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Wild edible mushrooms from high elevations in the Garhwal Himalaya—II

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Abstract

A survey of wild edible mushrooms in the Garhwal Himalaya of northern India resulted in the identification of 21 species from 10 study sites that ranged in elevation from 1500−3500 masl. These 21 species belong to 15 genera and 13 families. Except for *Aleuria aurantia* and *Helvella crispa*, which are the members of the ascomycetes, all of the other macrofungi considered herein are basidiomycetes. A brief description of all the species is provided, along with their habit, habitats and associations with higher plants.

Key words – Ascomycetes – Basidiomycetes – macrofungi – Northern India

Introduction

Edible mushrooms are considered to be one of the world's greatest natural resources, since they have the ability to transform nutritionally valueless substances into high protein foods. Mushrooms are highly valued for their rich characteristic flavor, delicate taste and significant nutritional properties. They are low in calorific value but rank very high for their vitamin, mineral and protein content. Their protein content is of good quality and characterized by high digestibility. Because of this, mushrooms are recognized universally as a highly desirable food (Bhatt et al. 2016). They form a reliable source of seasonal food and also serve as an alternative method for generating income for the inhabitants who collect them, while maintaining forest health.

The Garhwal Himalaya (Fig. 1) is an oblong shaped land mass encompassing many beautiful shrines, valleys and hills. It is located in northern India between 29° 31'9" and 31° 26'5" N latitude and 77° 33'5" and 80° 6'0" E longitude, comprising a total area of 29,089 km^2. The region is blessed with a rich forest growth, and the forest cover is about 20,686 km^2, including reserve forests. The forests are dominated by *Pinus roxburghii* (chir pine), *Quercus leucotrichophora* (banj oak), *Rhododendrom arboreum* (burans) from 1200 to 2200 masl, *Quercus floribunda* (moru oak) from 1400 to 2400 masl, *Abies pindrow* (silver fir) from 2000 to 3000 masl, *Picea smithiana* (morinda spruce) from 2000 to 3200 masl, *Cupressus torulosa* (Himalayan cypress) from 2000 to 3000 masl, *Cedrus deodara* (deodar) from 2500 to 3000 masl, *Quercus semecarpifolia* (kharsu oak) and *Betula utilis* (birch) from 2500 to 3200 masl. Some mixed hardwoods found in the sheltered valleys, often in scattered areas at elevation of 2000 to 3000 masl, form humid deciduous forests. Some other common tree species of the region are *Acer caesium* (kanjula), *Acer pictum* (gad papri), *Alnus*

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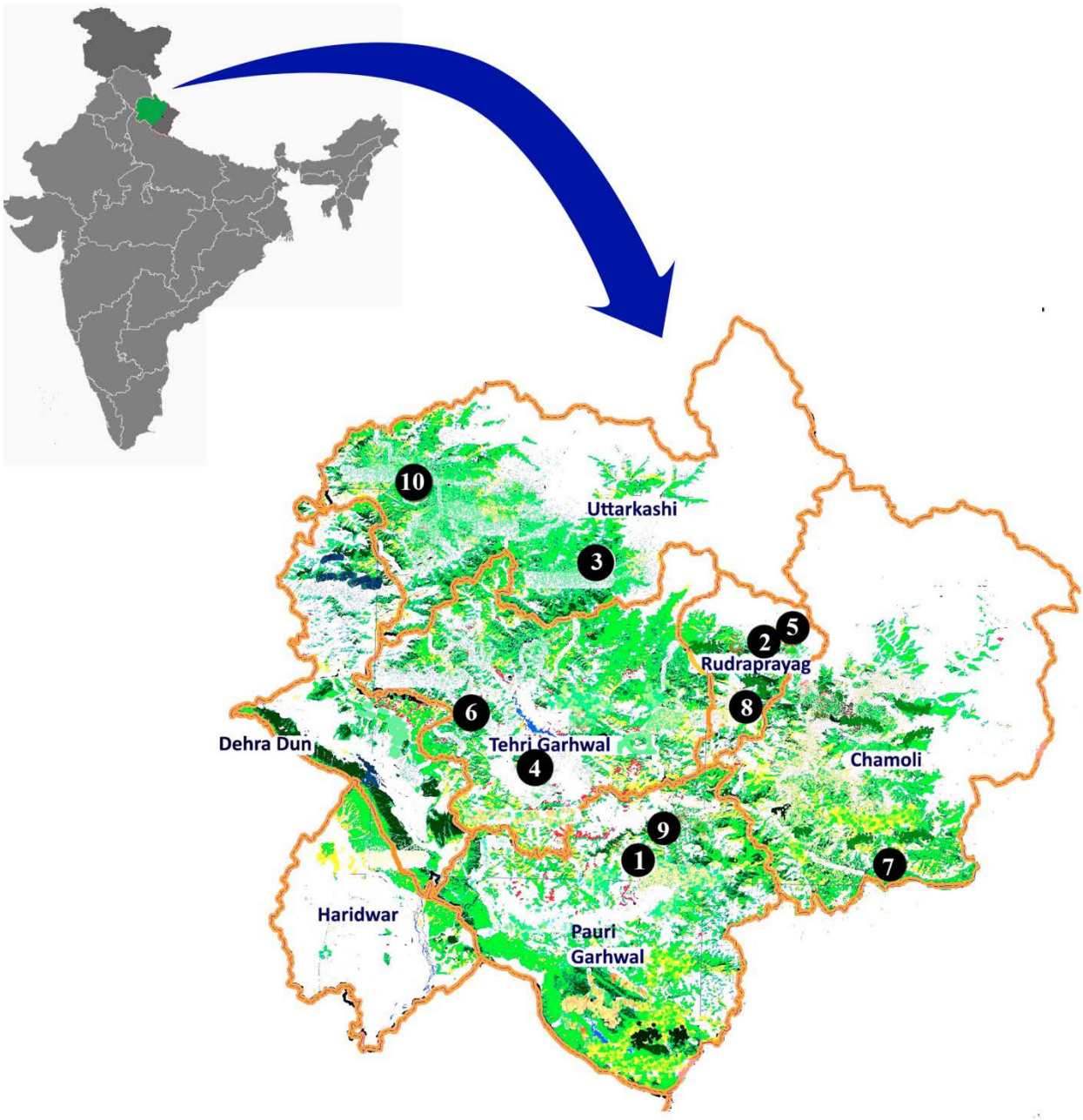

Fig. 1 – Map of the the Garhwal Himalaya showing the ten study sites – 1. Adwani. 2. Baniyakund. 3. Bhatwari. 4. Chamba. 5. Chopta-Tumgnath. 6. Dhanaulti. 7. Gwaldum. 8. Hariyali Devi forest. 9. Khirsu. 10. Purola.

nepalensis (utees), *Buxus wallichina* (papri), *Aesculus indica* (pangar), *Corylus jacquemontii* (bhotia badam), *Juglans regia* (akhrot), *Rhus punjabensis* (amlara) and *Ulmus wallichiana* (mairu) (Vishwakarma et al. 2011).

During the past few decades, several workers have studied the diversity of mushrooms in India. From the Garhwal Himalaya, only limited reports are available with respect to wild edible mushrooms (Zhang & Minter 1988, Sharda et al. 1997, Atri & Lakhanpal 2002, Prasad et al. 2002, Joshi et al. 2013, Vishwakarma & Bhatt, 2013, Bhatt et al. 2014, Semwal et al. 2014, Bhatt et al. 2016). Although the forests of the Garhwal Himalaya have a rich and varied mycoflora, they have yet to be explored thoroughly for the diversity of wild edible mushrooms. The present study is a

part of an ongoing effort to document wild edible mushrooms from a number of different study sites in the Garhwal Himalaya, with most of these located between the elevations of 1500−3500 masl.

Materials and Methods

Numerous field trips were made to ten study sites in the Garhwal Himalaya. These were Bhatwari and Purola in district Uttarkashi; Chamba and Dhanaulti in district Tehri; Baniyakund, Chopta-Tungnath and the Hariyali Devi forest in district Rudraprayag; Adwani and Khirsu in district Pauri and Gwaldum in district Chamoli (Fig. 1). The field trips took place between July and September of 2014−2016 and a total of 1467 specimens of macrofungi were collected. Information related to the use of wild edible mushrooms by local villagers was collected through verbal interviews and questionnaires. Standard methods were followed for the collection, preservation and macro- and microscopic studies of the specimens (Singer 1986). Photographs of all specimens were obtained using a Sony digital DSC–W730 and Cannon Power Shot SX 50 cameras. Identification of species was based on critical observations of the specimens and perusal of the relevant literature (e.g., Moller 1950, 1952, Moser 1978, Hesler & Smith 1979, Miller 1981, Arora 1986, Singer 1986, Kibby & Fatto 1990, Phillips 1991, Yang 1997). The color terminology used is that of the *Methuen Handbook of Color* (Kornerup & Wanscher 1978).

Results and Discussion

A total 21 species belonging to 15 genera and 13 families of wild edible macrofungi were recorded from the ten study sites in the Garhwal Himalaya. The families *Agaricaceae, Russulaceae* and *Tremellaceae* were represented by three species each, followed by two species each in the families *Gomphaceae* and *Hericiaceae.* Eight other families were represented by a single species each. Of these, *Agaricus augustus, Hericium coralloides, H. erinaceus, Laetiporus sulphureus, Macrolepiota procera, Chlorophyllum rachodes, Pleurotus ostreatus* and *Ramaria sanguinea* were found to be the most significant seasonal food species. Local people (the Garhwali), Van Gujjar (a tribal caste) and Nepali communities residing in this area use these wild mushrooms in the preparation of various recipes. The consumption of different mushrooms varies from area to area. Indigenous knowledge of wild edible mushrooms depends upon information gathered by the local people, Van Gujjar and Nepali communities in this region from their ancestors over the years. Traditional methods for the identification of wild edible mushrooms by these people are based upon morphological characters. The association of a mushroom with a particular higher plant also helps in the recognition of a wild edible form.

As mentioned above, a total of 1467 specimens of macrofungi were collected, and these were identified and assigned to 21 species, 15 genera and 13 families. Information relating to locality, habit, habitat, edibility and their associations with higher plants is provided below.

Agaricaceae

Agaricus augustus Fr. Epicrisis Systematis Mycologici. 212 (1838). Fig. 9

Pileus 60−150 mm broad, globose at first, soon convex but becoming plane, sometimes slightly depressed at the centre, white to yellowish, surface dry, covered by numerous, dense, more or less concentric small brownish gray to cinnamon (4F2–6D6), fibrillose squamules on a pale (2A2) background, bruising yellow near the margin; margin entire. Context up to 4 mm at the disc, thinning towards the margin, firm, white to reddish white (7A2). Lamellae free, close to crowded, cinnamon (6D6) to light brown (7D6), finally chocolate brown (6F4), lamellulae numerous. Stipe 80−200 × 10−25 mm, centric, equal to enlarged at base, narrowly fistulate, smooth, floccose squamose below the ring, whitish to yellowish brown (5E8), bruising yellowish. Context slightly yellowing below. *Annulus* superior, membranous, persistant, pendant, floccose- fibrillose below. Taste sweet. Odor slightly that of almonds. Spore deposit chocolate brown (6F4).

Habit and habitat − Solitary to scattered, on the ground in the forests, in disturbed soil, grassy areas, along paths and roads, associated with *Quercus semecarpifolia, Rhododendron arboreum* and *Cupressus torulosa.*

Specimens examined − India: Uttarakhand, Rudraprayag, Chopta-Tungnath, 25 August 2014, US/RPB 0453; Baniyakund, 26 August 2014, US/RPB 0465.

Discussion − People recognize this mushroom on the basis of its large size, the sepia to cinnamon fibrillose squamules on the cap and the distinct almond-like odor. They fry pieces of fruit bodies with garlic, onion and boiled potatoes.

Edibility − Edible and choice; commented upon by Smith (1975), Lincoff (1981), Miller (1981), Arora (1986), Phillips (1991), Gardezi (1993), Hall et al. (1998), Boa (2004) and Das (2009).

Chlorophyllum rachodes (Vittad.) Vellinga, Mycotaxon 83: 416 (2002). Fig. 6

Pileus 60−150 mm broad, subglobose, becoming convex to plano-convex with a broad, shallow umbo, centre entire, elsewhere breaking up into large, thick, brown (6F4), concentrically arranged scales on a white background; margin inrolled at first, becoming decurved and finally plane, not striate, frequently appendiculate. Context 5−10 mm thick at the disk, white turning into olive yellow (3D6) on exposure. Lamellae free, close or crowded, yellowish white (3A2) to dull yellow (3B3), lamellulae numerous, of 3−4 different lengths. Stipe 70−140 × 10−20 mm, cylindrical with a bulbous base, surface glabrous, silky, white, brownish gray (5D2) on bruising. Annulus superior, white, thick, fleshy, double edged, membranous, movable. Taste mild. Odor pleasant. Spore deposit yellowish white (4A2).

Habit and habitat − Solitary to scattered, sometimes gregarious, on the ground under trees and smaller woody plants, in gardens and in compost piles, along roads and in other disturbed places, sometimes also occurring in open fields or in the forest.

Specimen examined − India: Uttarakhand, Pauri, Adwani, 13 July 2014, US/RPB 0163.

Discussion – This is an edible mushroom. Inhabitants collect this mushroom on the basis of its white colored fruiting body with brownish scales on the cap and a long stipe. The stipe is avoided in cooking due to being fibrous, only the cap is used as food in most parts of the study area.

Edibility – Edible; commented upon by Ghosh & Pathak (1965), Krieger (1967, as *Lepiota rachodes*), Iordanov et al. (1978), Lincoff (1981, as *Lepiota rachodes*), Miller (1981, as *Lepiota rachodes*), Purkayastha & Chandra (1985), Arora (1986, as *Lepiota rachodes*), Phillips (1991, as *Lepiota rachodes*), Walleyn & Rammeloo (1994), Chang & Mao (1995), Martinez et al. (1997), Hall et al. (1998), Tedder et al. (2002) and Boa (2004).

Coprinus comatus (O. F. Müll.) Pers., Tent. Disp. Meth. Fung.: 62 (1797). Fig. 3

Pileus 50−140 mm broad, cylindrical to oval when young, then campanulate or conical and soon becoming torn with a lifting margin, surface white but becoming brownish towards the margin and then blackish, centre smooth and brownish to black, with shaggy white to brownish scales; margin decurved, turning to black ‘ink’ with age. Context white, soft, thin. Lamellae free or adnexed, crowded, white then pinkish or purple, finally black and inky, lamellulae numerous, of 3−4 different lengths. Stipe 80−180 × 10−20 mm, central, white, hollow, cylindrical to tapering towards the apex, with a bulbous to abrupt base. Annulus white, membranous, moveable, sometimes dropping to the base of the stipe. Taste and Odor mild. Spore deposit black.

Habit and habitat − Solitary to scattered, sometimes in clusters, on lawns, disturbed soil, and along roadsides.

Specimen examined − India: Uttarakhand, Pauri, Khirsu, 30 September 2014, US/RPB 0595.

Discussion – This mushroom is a good edible but should be eaten when young. Local people recognize this mushroom on the basis of its oval to campanulate shape and the shaggy white to brownish scales on cap.

Edibility – Edible and delicious; commented upon by Bose & Bose (1940), Christensen (1955), Chopra & Chopra (1955), El' chibaev (1964), Krieger (1967), Kaul (1971), Smith (1975), Delmas (1978), Jong (1978), Soothill & Fairhurst (1978), Lincoff (1981), Miller (1981), Phillips (1981), Saenz et al. (1983), Purkayastha & Chandra (1985), Arora (1986), Zerova & Rozhenko (1988), Villarreal & Moreno (1989), Phillips (1991), Metzler et al. (1992), Adhikari & Durrieu (1996), Afyon (1997), Martinez et al. (1997), Hall et al. (1998), Boa (2004), Das (2009), Vishwakarma et al. (2011) and Vishwakarma & Bhatt (2013).

Figs 2–9 – 2. *Pleurotus ostreatus*. 3. *Coprinus comatus*. 4. *Stropharia rugoso-annulata*. 5. *Helvella crispa*. 6. *Chlorophyllum rachodes*. 7. *Psathyrella candolleana*. 8. *Cantharellus lateritius*. 9. *Agaricus augustus*.

Macrolepiota procera (Scop.) Singer, Pap. Mich. Acad. Sci. 32: 141 (1948). Fig. 13

Pileus 70−180 mm broad, oval when young, becoming convex to plano-convex in age, with an obtuse umbo at the disc, dry, smooth, white to whitish, covered with brown (6E8) to grayish brown (6E3) squamules which are irregularly arranged towards the margin on the dirty white background; margin inrolled when young, becoming decurved and finally plane. Context 4−10 mm thick at the disc, white to cream, turning pinkish. Lamellae free, crowded, thin, white when young, white to cream at maturity, lamellulae numerous, of 2−3 different lengths. Stipe 100−200 × 10−18 mm, central, long and cylindrical with an enlarged base, surface pale above the ring, below the ring with small brown (6E4) to dark brown (6E5) velvet squamules that break up with age, creating irregular bands, hollow or fibrous–stuffed. Annulus superior, dirty white above, underside brownish, double edged, moveable. Taste and Odor mild. Spore deposit white.

Habit and habitat − Solitary to widely scattered or in small groups, in open forests and at their edges, in old pastures, along trails and other disturbed places.

Specimens examined − India: Uttarakhand, Rudraprayag, Baniyakund, 19 July 2016, US/RPB1116; Hariyali Devi forest, 26 July 2016, US/RPB 1216; Pauri, Adwani, 16 August 2016, US/RPB 1301.

Discussion − This is one of the most popular mushrooms used by the local people (Fig. 14). It is called the parasol mushroom. This mushroom is easy to identify on account of its white cap with brownish patchy, scattered scales, the moveable ring on the stipe and the somewhat smooth stipe with a slightly swollen base. The flesh is white, turning pinkish brown on handling. The stipe is avoided in cooking due to being fibrous, and only the cap is used as food in most parts of study area. Our team members enjoyed this mushroom very much along with the villagers who prepared it for a meal and also assisted us during forest forays. The locals collect wild mushrooms to eat during their stay in chaani, a place in the high hills where villagers live with their cattle during the monsoon season when grazing their animals in high-elevation grasslands.

Edibility – Regarded as edible and choice; commented upon by Krieger (1967, as *Lepiota procera*), Bouriquet (1970), Iordanov et al. (1978), Vasiléva (1978), Pegler & Piearce (1980), Lincoff (1981, as *Lepiota procera*), Miller (1981, as *Lepiota procera*), Purkayastha & Chandra (1985), Weber & Smith (1985, as *Lepiota procera*), Arora (1986, as *Lepiota procera*), Phillips (1991, as *Lepiota procera*), Metzler et al. (1992), Rammeloo & Walleyn (1993), Chang & Mao (1995), Adhikari & Durrieu (1996), Martinez et al. (1997), Hall et al. (1998), Zerova & Rozhenko (1988), Atri & Lakhanpal (2002), Boa (2004) and Semwal et al. (2014).

Hydnaceae

Cantharellus lateritius (Berk.) Singer, Lilloa 22: 729 (1951). Fig. 8

Pileus 25−95 mm broad, convex at first with an inrolled margin, often becoming funnel-shaped with a wavy margin, pale yellow (2A3) to orange yellow (4B8) to almost orange (5B7), surface smooth to very minutely radially fibrillose. Lamellae absent, fertile surface smooth or with shallow radial wrinkles or veined, decurrent, concolorous with pileus. Stipe 25−60 × 5−20 mm, thick, stuffed to almost solid, smooth, tapering to the base, concolorous with the pileus. Taste pleasant. Odor fragrant, fruity. Spore deposit yellowish white (2A2) to pale yellow (2A3).

Habit and habitat − Solitary to scattered, sometimes gregarious, in broadleaf and mixed forests, associated with *Quercus leucotrichophora, Rhododendron arboreum, Myrica esculenta, Cedrus deodara* and *Cupressus torulosa.*

Specimens examined − India: Uttarakhand, Pauri, Adwani, 07 September 2015, US/RPB 1034; Rudraprayag, Hariyali Devi forest, 26 July 2016, US/RPB 1220.

Discussion – Local villagers easily identify this mushroom by its funnel-shaped structure, orange yellow color and the smooth undersurface of cap. This mushroom is consumed by villagers in most parts of the general study area. Fresh fruit bodies are boiled, the water squeezed out and fried in oil. The color and aroma of this mushroom is retained after cocking.

Edibility – Edible and choice; commented upon by Lincoff (1981), Miller (1981, as *Craterellus cantharellus*), Phillips (1991) and Metzler et al. (1992).

Figs 10–17 – 10. *Hericium coralloides*. 11. Slashed basidiocarp of *Hericium* is being cleaned and washed by a local woman. 12. *Hericium* is being cooked by the locals. 13. *Macrolepiota procera*. 14. A local boy collecting *M. procera*. 15. *Aleuria aurantia*. 16. *Tremella mesenterica*. 17. *Tremella fuciformis*.

Gomphaceae

Ramaria botrytis (Pers.) Ricken, Vadem. Pilzfr.: 253 (1918). Fig. 20

Fruiting body 90−200 × 80−220 mm, coralloid, braches arising from a thick base, base and lower branches elongated, thick, smooth, white to creamy white, pastel yellow (3A4) when bruised, upper branches short, up to 150 mm long, densely clustered on the lower branches, crowded, flesh color (6B3) to brownish red (8C7). Context white, brittle. Stipe 20−50 × 20−40 mm, short, compact, tapering downwards, white to yellowish with age. Taste indistinctive. Odor Pleasant. Spore deposit not observed.

Habit and habitat − Solitary to scattered in mixed forests, associated with *Quercus* spp., *Myrica esculenta*, *Rhododendron arboreum* and scattered *Pinus roxburghii*.

Specimens examined − India: Uttarakhand, Rudraprayag, Baniyakund, 15 July 2015, US/RPB 0637; Pauri, Khirsu, 15 September 2014, US/RPB 0571.

Figs 18−24 – 18. *Laetiporus sulphureus*. 19. Cut portions of *Laetiporus* for cooking. 20. *Ramaria botrytis*. 21. *Ramaria sanguinea*. 22. A local person collecting *Ramaria sanguinea*. 23. *Russula cyanoxantha*. 24. Nepali man separating fresh fruiting bodies from his mixed collection of *Russula* spp. for cooking.

Discussion – Formerly known as *Clavaria botrytis*, this is a large cauliflower like coral fungus with many branches. The local people easily recognize this mushroom by its coral-like structure and the brownish red color of the flesh. It is consumed by locals in many parts of the

Garhwal Himalaya. This mushroom is referred to ungli–cheun in Uttarakhand and siun in Himachal Pradesh (Semwal et al. 2014). It is eagerly sought by all who have once tasted its agreeably flavoured flesh (Krieger 1967).

Edibility – Edible and choice; commented upon by Corner (1950, as *Clavaria botrytis*), Atkinson (1961, as *Clavaria botrytis*), Krieger (1967, as *Clavaria botrytis*), Iordanov et al. (1978), Lincoff (1981), Miller (1981), Purkayastha & Chandra (1985 as *Ramaria botrytoides*), Arora (1986), Metzler et al. (1992), Hall et al. (1998), Adhikari (1999), Atri & Lakhanpal (2002), Boa (2004) and Semwal et al. (2014).

Ramaria sanguinea (Pers.) Quél., Fl. Myco. de la France at des pays limit.:466 (1888). Fig. 21

Fruiting body 80−130 × 5−80 mm, coralloid, profusely branched, polychotomous at the base, dichotomous near the branches, axils narrowly rounded, apices minute, crowded, fleshy, surface smooth, pastel yellow to light yellow (2A4–2A5), reddish brown (9E8) on bruising. Context white, solid. Stipe 20−30 × 15−25 mm, tapering downward, rounded at base, yellowish white (3A2), reddish brown (9E8) on bruising. Taste mild. Odor faintly aromatic. Spore deposit not observed.

Habit and habitat − Solitary to scattered, in mixed forests, associated with *Quercus* spp., *Myrica esculenta*, *Rhododendron* spp. and scattered individuals of *Abies pindrow*.

Specimens examined − India: Uttarakhand, Rudraprayag, Chopta–Tungnath, 14 July 2015, US/RPB 0615; 15 July 2015, US/RPB 0638; Baniyakund, 19 July 2015, US/RPB 0697.

Discussion − People easily recognize this mushroom by its coral-like structure and pastel yellow to light yellow color, which turns reddish brown after bruising (Figs 21, 22). Fresh fruiting bodies of this mushroom are used in the same way as vegetables by boiling in water, decanting the water and then frying in oil. Fruiting bodies are also dried and stored for winter use.

Edibility – Edible and choice; commented upon by Smith (1975), Sharma & Jandaik (1978), Purkayastha & Chandra (1985), Arora (1986), Montoya–Esquivel (1998) and Boa (2004).

Helvellaceae

Helvella crispa (Scop.) Fr., Syst. Mycol. 2: 14 (1822). Fig. 5

Pileus 15−50 mm broad, saddle-shaped, 2−3 regularly to irregularly lobed, white, creamy to slightly yellowish, margin inrolled, expanded with age. Hymenium concolorous with the pileus surface, hairy. Stipe 30−70 × 5−20 mm, concolorous with the pileus surface, tapering towards the pileus, with deep longitudinal furrows, ribs sharp-edged, irregular. Taste not recorded. Odor indistinct. Spore deposit not observed.

Habit and habitat − Solitary or gregarious, on the ground in both broadleaf and coniferous forests, and also occurring in open grassy or forested areas.

Specimens examined − India: Uttarakhand, Pauri, Khirsu, 15 September 2014, US/RPB 0567; Uttarkashi, Purola, 01 August 2015, US/RPB 0790; Pauri, Adwani, 09 September 2015, US/RPB 1044.

Discussion – The white to buff cap and deeply ribbed or fluted stipe are characteristics of this beautiful elfin saddle. The fruiting bodies are edible when young but must be tried only after cooking them thoroughly. People recognize this mushroom by its saddle-shaped structure, white color and deep longitudinal furrows on the stipe.

Edibility – Edible; commented upon by Kaul et al. (1978), Purkayastha & Chandra (1985), Phillips (1991), Metzler et al. (1992) and Atri & Lakhanpal (2002)

Hericiaceae

Hericium coralloides (Scop.) Pers., Neues Magazin für die Botanik 1: 109. (1794). Fig. 10

Fruiting body 150−190 × 130−155 mm, primary branches arising from a distinct stipe-like brownish rooting base, attached to dead wood. Primary branches up to 9 mm wide, creamish in color, giving rise to secondary branches. Secondary branches comparatively thinner, up to 5 mm wide, bearing tertiary branches followed by thinnest quaternary branches. All branches are fertile and bear spines. Spines dense, pendant on primary, secondary and tertiary branches and present all

around on quaternary branches, white, 1−8 mm long. Context creamish, unchanging with exposure. Taste and Odor pleasant. Spore deposit white.

Figs 25−31 – 25. *Hericium erinaceus*. 26. Cut pieces of *H. erinaceus* ready for boiling. 27. *Lactifluus corrugis.* 28. *Tremella foliacea*. 29. *Lactifluus volemus*. 30. Soup prepared with *Tremella foliacea* and *Hericium* spp. 31. Mushroom foray with local people.

Habit and habitat − Solitary, growing on the dead wood of *Quercus* spp. in moist temperate mixed forests.

Specimen examined – India: Uttarakhand, Rudraprayag, Baniyakund, 19 July 2015, US/RPB 0696.

Discussion – This mushroom is quite popular and consumed when young and fresh. It is considered one of the best wild edible mushrooms by the people residing at higher elevations in the

Garhwal Himalaya. The overall white appearance of the fruiting bodies, the short spines and its occurrence on dead or decomposing wood make it easy to recognize in the field. Normally it is cooked separately or mixed with various vegetables (Fig. 12). Fruiting bodies are cut into small pieces, washed thoroughly and boiled prior to cooking (Fig. 11).

Edibility – Edible, good; commented upon by Atkinson (1961), Krieger (1967), Soothill & Fairhurst (1978), Lincoff (1981), Miller (1981), Zang (1984), Purkayastha & Chandra (1985), Villarreal & Perez-moreno (1989), Phillips (1991), Metzler et al. (1992), Walleyn & Rammeloo (1994), Yilmaz et al. (1997), Adhikari (1999), Atri & Lakhanpal (2002) and Boa (2004).

Hericium erinaceus (Bull.) Pers., Comm. de Fung. Clav.: 27 (1797). Fig. 25

Fruiting body 75−100 × 60−90 mm, primary branches arising from a base rooting in to the dead wood, wide up to 11 mm, creamish in color with small spines (up to 3 mm long) all around, giving rise to secondary branches. Secondary branches comparatively thinner (up to 8 mm), with no spines and bearing tertiary branches. Tertiary branches fertile, up to 4 mm wide and bearing spines. Spines dense, tapering, pendant, white, up to 28 mm long. Context creamish, unchanging with exposure. Taste and Odor pleasant. Spore deposit white.

Habit and habitat − Usually solitary, arising from wounds of living or decaying trunks, stumps and logs of broadleaf trees, most common on *Quercus* spp.

Specimens examined − India: Uttarakhand, Rudraprayag, Chopta–Tungnath, 31 August 2015, US/RPB 1019; Baniyakund, 02 August 2016, US/RPB 1264.

Discussion – This is commonly known as the lion's mane or hedgehog mushroom. Locals call it bakercheun because of its similarity to a goat's beard. People recognize this mushroom by its pure white to cream-colored fruiting bodies, occurrence on dead and decaying wood and the long spines. It is consumed when young and fresh and relished by the people in the general study area. It is used after boiling with other vegetables or directly sauteed in oil or butter (Fig. 26).

Edibility – Edible, good; commented upon by Atkinson (1961), Krieger (1967), Vasiléva (1978), Phillips (1981), Purkayastha & Chandra (1985), Arora (1986), Metzler et al. (1992), Adhikari (1999), Boa (2004) and Semwal et al. (2014).

Pleurotaceae

Pleurotus ostreatus (Jacq.) P. Kumm., Der Fuhrer in die Pilzkunde: 105 (1871). Fig. 2

Pileus 45−140 mm broad, fan-shaped, convex to sometimes plane at maturity, white to light grayish brown (5D3), smooth; margin lobed to wavy. Context white, firm. Lamellae decurrent, close, white, pale yellow (2A3) at maturity. Stipe 10−25 × 5−15 mm, eccentric-lateral, short, concolorous to the pileus, surface smooth, white hairs near the base. Taste mild. Odor anise. Spore deposit white to cream.

Habit and habitat − Growing in shelf-like clusters on dead logs or living trees of hardwoods.

Specimen examined − India: Uttarakhand, Pauri, Khirsu, 27 September 2016, US/RPB 1415.

Discussion – This fungus is called the oyster mushroom. The common name supposedly refers to the shape of the cap. The distinctive features are the smooth caps that are white to light grayish brown, decurrent white to pale yellow gills and a stipe that when present is attached at or toward the side of the cap (lateral to eccentric). Oyster mushrooms are cultivated commercially. However, the wild mushrooms are considered better than the cultivated ones. This is another collective species that includes several variants. Fortunately, none of these is known to be poisonous. Small black beetles are often found hiding between the gills, so one should be careful to remove these before the preparation of this mushroom for consumption. People recognize this mushroom on the basis of its fan shaped fruiting bodies, white to light grayish brown color, eccentric lateral short stipe and its habitat, since it is found to grow in large clusters on stumps, logs and trunks of hardwoods both living and dead. Fresh and young fruit bodies are preferred and tough, the leathery stipes are discarded before cooking.

Edibility – Edible and choice; commented upon by Bose & Bose (1940), Christensen (1955), Atkinson (1961), El' chibaev (1964), Krieger (1967), Smith (1975), Jong (1978), Gorlenko et al.

(1980), Lincoff (1981), Miller (1981), Phillips (1981), Saenz et al. (1983), Purkayastha & Chandra (1985), Weber & Smith (1985), Arora (1986), Singer (1986), Remotti & Colan (1990), Phillips (1991), Metzler et al. (1992), Hall et al. (1998), Boa (2004) and Das (2009).

Polyporaceae

Laetiporus sulphureus (Bull.) Murrill, Annls Mycol. 18 (1/3): 51 (1920). Fig. 18

Fruiting body 60−190 × 25−105 mm, annual, pileate, imbricate with rudimentary stipe like base, upper surface lemon yellow (3B8) to orange when fresh, fading to brownish yellow (5C8) with age or drying, minutely tomentose to glabrous, azonate to faintly zonate, radiately furrowed. Margin concolorous, often undulate, rounded, sterile or fertile below. Pore surface sulphur yellow (1A5) when fresh, fading to pale (2A2) on drying, the pores angular, 3−4 per mm, with thin dissepiments that quickly become lacerate. Context white, azonate, brittle and sappy or succulent when fresh, drying crumbly or chalky, up to 20 mm thick, rapidly becoming crumbly and white in old, deteriorating specimens. Tubes sulphur yellow (1A5) when fresh, drying pale (2A2), distinct, up to 4 mm thick. Taste and Odor pleasant. Spore deposit white.

Habit and habitat – Solitary or in large overlapping clusters on stumps, trunks and logs of dead or living broadleaf or coniferous tree.

Specimens examined − India: Uttarakhand, Rudraprayag, Chopta-Tungnath, 31 August 2015, US/RPB 1018; Baniyakund, 25 July 2016, US/RPB 1213.

Discussion – This mushroom is known as the chicken of the woods or sulphur shelf. The fruiting bodies are quite large, fan-shaped and orange yellow to orange in color. The top sides of the shelves are orange and the margins are a bright lemon yellow. It is easy to recognize in the field on account of its thick, fleshy shelves with their bright yellow and orange colors, arising as solitary fruiting bodies or more commonly in large overlapping clusters. This mushroom occurs on stumps, trunks and logs of broadleaf and coniferous trees, also on living trees and buried roots. This is the most popular edible polypore. Fresh young specimens are delicious when cooked. Local villagers, Nepali and Van Gujjar recognize this mushroom on the basis of its fan-shaped structure, yellow to orange color and sulphur yellow pores on the underside of the fruiting body. They collect this mushroom during grazing time. Before preparation they wash the fruiting bodies thoroughly, check them carefully for insect larvae and then cut the fruiting bodies into small pieces and fry them with butter along with garlic and spices (Fig. 19).

Edibility – Edible, Choice; commented upon by Atkinson (1961), El' chibaev (1964), Krieger (1967, as *Polyporus sulphureus*), Jong (1978), Iordanov et al. (1978), Vasiléva (1978), Lincoff (1981), Miller (1981, as *Polyporus sulphureus*), Phillips (1981), Zang (1984), Purkayastha & Chandra (1985), Weber & Smith (1985), Arora (1986), Phillips (1991), Metzler et al. (1992), Adhikari (1999), Des Champs (2002), Tedder et al. (2002), Boa (2004) and Das (2009).

Psathyrellaceae

Psathyrella candolleana (Fr.) Maire, Bull. Soc. mycol. Fr.:185 (1913). Fig. 7

Pileus 15−60 mm broad, broadly conical to convex, brownish orange (5C4) to light brown (6D6), hygrophanous, squamules present in the early stages, glabrous at maturity; margin appendiculate with small fragments of hanging partial veil. Context up to 2 mm thick at the disc, thin, white. Lamellae adnate, white when young, becoming yellowish gray (4B2) and dark brown (6F6) at maturity, lamellulae numerous, of 2−3 different lengths. Stipe 30−70 × 3 −5 mm, hollow, equal, surface fibrillose, white. Veil persistent in the early stages, fibrillose. Taste and Odor mild. Spore deposit violet brown (11F8).

Habit and habitat − Caespitose to gregarious around old hardwood stumps or buried wood, often occurring in lawns or gardens.

Specimen examined − India: Uttarakhand, Rudraprayag, Baniyakund, 14 July 2015, US/RPB 0621.

Discussion – Local people recognize this mushroom on account of its small size, fragile texture, usually convex cap, more or less honey-colored when fresh but becoming pallid in age, its

fragile, white stipe, caespitose to gregarious habit, found growing around old hardwood stumps or buried wood, often in lawns or gardens. It is a good edible mushroom but the flesh is so thin that it must be collected in large quantities for a meal.

Edibility – Edible, choice; commented upon by Lincoff (1981), Miller (1981), Arora (1986), Wilson et al. (1989), Phillips (1991), Rammeloo & Walleyn (1993), Hall et al. (1998), Boa (2004) and Bhatt et al. (2014).

Pyronemataceae

Aleuria aurantia (Pers.) Fuckel, Jahrbücher des Nassauischen Vereins für Naturkunde 23−24: 325. (1870). Fig. 15

Fruiting body 8−75 mm broad, cup-shaped, often becoming flattened or irregular, yellowish−orange to orange, smooth. Hymenophore whitish to light orange, covered with fine white particles, without a stem. Context thin, brittle, whitish to orangish. Taste and Odor indistinct. Spore deposit not observed.

Habit and habitat − Gregarious or caespitose, growing on the ground, usually in areas of disturbed soil or landscaped areas.

Specimens examined − India: Uttarakhand, Rudraprayag, Baniyakund, 03 August 2015, US/RPB 0817; Pauri, Adwani, 09 September 2015, US/RPB 1045.

Discussion – This species is commonly known as the orange-peel fungus because in color and shape, it resembles an orange peel. Occurs in groups or clusters on hard or disturbed soil in gardens, in grassy areas or along roadsides. Local villagers easily identify this mushroom by its cup-shaped structure and yellowish-orange to light orange color. It is consumed by villagers in some parts of the general study area. Fruiting bodies are air-dried and pickled for storage or used when fresh.

Edibility – Edible, choice; commented upon by Rinaldi & Tyndalo (1974), Soothill & Fairhurst (1978), Vasiléva (1978), Lincoff (1981), Purkayastha & Chandra (1985), Villarreal & Perez-Moreno (1989), Phillips (1991), Hall et al. (1998), Boa (2004) and Das (2009).

Russulaceae

Lactifluus volemus (Fr.: Fr.) Kuntze, Revis. Gen. Pl. 2: 857 (1891) . Fig. 29

Pileus 35–70 mm in diam., plano-convex, plano-concave or infundibuliform when mature, with or without papilla; surface dry smooth, finally cracked when dry, ochraceous to cinnamon (6D6), reddish orange (7A8), orange-brown or dark brick, sometimes pinkish buff or saffron at the margin; margin incurved when young, mostly regular, pilear surface turns olive with KOH. Lamellae emarginate to slightly decurrent, rather broad, rather close, orange white (5A2) to pale orange (5A3), light brown (5D7) to yellowish brown (5D8) on damage. Stipe 55–70 × 6–15 mm, central, cylindrical or slightly tapered towards the base, glabrous, concolorous with the pileus or slightly darker towards the base. Context very firm, pale cream to cream, turning pale brownish. Latex white, milky copious, becoming brownish upon exposure to air, staining tissues brown, with KOH turns orange. Taste mild, delicious. Odor strong fish-like. Spore deposit whitish.

Habit and habitat − Solitary, scattered to gregarious on humicolous soil in association with *Quercus leucotrichophora*, *Myrica esculenta*, *Rhododendron arboreum* and scattered individuals of *Pinus roxburghii*.

Specimens examined − India: Uttarakhand, Chamli, Gwaldum, 21 August 2014, PU/RPB 0437; Rudraprayag, Chopta-Tungnath, 28 August 2014, PU/RPB 0510; Pauri, Khirsu, 15 September 2014, PU/RPB 0561; Tehri, Chamba, 07 August 2015, PU/RPB 0878.

Discussion − This mushroom is commonly known as the weeping milk cap. It is easily recognized in the field on account of its smooth, orange-brown cap that may be slightly velvety, the gills are close, orange white to pale orange colored, thick stipe that is orange−brown and velvety, and the copious milky latex that exuded when the tissue is cut or bruised, staining the flesh brown. Solitary to scattered, sometimes gregarious on the ground under hardwoods (especially oaks) or in mixed forests. *Lactifluus hygrophoroides* is closely related to the present species but easily

separated in the field on the basis of its distant gills. *Lactifluus. corrugis* is larger and more robust with a frequently wrinkled, dark brown to reddish brown cap, orange gills, brown−staining latex and a mild odor. Villagers residing in the Garhwal Himalaya recognize this species by its orange brown, velvety cap and the milky latex that is exuded from this mushroom when it is cut or broken.

Edibility – Edible, choice; Christensen (1955, as *Lactarius volemus*), Krieger (1967, as *Lactarius volemus*), Iordanov et al. (1978, as *Lactarius volemus*), Visiléva (1978, as *Lactarius volemus*), Lincoff (1981, as *Lactarius volemus*), Miller (1981, as *Lactarius volemus*), Phillips (1981, as *Lactarius volemus*), Purkayastha & Chandra (1985, as *Lactarius volemus*), Weber & Smith (1985, as *Lactarius volemus*), Arora (1986, as *Lactarius volemus*), Zerova & Rozhenko (1988, as *Lactarius volemus*), Phillips (1991, as *Lactarius volemus*), Metzler et al. (1992, as *Lactarius volemus*), Chang & Mao (1995, as *Lactarius volemus*), Adhikari & Durrieu (1996, as *Lactarius volemus*), Hall et al. (1998, as *Lactarius volemus*), Boa (2004, as *Lactarius volemus*) and Das (2009, as *Lactarius volemus*).

Lactifluus corrugis (Peck) Kuntze, Revis. Gen. Pl. 2: 856 (1891). Fig. 27

Pileus 35–110 mm broad, plano−convex, with a shallow depression; surface dry, smooth, wrinkled at the margin, reddish brown (8D6−8D8) to dark brown (8E7−8E8), paler toward the margin Lamellae adnate to subdecurrent, crowded, orange yellow (4A8) to light orange (5A5) turning brown (6E7−6E8) when bruised, lamellulae numerous. Stipe 40–75 × 9–17 mm, cylindrical, slightly tapering toward the base, concolorous with the pileus, paler downward, stuffed. Context pinkish white (7A2), staining brownish upon handling. Latex copious, white. Taste mild. Odor slight. Spore deposit white.

Habit and habitat − Solitary to scattered, common, usually under *Quercus leucotrichophora*, *Rhododenron arboreum* and *Myrica esculenta*.

Specimens examined − India: Uttarakhand, Tehri, Dhanaulti, 06 August 2015, PU/RPB 0869; Chamba, 07 August 2015, PU/RPB 0881; Rudraprayag, Chopta- Tungnath, 31 August 2015, PU/RPB 1030.

Discussion − *Lactifluus corrugis* is characterized by its dark brown to reddish-brown often wrinkled cap, orange yellow to light orange gills, copious, milky, brown−staining latex and usually a mild odor. This mushroom is quite close to *Lactifluus volemus* in having abundant white latex, a tissue that discolors brown and a bluish green reaction with $FeSO_4$ but differs significantly in the larger and more robust dark brown to reddish brown, corrugated cap, a stipe that is concolorous with the cap and its typically mild odor. Occurring as solitary or several fruiting bodies under hardwoods in deciduous, coniferous or mixed forests.

Edibility – Edible, choice; commented upon by Krieger (1967, as *Lactarius corrugis*), Lincoff (1981, as *Lactarius corrugis*), Miller (1981, as *Lactarius corrugis*), Weber & Smith (1985, as *Lactarius corrugis*), Phillips (1991, as *Lactarius corrugis*) and Metzler et al. (1992, as *Lactarius corrugis*).

Russula cyanoxantha (Schaeff.) Fr., Monogr. Hymenomyc. Suec. 2: 194 (1863). Fig. 23

Pileus 50−125 mm broad, convex at first, becoming plano-convex to plane with a depressed centre, surface viscid when wet, soon dry, sometimes areolate cracks are present, cuticle peels 1/3 of the radius, dull green (28E3), lighter towards the margin, yellowish white (3A2) to dull yellow (3B3) in places, sometimes with a pinkish tinge; margin regular when young splitting with age, pectinate-striate, involute. Context white, unchanging on cutting and bruising. Lamellae adnate to subdecurrent, white, unchanging upon cutting and bruising, close to crowded, lamellulae few, multiple forked, flexible; edges smooth or slightly irregular. Stipe 30−100 × 15−30 mm, central, cylindrical or slightly tapering below, solid, hard, surface veined, smooth, fleshy, white, becoming yellowish on bruising, staining ochraceous to tan in places with age. Taste mild. Odor fruity. Spore deposit white.

Habit and habitat − Solitary to scattered, on soil rich in humus, in coniferous, broadleaf and mixed forests.

Specimen examined − India: Uttarakhand, Rudraprayag, Chopta−Tungnath, 27 August 2014 US/RPB 0490.

Discussion – *Russula cyanoxantha*, commonly known as the variegated *Russula*, is a robust mushroom characterized by its variable cap color, usually dull green but more often a mixture of pinkish-lilac, dull purple, green, olive, yellow, blue−green, white or brownish, lamellae white, close to crowded, stipe solid or stuffed, rather hard, usually white, odor and taste mild and the flesh brittle. Occurring as solitary to scattered fruiting bodies or sometimes in groups under hardwoods, conifers and mixed forests. Local people collect this mushroom, cut the fruiting bodies into pieces and boil these before cooking (Fig. 24).

Edibility − Edible and choice; commented upon by Kühner & Romagnesi (1953), Bouriquet (1970), Iordanov et al. (1978), Delmas (1978), Vasiléva (1978), Gorlenko et al. (1980), Saenz et al. (1983), Purkayastha & Chandra (1985), Arora (1986), Zerova & Rozhenko (1988), Philips (1991), Rammeloo & Walleyn (1993), Martinez et al. (1997), Hall et al. (1998) and Atri & Lakhanpal (2002).

Strophariaceae

Stropharia rugosoannulata Farl. ex Murrill, Mycologia 14 (3): 139 (1922). Fig. 4

Pileus 50−140 mm broad, convex, becoming flattened then finally subdepressed; color dark red (8C8) to dark reddish brown (8D8), becoming more brownish in age; surface humid to slightly subviscid, squamulose to almost smooth; margin slightly incurved, crenate, with velar remnants appendiculate. Context fleshy, firm, whitish. Lamellae adnexed with decurrent tooth; gray (2D1), becoming black with the maturity; margin whitish, irregular. Stipe 60−170 × 10−15 mm; central, clavate or with a sub−bulbous base; white in the apex to grayish brown (5D3) towards the base; surface dry, longitudinally striate with brownish fibrils below the annulus; basal mycelium white, with numerous and well−developed whitish rhizomorphs. Veil present; on pileus margin it is present as membranous and whitish velar remnants and thus appendiculate; on the stipe it produces a fleshy and white annulus, grooved and violaceous on upper surface. Spore deposit black.

Habit and habitat − Solitary to gregarious into forests or lawns in broadleaf forests, on fallen leaves or rarely much decomposed wood.

Specimen examined − India: Uttarakhand, Pauri, Adwani, 03 September 2016, US/RPB 1381.

Discussion − *Stropharia rugosoannulata* is characterized by its dark red to dark reddish brown or wine red cap which fades to tan, gills grayish, becoming black with age, purple-black or black spores and a grooved, often segmented annulus. Occurring as solitary fruiting bodies to sometimes gregarious in mulch, on wood chips or straw, in lawns, in gardens and also in some cultivated areas. This mushroom provides delicious food for the local inhabitants. Fresh young fruiting bodies are preferred for meals.

Edibility – Edible and choice; commented upon by Vasiléva (1978), Miller (1981), Arora (1986), Phillips (1991), Chang & Mao (1995) and Boa (2004).

Tremellaceae

Tremella foliacea Pers., Observ. mycol. 2: 98 (1800). Fig. 28

Fruiting body up to 125 × 75 mm broad, foliose, cartilaginous, dark brown (6F7) to reddish brown (8E8) when fresh, becoming black with age or drying, compose of thin, branching fronds; surface smooth; margin crenate or sometimes entire or undulate. Context thin, translucent, rubbery. Taste and Odor indistinct. Spore deposit not observed.

Habit and habitat – Solitary to scattered, occurring on logs of *Quercus* spp. and other hardwoods.

Specimens examined – India: Rudraprayag, Chopta-Tungnath, 27 July 2015, US/RPB 0731; Baniyakund, 31 July 2015 US/RPB 0766.

Discussion – *Tremella foliacea* is also known as jelly leaf because of its overall similarity to a cluster of folded leaves. People recognize this jelly fungus by its reddish brown to dark brown color

and gelatinous fruiting body. They use this mushroom along with vegetables for thickening curry (Fig. 30). Fruiting bodies are also saved in form of sun-dried flakes for use after the rainy season. Occurring as solitary fruiting bodies or several in one place on hardwood stumps, logs and fallen branches, but occasionally found on conifers.

Edibility – Edible and good; commented upon by Lincoff (1981), Arora (1986), Hall et al. (1998) and Boa (2004).

Tremella fuciformis Berk., Hooker's J. Bot. Kew Gard. Misc. 8: 277 (1856). Fig. 17

Fruiting body up to 110 × 70 mm broad, foliose, gelatinous, translucent white to white, composed of thin, erect, branching portions; surface smooth, shiny; margin crenate or sometimes entire or undulate. Context gelatinous, transparent to whitish. Taste and Odor mild. Spore deposit not observed.

Habit and habitat − Solitary to scattered, occurring on the logs of *Quercus* spp. in temperate mixed forests.

Specimens examined – India: Uttarakhand, Rudraprayag, Baniyakund, 26 August 2014, US/RPB 0467; Baniyakund, 19 July 2015, US/RPB 0712; Baniyakund, 31 July 2015, RPB/US 0767; Chopta-Tungnath, 01 August 2015, US/RPB 0791.

Discussion – *Tremella fuciformis* is also called white jelly fungus or silver ear fungus. This jelly fungus has many leafy lobes emerging from a single point of attachment. People recognize this mushroom by its translucent white to white color and gelatinous fruiting body. They use it along with vegetables for thickening curry. Fruiting bodies are also saved in form of sun dried flakes for use after the rainy season. This mushroom occurs as single to several fruiting bodies on dead and downed wood.

Edibility – Edible and good; commented upon by Chen & Hou (1978), Chin-Chyu-Tu (1981), Quimio (1981), Purkayastha & Chandra (1985), Metzler et al. (1992), Chang & Mao (1995) and Boa (2004).

Tremella mesenterica (Schaeff.) Retz., K. svenska Vetensk-Akad. Handl. 30: 249 (1769). Fig. 16

Fruiting body up to 120×80 mm, gelatinous, surface pustular when young, foliose when mature, lobes undulate-plicate; yellow to yellowish orange (4A8), occasionally pale yellow (3A3) to yellowish white (3A2), color reduced when fruiting bodies are mature; margin crenate or sometimes entire or undulate. Context gelatinous, hard crust. Taste and Odor mild. Spore deposit not observed.

Habit and habitat – Solitary to scattered, growing on logs of *Quercus* and other hardwoods.

Specimens examined − India: Uttarakhand, Rudraprayag, Chopta-Tungnath, 25 August 2014, US/RPB 0464; Baniyakund, 31 July 2015, US/RPB 0768.

Discussion – Fruiting bodies of *Tremella mesenterica* typically consisting of several convoluted or brain like lobes or folds, pure yellow to yellowish orange at first, but pale yellow to yellowish white when old. It occurs as solitary to several fruiting bodies on hardwood sticks and logs. People recognize this jelly mushroom by its pure yellow to yellowish orange color and gelatinous fruiting body. They use this mushroom along with other vegetables for thickening curry. Fruiting bodies are also saved in form of sun−dried flakes for use after the rainy season.

Edibility – Edible and good; commented upon by Lincoff (1981), Metzler et al. (1992), Adhikari & Durrieu (1996), Hall et al. (1998), Boa (2004) and Das (2009).

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