi from Kashmir. *Nov Hedwigia*. **32**, 494-564.
- Wilkinson. J. and Buczaki, S. 1982. *Mushrooms and toadstools*. Wm Collins Sons and Co. Ltd. Birmingham, pp 240.

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