

Full Length Research Paper

Studies on biodiversity of fleshy fungi in Navsari (South Gujarat), India

Korat Chandulal, Chopada Gopal and Priya John*

Department of Plant Pathology, N. M. College of Agriculture, Navsari Agricultural University, Navsari-396450 Gujarat, India.

Accepted 12 June, 2013

Mushrooms have created great excitement because of their presence especially after the down pour during the monsoon season. So a detailed survey was made in and around Navsari, south Gujarat, from July to September, 2010, to understand the morphological variability in their population which has not been done earlier. The region is a habitat of well distributed micro flora and fauna. Navsari is located between the latitude 20.95° N. It has an average elevation of 9 m above the sea level. The average maximum and minimum temperatures are 40 and 18°C, respectively, with an average annual rainfall of 122 cm. Out of several mushroom collected, 17 species were identified belonging to 2 different classes namely, *Gastromycetes* - *Daldinia concentrica* [(Xylariaceae) (cramp ball)], *Lycoperdon pyriforme* [(Lycoperdaceae, edible) (wood or stump puff ball)], *Scleroderma citrinum* (Sclerodermataceae, edible); *Hymenomycetes* - *Cantharellus umbonatus*, *Coriolus versicolor* (Polyporaceae, inedible), *Schizophyllum commune* (Schizophyllaceae, inedible) (the split gill), *Ganoderma lucidum* (Ganodermataceae), *Ganoderma applanatum* (ganodermataceae), *Laetiporus sulphureus* (Polyporaceae, edible), *Lepiota organensis*, *Collybia butyracea*, *Lentineullus cochleatus* (Auriscalpinaceae, edible), *Galerina unicolor* (Hymenogatraceae), *Citocybe flaccida* (Trichomataceae, edible), *Oudemansiella redicata* (Physalacriaceae, edible), *Hygrophorus eburnes* (Hygrophoraceae, edible) and *Agaricus campestris* (Agaricaceae, edible). The investigation proves that there exists a distinct biodiversity in mushroom population.

Key words: Navsari, south Gujarat, mushroom, population, flora, fauna.

INTRODUCTION

A mushroom is the fleshy spore bearing fruiting body of a fungus, typically produced above ground soil or on its food source. Some species of mushrooms are edible and poisonous. Mushrooms have been existing on earth even long time before man appeared on earth as it is evident from the fossil records of the lower cretaceous period. Although, biologically speaking, possibly man might have used mushroom as food gatherer and hunter on the chronology of cultural evolution, but their nutritive value is untapped till now. Wild edible fungi have been collected and consumed by people for thousands of years. The

geological records reveal that edible species associated with people living 13,000 years ago in Chile. Many mushrooms have been used as food and medicines. So they contribute towards diet, income and human health. Some mushrooms have been important source of revenue for rural communities in India and other developing countries (Wani et al., 2010). Navsari is located between 20° 51" N, 72° 55" E and about 9 m above the sea level. Minimum and maximum temperature is 18 and 40°C. The average annual rainfall is about 122 cm. The dominant tree species of this area are Subabul (*Leucaena*

*Corresponding author. E-mail: asadbotanist@yahoo.com..

leucocephala), Garmalo (*Cassia fistula*), Ashoka (*Saraca indica*), Rain tree (*Samanea saman*), Peltrophorum (*Peltrophorum inrme*), Pink cassia (*Cassia rainigera*), Cordia (*Cordia myxa*) and Gulmohar (*Delonix regia*).

During rainy season, there is abundant growth of several kinds of mushroom. There is an urgent need to explore this area for mushroom emanating in different seasons under varying environment and conserve the biodiversity prevailing in this area. The present communication, as part of continuing investigations, describes some newly reported mushrooms from Navsari (south Gujarat), India.

Classification of mushrooms

Gasteromycetes

These are examples of the basidiomycetes commonly called the Gasteromycetes. It means "stomach fungus" - and these fungi produce their spores inside the fruiting body, that at least initially enclosed within an outer skin. These fungi show considerable variation in both, the overall appearance and internal structure of the immature basidia-bearing fruiting bodies. The spores are shed by variety of interesting mechanisms. Young specimens of the more fleshy members are edible, but this group includes many small, dry, inedible species.

Hymenomycetes

One of the three major classes of Basidiomycota is Hymenomycetes, Urediniomycetes and Ustilagomycetes. About 98% of the species of the Hymenomycetes are in a clade called the Homobasidiomycetes, which includes mushrooms, bracket fungi, puffballs and others.

MATERIALS AND METHODS

Collection of mushroom samples

Detailed survey was carried out in and around Navsari from July to September, 2010 to understand the morphological variability in the mushrooms population. The collection was made by method given by Hailing (1996). Collection site is Navsari agricultural university campus, college farm, residential area and nearby villages of Navsari. Spotted mushrooms were minutely inspected in their natural habitats and brought to laboratory for detailed study. Photographs were taken by means of a Canon Camera with power of 12 megapixels.

Identification and classification of mushroom samples

We were using the following parameters for identification of mushrooms specimens- Cap colour, cap surface, cap margin, cap diameter, stipe length, gill attachment, gill spacing and spore print. Spore prints were taken according to guidelines given by Michelo (2004). Individual spore characteristics like shape, size and colour

were recorded. For this purpose, we used scale, Petri plate, black-white paper for spore print, microscope with camera and measuring scale. We were measuring 6 samples of each mushroom for collecting information. Final identification and classification were done by comparing recorded characteristics of mushrooms with the colour dictionary of mushroom given by Dickinson and John (1982), the mushroom guide and identifier by Jorden (2000) and the mushroom identifier by Pegler and Spooner (1997).

Mushrooms demystified

A comprehensive guide to the fleshy fungi given by Arora (1986) and the *Agaricales* in morden taxonomy Singer (1986).

RESULTS

During survey, several numbers of mushrooms were collected and identified. At present, we could be able to identify 18 genera belonging to 12 families and two classes. They are individually described (Figures 1 and 2).

Gasteromycetes

Daldinia concentrica

Family: Xylariaceae

Common name: Cramp balls

Cap colour: Jamun colour later becoming black.

Cap shape: Hemispherical with slightly incurved base.

Cap diameter: 2.5 to 6.0 cm.

Spore print: Black.

Spore colour: Black.

Spore size: 4.74 to 5.54 × 2.74 to 3.40 μ

Spore shape: Spindle shaped

Edibility: Not known (Figure 1).

Lycoperedon pyriforme

Family: Lycoperdaceae

Common name: Wood or stump puff ball

Cap colour: Yellowish brown

Cap shape: Pear shaped with hump at center

Cap surface: Smooth

Cap diameter: 2 to 7 cm

Strip length: 0.5 to 3.5 cm

Spore colour: Golden yellow

Spore size: 4.44 to 4.58 × 4.07 to 4.94 μ

Spore shape: Round

Edibility: Edible

Scleroderma citrinum

Family: Sclerodermataceae

Cap colour: Dirty olive-yellow

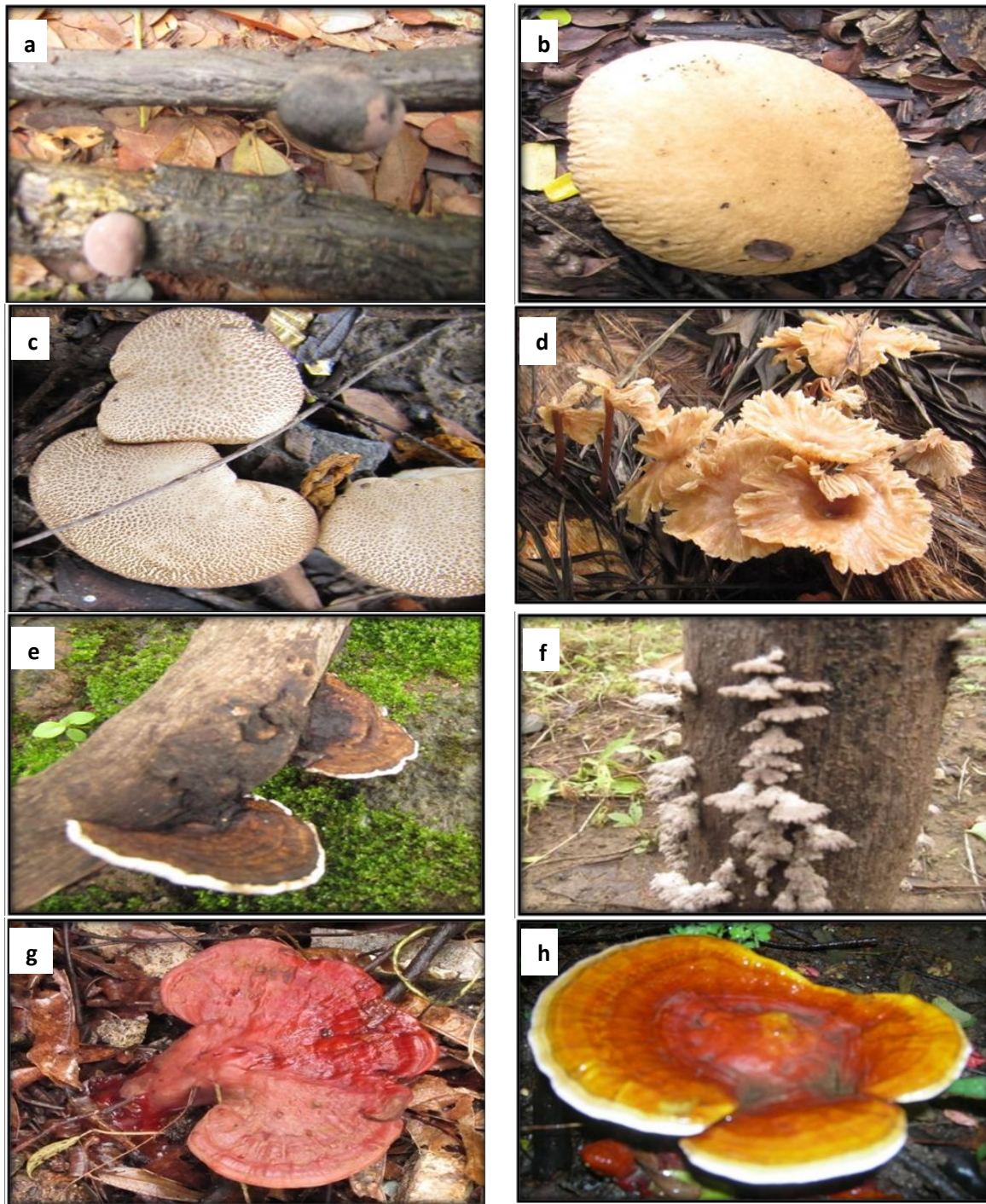


Figure 1. a = *Daldinia concentrica*; b = *Lycoperedon pyriforme*; c = *Scleroderma citrinum*; d = *Cantharellus umbonatus*; e = *Coriolus versicolor*; f = *Schizophyllum commune*; g = *Ganoderma lucidum*; h = *Ganoderma applanatum*.

Cap shape: Rounded or pumpkin shaped
Cap surface: Rough
Cap diameter: 4 to 6 cm
Spore colour: Blackish brown
Spore size: 9.5 μ in diameter
Spore shape: Spherical
Edibility: Edible.

Hymenomycetes

Cantharellus umbonatus

Family: Tricholomataceae
Cap colour: Brown

Cap shape: Convex, centrally depressed
 Cap surface: Smooth, flocculose silky.
 Cap diameter: 6 cm
 Cap margin: Wavy
 Gill colour: White
 Gill spacing: Distant
 Gill attachment: More or less decurrent
 Stipe length: 1 to 5 cm
 Stipe colour: White
 Spore print: Yellow
 Spore colour: White
 Spore size: 0.32 to 0.56×0.32 to 0.51μ
 Spore shape: Oblong
 Edibility: Edible (Figure 1).

Coriolus versicolor

Family: Polyporiaceae

Cap colour: Grey brown with white border at the edge of each cap.
 Cap shape: Flat
 Cap diameter: 2.5 cm
 Pores: Quite fine and white or cream like the flesh.
 Habitat: Decaying timber
 Edibility: Inedible.

Schizophyllum commune

Family: Schizophyllaceae
 Common name: The split gills
 Cap colour: Whitish grey
 Cap shape: Kidney shaped
 Cap surface: Velvety
 Cap diameter: 1 to 4 cm
 Cap margin: Incurved somewhat lobbed
 Gill colour: Grey or violet
 Gill spacing: Distant
 Spore print: White
 Spore colour: White
 Spore size: $5.0 \times 1.3 \mu$
 Spore shape: Cylindrical
 Edibility: Inedible.

Ganoderma lucidum

Family: Ganodermataceae
 Cap colour: Brick red
 Cap shape: Flat and kidney shaped
 Cap surface: Smooth
 Cap diameter: 3.3 cm
 Stipe length: 6 to 10 cm
 Stipe colour: Brick red
 Spore color: Dull brown
 Edibility: Poisonous.

Ganoderma applanatum

Family: Ganodermataceae

Cap colour: Brick red with white margin
 Cap shape: Flatted dish shape
 Cap surface: Smooth
 Cap diameter: 4 to 5 cm
 Cap margin: White with incurved
 Tube length: 2 to 3 cm
 Spore colour: Brown
 Spore size: $10.3 \times 6.3 \mu$
 Edibility: Poisonous.

Laetiporus sulphurus

Family: Polyporaceae
 Cap colour: Orange yellow
 Cap shape: Bracket shaped
 Cap surface: Smooth
 Cap diameter: 25 to 35 cm
 Cap margin: Wavy
 Spore colour: Yellow
 Spore size: $6.4 \times 4.5 \mu$
 Spore shape: Rounded
 Edibility: Edible (Figure 2).

Lepiota oregonensis

Family: Agaricaceae

Cap colour: Pale yellow depressed darker at center
 Cap shape: Knobbed
 Cap surface: Smooth
 Cap diameter: 4.4 cm
 Cap margin: Enrolled to uplifted
 Gill colour: Brown to milky white
 Gill spacing: Crowded
 Gill attachment: Adnexed
 Stipe length: 4 cm
 Stipe colour: Stipe is bulbous swollen at the base.
 Spore print: White
 Spore colour: Golden brown
 Spore size: 1.30 to 1.45×0.63 to 0.89μ
 Spore shape: Ellipsoidal
 Edibility: Inedible.

Collybia butyracea

Family: Tricholomataceae
 Cap colour: Whitish with brown center
 Cap shape: Convex
 Cap surface: Smooth
 Cap diameter: 1.5 to 3.5 cm
 Cap margin: Incurved
 Gill colour: White
 Gill spacing: Crowded
 Gill attachment: Adnexed
 Stipe length: 1.5 to 3.0 cm
 Stipe colour: Creamy white
 Spore print: Brownish
 Spore color: Hyaline
 Spore size: 0.42 to 0.58×0.42 to 0.51μ

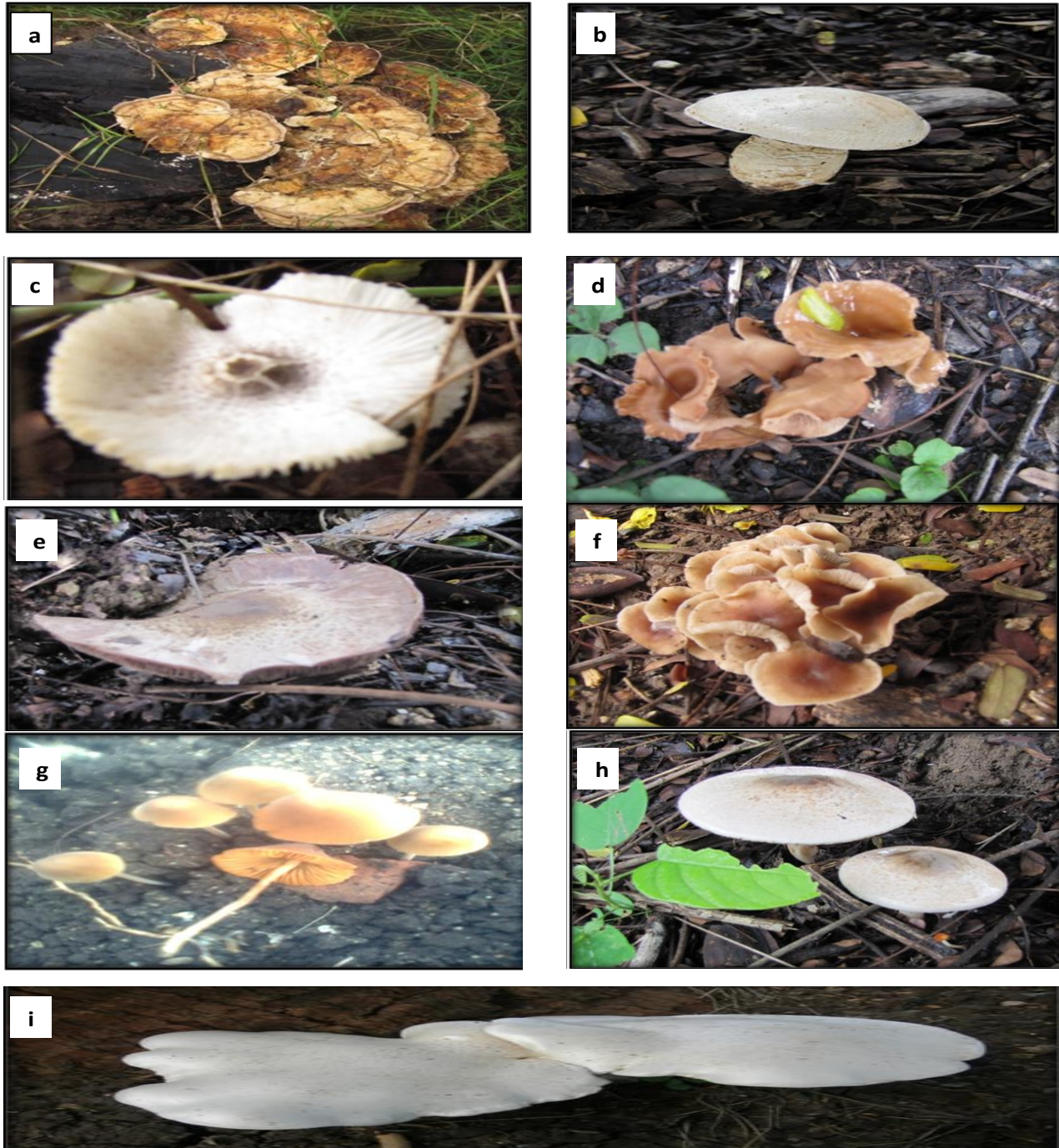


Figure 2. a = *Laetiporus sulphurus*; b = *Lepiota oregonensis*; c = *Collybia butyracea*; d = *Lentinellus cochleatus*; e = *Galerina unicolor*; f = *Citocybe flassida*; g = *Oudemansiella redicata*; h = *Hygrophorus eburnes*; i = *Agaricus campestris*.

Spore shape: Globose
Edibility: Inedible.

Lentinellus cochleatus

Family: Auriscalpinaceae

Cap colour: Red brown

Cap shape: Irregular funnel
Cap surface: Smooth
Cap diameter: 7.5 cm
Cap margin: Wavy
Gill colour: Watery pale brown
Gill spacing: Close
Gill attachment: Decurrent
Stipe length: 2 cm

Stipe colour: Flash at the top, reddish brown towards base
 Spore print: Pinkish brown
 Spore size: $5.93 \times 5.56 \mu$
 Spore shape: Round
 Edibility: Edible.

Galerina unicolor

Family: Hymenogatraceae

Cap colour: Brown
 Cap shape: Completely convex, initially bell shaped
 Cap surface: Smooth/slimy/shiny
 Cap diameter: 3 to 4 cm
 Cap margin: Extending beyond gills
 Gill colour: White
 Gill spacing: Distant
 Stipe colour: Dark brown, with white cottony mycelia at base
 Spore print: Dark brown to blackish
 Spore colour: Brown
 Spore size: $4.87 \times 3.70 \mu$
 Spore shape: Spherical to oval
 Edibility: Inedible.

Citocybe flassida

Family: Tricholomataceae

Cap colour: Reddish leather brown
 Cap shape: First convex than turn funnel shaped
 Cap surface: Smooth and shiny
 Cap diameter: 3.5 cm
 Cap margin: Expanded downward often wavy
 Gill colour: White
 Gill spacing: Crowded
 Gill attachment: Free
 Stipe length: 3 cm
 Stipe colour: Leather brown
 Spore print: White
 Spore colour: Sparse hyaline
 Spore shape: Sub globose
 Edibility: Edible.

Oudemansiella redicata

Family: Physalacriaceae
 Cap colour: Pale brown, grey to dark olive brown
 Cap shape: Bell shaped finally flat with slight hump
 Cap surface: Slimy and slightly wrinkled
 Cap diameter: 3 to 9 cm
 Cap margin: Wavy
 Gill colour: Clear white
 Gill spacing: Distant
 Gill attachment: Adnexed
 Stipe length: 10 to 20 cm tapres toward the top with long taproot
 Stipe colour: Whitish brown
 Spore print: White

Spore colour: Hyaline white
 Spore size: $2.59 \times 1.89 \mu$
 Edibility: Edible

Hygrophorus eburnes

Family: Hygrophoraceae
 Cap colour: White, bicid
 Cap shape: Convex to nearly plane
 Cap diameter: 3.5 cm
 Gill colour: White
 Gill spacing: Distant
 Gill attachment: Decurrent
 Stipe length: 3 cm narrow at base
 Stipe colour: White
 Spore print: Yellowish
 Spore colour: Yellowish
 Spore size: 2.25 to 2.59×2.22 to 2.99μ
 Edibility: Edible.

Agaricus campestris

Family: Agaricaceae
 Cap colour: White
 Cap shape: Hemispherical
 Cap surface: Smooth
 Cap diameter: 5 to 10 cm
 Cap margin: Incurved
 Gill colour: Bright pink when young
 Gill spacing: Dense
 Gill attachment: Free
 Stipe length: 6 to 7 cm
 Stipe colour: White
 Spore colour: Brown
 Spore size: 7 to 8 to 4 to 5μ
 Spore shape: Ovate
 Edibility: Edible.

DISCUSSION

Mushroom have been objects of much curiosity and speculation since time immortal. They are an important component of the ecosystem. Their edibility, poisonous nature, psychotropic properties, mycorrhizal and parasitic association with the trees makes them economically important and interesting to study. Mushrooms are of ancient lineage, omnipresent, remarkably beautiful and diverse in their form, in their interaction with biota. The occurrence of such familiar substrate as wood, litter and soil, implies a role for them in these micro habitats (Lakhanpal, 1996). Fleishy fungi tend to appear seasonally, the most productive months are those of rainy days (July to October), starting after summer season. Mushrooms are cosmopolitan and are found almost everywhere; such as pastures, forested areas. Many of them are found in only one kind of habitat such as bog, a forest, gardens, roadsides, deserts etc. They actually

emerge from substrates such as peat, along or soil, humus, dung, saw dust, charcoal heaps etc. (Sharman and Samota, 2006). Mushrooms grow wild in almost all types of soils, on decaying organic matter, wooden stumps etc. They appear in all seasons; however, rains favor rapid growth when organic matter or its decomposition products are easily available (Manoharachary et al., 2005).

Singer (1989) had reported 1320 species belonging to 129 genera under Agaricales. Mushrooms alone are represented by about 41,000 species, of which approximately 850 species are recorded from India (Deshmukh, 2004). Besides extensive surveys of the Himalayan region are compiled by Lakhanpal (1997). Atri et al. (2000) had done taxonomic studies of Agarics from Punjab plains. Pradeep et al. (1998) worked on the diversity of mushrooms from Western Ghats.

Conclusion

Mostly, mushrooms are found in forest area, in field area, on branches of trees, and some time in west land area. The possible reason for the growth and survival of various kinds of naturally occurring mushrooms can be the prevailing climatic condition with different vegetation which provided the favorable environment. Through this study we are reporting the existing biodiversity of mushroom in this region for the first time.

REFERENCES

- Arora D (1986). Mushrooms Demystified: A Comprehensive Guide to the Fleshy Fungi. Berkeley Speed Press.
- Atri NS, Kaur A, Saini SS (2000). Taxonomic studies on *Agaricus* from Punjab plains. Indian J. Mushroom. 18:6–14.
- Dickinson C, John L (1982). The Colour Dictionary of Mushroom, Orbis Publishing London.
- Deshmukh SK (2004). Mushroom Cultivation Nutritional value, Medicinal effect and Environmental impact. Second Edition. CRC Press., pp.2–4.
- Hailing RE (1996). Recommendations for collecting mushrooms for scientific. In Alexialdes MM. and JW. (eds). *Selected Guide Lined for Ethnobotanical Research. A field Manual*, The New York Botanical garden Press, Bronx., pp. 135-141.
- Jorden P (2000). The Mushroom Guide and Identifier. Anness publishing limited Hermes house London.
- Lakhanpal TN (1996). Mushrooms of India Boletaceae – Vol – I Studies in Cryptogamic Botani (ed. Mukherjii KG), APH Publishing Corporation Delhi.
- Lakhanpal TN (1997). Diversity of Mushroom Microflora in the North Western Himalaya. In *Recent Research in Ecology, Environment and Pollution* (eds Sati SC, Saxena J and Dubey RC), Today and Tomorrow's Printers and Publishers, New Delhi, pp.35-68.
- Manoharachary C, Sridhar K, Singh R, Adholeya A, Suryanarayanan TS, Rawat S, Johri BN (2005). Fungal biodiversity: Distribution, conservation, and prospecting of fungi from India. *Curr. Sci.*, 89:58–71.
- Pegler D, Spooner B (1997). The Mushroom Identifier. Quintet publishing limited.
- Pradeep CK, Virinda KB, Mathews S, Abrahm TK (1998). The genus *Volvariella* in Kerala state, India. *Mushroom Res.*, 53-62.
- Sharman SS, Samota RK (2006). Trapping into India's Mushroom biodiversity; Identification, Conservation and Domestication of wild Mushroom flora. Compendium of lectures-Emerging Areas in Mushroom diversity, production and post harvest development. Organized by Mushroom Research laboratory, Deptt. Of Plant Pathology. Indira Gandhi Agriculture University Raipur. pp.69-84.
- Singer R (1986). The Agaricales in Morden Taxonomy, J. Cramer, Weinheim, 4th ed, p.912.
- Singer R (1986). The Agaricales in Morden Taxonomy. Seven Koeltz Scientific Books. Koenigstein, Germany. p.624.
- Wani H, Pala SA, Boda RH, Mir RA (2010). Morels in Southern Kashmir Himalaya. *J. Mycol. Pl. Pathol.* 40:540-546.