

# Diversity of Agaricaceae (Basidiomycota: Agaricales) in Dharampur and Kaprada Taluka, Valsad District: A Taxonomic Study

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## Abstract

*The fungal diversity of Dharampur and Kaprada Taluka in Valsad District, Gujarat, India, particularly within the Agaricaceae family, has been extensively studied. According to a standard reference text, the Agaricaceae contains 85 genera and 1340 species. Agaricaceae fungi, categorized as macrofungi, are prevalent in this region and are notably utilized by local tribal communities for culinary purposes due to their edibility. The life cycle of Agaricus is cyclic beginning with the inoculation and germination of spores. This is followed by mycelium and primordia growth, fruiting body generation, maturation and release of spores. During fieldwork, specimens of Agaricaceae fungi were systematically collected using knives and transported to the laboratory for taxonomic and morphological analysis. Taxonomic classification and morphological characterization were conducted using authoritative sources such as "Fungi of Temperate Europe Volume 1 and 2" by Laesse and Peterson (2019) and "Mushrooms: How to Recognise and Gather Wild Mushrooms and Other Fungi" by Laessøe (2013). A total of 45 distinct species belonging to the Agaricaceae family were identified in the study area, highlighting their diverse ecological niches including soil, dead leaves, cow dung, and decomposed organic matter. This research underscores the rich fungal biodiversity present in the region and provides valuable insights into the ecological roles and potential applications of Agaricaceae fungi within local ecosystems. The findings contribute significantly to our understanding of fungal diversity in this specific geographical area, emphasizing both the ecological importance and cultural relevance of these fungi to the communities that depend on them. Further research could explore their pharmacological potentials or their roles in nutrient cycling, thereby enriching our knowledge of these understudied yet ecologically significant organisms.*

**Keywords:** Agaricaceae, mushrooms, dharampur, kaparada, diversity

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## INTRODUCTION

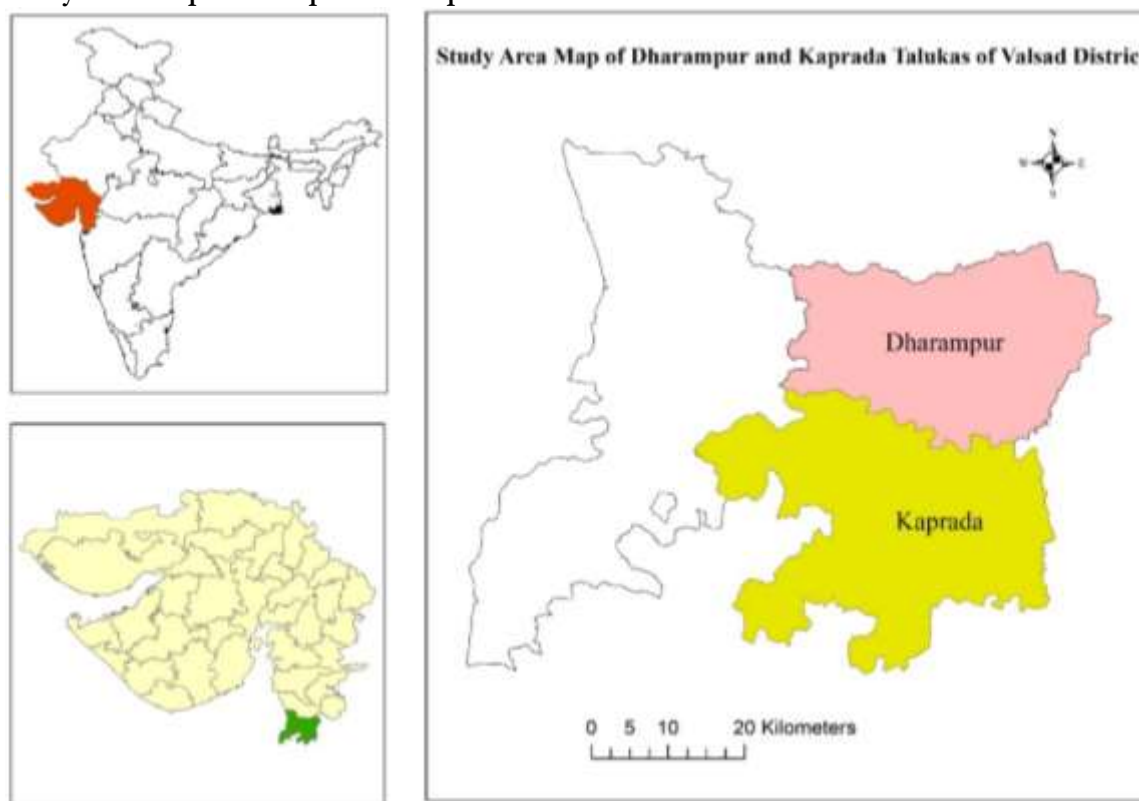
The nutrition, metabolism, growth, reproduction, and fatality of fungal cells are all covered by the concept of fungal physiology. Additionally, it deals with how fungi interact with their biotic and abiotic environments, particularly how cells react to environmental stress [12]. Fungi are known for their cosmopolitan distribution, thriving particularly in environments characterized by low climatic conditions and the rainy season [4]. Agaric, and having separated the stem from the pileus, invert the latter, with the gills downwards, upon a piece of glass or a sheet of writing paper, in the course of an hour or two a number of fine dust-like bodies will be seen to have fallen from the

under surface of the pileus upon the glass or paper [2].

Basidiomycetes have separate hyphae with “complex” septal pores called dolipore, which allow cytoplasmic but not nuclear migration [3]. Mushrooms are the fruiting bodies of higher fungi that release spores for dissemination. Spores are only a small part of a much larger organism. Mushrooms are integral part of the forest ecosystem that helps in the recycling of forest waste [5].

Similarly, the Western Ghats of Karnataka have been explored for their fungal diversity, with a morpho-taxonomic analysis revealing 15 agaric species of Agaricales and their geographic distribution across India [11]. A broader perspective on fungal diversity in India reveals a rich tapestry of 135 species spanning 27 genera and 10 families within the order Agaricales, class Agaricomycetes, and phylum Basidiomycota [1]. These studies collectively underscore the importance of understanding fungal diversity and distribution patterns, providing valuable insights into the ecological roles and conservation needs of these organisms.

#### Study Area Map: Dharampur and Kaparada Talukas



**Figure 1 : Study Area Map**

#### **MATERIAL AND METHODS**

The methodology encompassed the systematic observation, collection, preservation, and identification of fungi from the Agaricaceae family. Fungi were observed during the monsoon season in Dharampur and Kaparada Taluka of Valsad District, Gujarat, given the relevance of this season for fungal growth. Visual documentation of the fungi was conducted through photography, followed by careful collection using a knife and placement into ziplocked polythene bags. Collection efforts were carried out throughout the period spanning 2020 to 2021.

Upon transportation to the laboratory, collected specimens were preserved in formaldehyde solution to maintain their structural integrity. Identification of the fungi was facilitated using authoritative taxonomic resources, including "Fungi of Temperate Europe Volume 1 and 2" by Laesse and Peterson (2019) for recognition of Basidiomycetes fungi, as well as "Mushrooms: How to Recognise and

Gather Wild Mushrooms and Other Fungi" [7,8] and "Mushrooms of Britain: An Identification Guide to Mushrooms of Britain and Northern Europe". Additionally, relevant study papers, identification guides, books, and other scholarly resources were consulted for comprehensive identification.

Fungi were discovered across a variety of substrata, including soil, cow dung, and tree trunks, indicating their diverse ecological niches within the study area.

## RESULT AND DISCUSSION

A key in taxonomy helps in the identification of unknown species of organisms based on complementary characters of any plant or animal kingdom. It distributes basic characters on the basis of which one can get the taxonomic position of an unknown organism. Here in bellow are general characters and identification keys from different orders of Basidiomycetes are given with photo plates of each:

### Order: Agaricales

Gilled mushrooms comprise a very large group of macro fungi. They are characterized by having gills under the cap, always held in the vertical position. Most speices also have a stem is reduced or absent. *Spore colour* : The colour of spore deposits is a key character for dividing the gilled mushrooms into manageable groups; white, cream and yellow or brownish, rose-brown to black. In addition, a few species have green or lilac spore-deposits. *Veil*: In some agarics the gills develop freely-a naked development. Others have a protecting tissue over the young gills-a partial veil. Some have the entire fruitbody covered in a universal veil. The partial veil is seen as a ring on the stem at maturity, Volva at the stem base. *Gill attachment*: The gills may be free, adnexed, adnate, emarginated or decurrent *Microscopical characters*: Agarics have cystidia on the stem (caulocystidia), cap surface (pileocystidia) or on the gills. The gill cystidia are divided into those in the hymenium (pleurocystidia) and those on the edges (cheilocystidia) [9].

Agaricaceae Family fungi found from Dharampur and Kaprada are described in this Table 1. 45 Species are found from dharampur and Kaprada. Name of the Village from where they are found and Substratum are also described.

**Table 1.** Agaricaceae family in Dharampur and Kaparada Taluka's of Valsad District

S.N.	Scientific Name	Name of Village	Substratum
1	<i>Cystolepiota hetieri</i>	Nandigram	Soil, Cow dung
2	<i>Cystolepiota icterina</i>	Arnai	Soil
3	<i>Cystolepiota seminuda</i>	Khoba	Soil
4	<i>Lepiota brunneoincarnata</i>	Jagir Bhavada	Soil, Sandy Soil
5	<i>Lepiota castaneidisca</i>	Zariya	Sandy Soil
6	<i>Lepiota cristata</i>	Nandigram	Sandy Soil
7	<i>Lepiota erminea</i>	Manaichauti	Soil
8	<i>Lepiota felina</i> (Pers.) P. Karst.	Zariya	Soil
9	<i>Lepiota haroonabadensis</i>	Gomatipada	Soil
10	<i>Lepiota ignivolvata</i> Bousset & Joss. ex Joss.	Veri Bhavada	Soil
11	<i>Lepiota lilacea</i> Bres.	Zariya	Cow dung
12	<i>Lepiota magnispora</i> Murrill.	Lakadmad	Soil
13	<i>Lepiota procera</i> (Scop.)	Kasda	Soil
14	<i>Lepiota subincarnata</i>	Aavdha	Soil or dead leaves
15	<i>Lepiota tomentella</i>	Gadi	Soil or dead leaves
16	<i>Leucocoprinus birnbaumii</i>	Tutarkhed	Soil
17	<i>Leucocoprinus brebissoni</i>	Zariya	Soil
18	<i>Macrolepiota excoriata</i> (Schaeff.) Wasser	Zariya	Soil

19	<i>Macrolepiota mastoidea</i> (Fr.)	Mamabhacha	Sandy Soil
20	<i>Macrolepiota procera</i> (Scop.)	Ganva	Soil
21	<i>Chlorophyllum brunneum</i> (Farlow & Burt) Vellinga	Nandigram	Soil
22	<i>Chlorophyllum molybdites</i>	Chavshala	Soil
23	<i>Chlorophyllum rhacodes</i>	Veri Bhavada	Soil
24	<i>Agaricus bohussii</i>		Soil, dead leaves
25	<i>Agaricus brunneolus</i>	Manai chauti	Soil
26	<i>Agaricus californicus</i>	Aavdha	Soil
27	<i>Agaricus cupreobrunneus</i>	Aavdha	Soil
28	<i>Agaricus dulcidulus</i>	Veri Bhavada	Cow dung
29	<i>Agaricus flavistipus</i> Atri	Aavdha	Soil
30	<i>Agaricus langei</i>	Bhuvada	Soil, dead leaves
31	<i>Agaricus parvitiginus</i>	Zariya	Soil
32	<i>Agaricus phaeolepidoytus</i>	Zariya	Soil, dead leaves
33	<i>Agaricus stellatus-cuticus</i>	Veri Bhavada	Soil
34	<i>Agaricus subfloccosus</i>	Gadi	Cow dung
35	<i>Agaricus subrutilescentes</i>	Chokhar	Soil
36	<i>Leucoagaricus melanotrichus</i>	Arnai	Soil, Sandy Soil
37	<i>Leucoagaricus meleagris</i> (Gray.)	Mandva	Decomposed matter
38	<i>Leucoagaricus nympharum</i> (Kalchbr.)	Panas	Soil
39	<i>Leucoagaricus sericifer</i> (Locq.)	Mandva	Soil
40	<i>Bovista aestivalis</i> (Bonord.)	Samarsingi	Soil, Sandy Soil
41	<i>Bovista nigrescens</i>	Gundiya	Soil
42	<i>Bovista paludosa</i>	Nandigram	Soil
43	<i>Bovista pusilla</i>	Aavdha	Sandy Soil
44	<i>Lycoperdon molle</i> Pers.	Panas	Soil
45	<i>Lycoperdon utriforme</i> Bull.	Gundiya	Soil

Total 45 Species of Agaricaceae Fungi were observed and described from Dharampur and Kaprada during field visits. Similar observations for Basidiomycetes in Nandigram area [10].

### Identification Key of Agaricaceae Family

#### Family : Agaricaceae

Finely wide variety of mushrooms-spore color varies and sizes range from tiny species of *Leucocoprinus* to huge parasols in the genus *Macrolepiota*. However, all family members have free gills and most have a distinct ring on the stem. Only rarely does the stem have any kind of sac-like structure at its base.

#### Genus : *Cystolepiota*

Small lepitoids with the cap covered in a powdery layer from the universal veil. Often with powdery stems, sometimes denate at the margin or with an annular zone. The powder typically consists of globose cells. The spores are non-dextrinoid. They are decomposers that prefer mull-rich soils in scrub and forests.

#### Genus : *Lepiota*

Small to medium-sized agarics with free gills and white spore-deposits. The cap surface is cracking from the margin, but has a smooth centre. Many species have veil remnants in the form of a ring or girdles on the stem. The spores are dextrinoid. Many species are toxic.

**Genus : *Leucocoprinus***

Rather small; thin-fleshed; with ring, mostly with plicate margin.

**Genus : *Chlorophyllum***

Genus of large, lepiotoids with complex, loose, muff-like rings and reddening flesh. The spores are dextrinoid, thick-walled and the germ pore lacks a cap. One species occurs in dry grasslands.

**Genus : *Macrolepiota***

Very large fruitbodies with a loose ring. The flesh is non-staining or somewhat yellowing or reddening. The stems often have a distinct snake-skin pattern. The spores are dextrinoid, thick-walled and have a covered germ pore.

**Genus : *Agaricus***

Has free gills, a partial veil as stem rings and chocolate-brown spore-deposits. Genera such as *Coprinellus*, *Coprinopsis* and *Coprinellus* share some of the characters but their gills dissolve at maturity. The **royals**, including “the prince”, are recognized by their fleshy fruitbodies, aniseed-like smells and a slowly yellowing reaction when bruised.

**Genus : *Leucoagaricus***

Small to medium-sized; mostly with well-defined, muff-like ring.

**Genus : *Bovista***

Small, puff-ball like fruitbodies that open via a pore at the top. The outer peridium is normally shed at maturity. The capillitium is mainly branched, flexible and has thin, pointed ends.

**Genus : *Lycoperdon***

Small to medium-sized fruitbodies that open via a pore at the top or through decay of the upper part of the peridium. Typically have spongy tissue in the stem, which is solid in *Apioperdon*. Capillitium of branched, but not particularly pointed hyphae.

***Cystolepiota hetieri***

Medium sized, very powdery, whitish to rose lepiotoid with slightly yellow tinted, free gills. The flesh and surface redden when bruised and with age. The spores measure  $4.5-6 \times 2-3 \mu\text{m}$ . Occurs on mull, mainly in deciduous forests and scrub. Rather rare, but locally fairly common, decreasing towards the north; mainly August-November.

***Cystolepiota Icterina***

Rather small, pale sulphur-yellow, powdery lepiotoid with yellowish, free gills. The stem becomes reddish towards the base with age. The spores are dextrinoid and measure  $3.5-5.5 \times 2.5-3 \mu\text{m}$ . Grows on mull, mostly in thermophilic, calcareous deciduous forests. Other yellow lepiotoids do not have a layer of powder or spherical cells on the cap. August-November.

***Cystolepiota Seminuda***

Small, slender, very powdery, white to somewhat pink lepiotoid. The gills are white to yellowish, and free. The stem powder disappears with age to reveal a reddish colour. Cap margin dentate fro veil when young. The spores are smooth, iodine inert and measure  $3.5-5.5 \times 2-2.5 \mu\text{m}$ . On mull soils or heavily decomposed wood on the rich soil in deciduous and mixed forests. Widespread and rather common; July-November.

***Lepiota Brunneoincarnata***

Rather fleshy, but not very large, short-stemmed, rather dark red-brown *Lepiota* with dark, red-brown to wine-red girdles on the lower half of the stem, but no true ring. It has clamps and the cap

cuticle cells are of different lengths. The dextrinoid, almond-shaped spores measure  $7-10 \times 4.5 \mu\text{m}$ . Occurs on mull soils in gardens, scrub and deciduous forests. July-November.

#### ***Lepiota Castaneidisca***

Rather slender, red-brown, appressed-scaly *Lepiota* that lacks an evident ring but has well developed red-brown girdles below the ring zone. The gills discolour orange with age. Smells of cedar wood. The cap cuticle has long elements that are 2-4 celled. The bullet-shaped spores measure  $7-14 \times 3-5.5 \mu\text{m}$ . Occurs on rich, mostly somewhat disturbed soils along roadsides or in deciduous and coniferous forests, etc. rather common and widespread; July-December.

#### ***Lepiota cristata* Figure 2. (b)**

Medium-sized, rather pale *Lepiota* with an orange-brown cap cuticle that splits to reveal the pale flesh. The stem has a evident, loose ring, but the veil may also adhere to the cap margin. The odour is unpleasant metallic or gas-like. The cap cuticle is a hymeniderm of short, pear-shaped cells. The dextrinoid spores are bullet-shaped and measure  $5.5-8.5 \times 2.5-3.5 \mu\text{m}$ . On disturbed soil along roads, both in rather open habitats and forests and gardens. Common and widespread; June-November.

#### ***Lepiota erminea* Figure 2. (f)**

Medium-sized *Lepiota* with whitish colours except for the brownish cap centre. The cap has a pale remnants of veil at the margin, while the stem is floccose below a evident, floccose ring. The fusiform, dextrinoid spores measure  $10-20 \times 5.5-7 \mu\text{m}$ . Occurs in sandy grassland and dunes. Rather common and widespread; July-November.

#### ***Lepiota Felina***

Rather small to medium-sized *Lepiota* with dark scales that contrast with the white flesh. It has a well-defined ring that is dark on the underside and margin. The cap centre is almost black. The ellipsoid spores measure  $6-8.5 \times 4-5 \mu\text{m}$ . Occurs on needle debris on the rich soil, but occasionally in deciduous forests, e.g. on very decomposed wood. Widespread and fairly common; mainly August-November.

#### ***Lepiota Haroonabadensis***

*Pileus* 2.1-4 cm diam, initially plano-convex with margin becoming revolute on maturity, light yellowish orange, with dark brown central disk and with brown squarrose scales, denser at central disc and becoming sparse towards margin; surface dry and dull; appendiculate margin becoming undulate on maturity. *Lamellae* free, creamy white, close, wavy, with even concolorous edge; 2 tiers of lamellulae. *Stipe*  $1.3-4.2 \times 0.3-0.6 \text{ cm}$ , bright yellowish from upper half and yellowish red from lower half, central; equal; with yellow spiny scales under the annular zone, becoming scattered towards the base, surface dry and dull; base slightly bulbous. Basidiospores thick-walled, ellipsoid.

#### ***Lepiota Ignivolvata***

Large, rather pale *Lepiota* with an orange-brown cap centre and a similarly coloured ring. The stem base stains orange-brown with age and after picking. The cap cuticle has long tapering elements. The dextrinoid, almond-shaped spores measure  $8.5-11 \times 5-6 \mu\text{m}$ . Occurs on mull soils in thermophilic sites in deciduous or mixed forests. August-October.

#### ***Lepiota Lilacea***

Rather small *Lepiota* with brown cap scales and a muff-like ring with a greyish-violet underside. It has a sweetish smell. The dextrinoid, ellipsoid spores measure  $4-6.5 \times 2.5-4 \mu\text{m}$ . Occurs on disturbed soils, e.g. in mulched beds in city parks, gardens, etc. mainly April-October.

#### ***Lepiota Magnispora***

large, apricot-orange *Lepiota* with yellow-brown tinted, floccose girdles on the stem. The

dextrinoid, fusiform, sway-backed spores measure  $13-25 \times 4-6 \mu\text{m}$ , and the apiculus is almost lateral. Occurs on mull soils amongst leaf-litter in both deciduous and coniferous forests. Rather common and widespread; July-November.

***Lepiota Procera* Figure 2. (c)**

At the early stages of development the basidioma looks much like a large brown drumstick; a long and hard stem grows progressively taller having the cap closed like a ball or an egg at top. 10-30(-45) cm wide when fully expanded, initially hemispherical or egg-shaped, then opens to become hemispherical, convex, finally plane with uplifted margin, flat at the centre or somewhat projecting to a shallow umbo; the skin is initially almost uniformly dark brown, soon breaking into upturned scales that look like roof-tales on a whitish or cream background, while at the centre remains unbroken. The margin of the cap is strongly denticulate and exceeding the gills, hanging. *Lamellae* free and attached to a collar around the stem, crowded, white at first and turning greyish cream, finally brown spotted. *Stipe* 10-30(-40)  $\times$  1-2(-4) cm, cylindrical but with a bulbous swollen base, hollow, fibrous and very firm; when young the surface is uniformly brown, but soon disrupts into snake-skin-like zig-zag markings revealing paler greyish cream background, the bulbous base is covered by rich white woolly mycelium. The ring is very conspicuous and large, double, white above and brown below, loosening from stem and easily moving up and down. The stem with some care can be pulled out of the cap without any damage of both parts. *Habitat* grows solitary or in small groups. Appears within woods, in clearing paths, but it prefers grassy places especially well-manured grass.

***Lepiota Subincarnata***

Rather small, fleshy, fleshy-pink to brownish-rose *Lepiota* with a scaly cap, and the stem has girdles below a narrow, brownish red ring. The dextrinoid, almond-shaped spores measure  $6-7.5 \times 3-4 \mu\text{m}$ . The cap cuticle has up to about 200  $\mu\text{m}$  long, tapering cells. Occurs on mull soils in gardens, scrub and forest edges – not especially demanding. Widespread and occasional to rather common. August-November.

***Lepiota Tomentella***

Small, pale brown, finely scaly *Lepiota* with rather indistinct, pale brown girdles on the stem and no ring. Has long, multicellular hairs in the cap cuticle. The dextrinoid spores are bullet-shaped and measure  $7-9.5 \times 3-4 \mu\text{m}$ . Occurs on calcareous, light soils in coastal thorny thickets, in deciduous forests, etc. mainly August-October.

***Leucocoprinus Birnbaumii***

Bright yellow *Leucocoprinus* with a grainy scaly cap surface and a somewhat clavate, widened stem and a muff-like ring. The cap cuticle is complex with elements of numerous dimensions and shapes. The dextrinoid, thick-walled spores measure  $8-12 \times 5-9 \mu\text{m}$ . Tropical species, mostly known from greenhouses and potted plants; very rare in the wild. Occasional; all year indoors.

***Leucocoprinus Brebissoni***

Pale *Leucocoprinus* with a dark brown cap centre surrounded by concentric rings of brown scales. The margin is furrowed-floccose. The stem ring is white and muff-like. The dextrinoid spores measure  $8.5-13 \times 5-8 \mu\text{m}$ . Occurs on rich, disturbed soils in forests and parks, but also in greenhouses, etc. Mainly June-November.

***Macrolepiota Excoriata***

Small, very pale *Macrolepiota* species. The cap is fibrillose-scaly, somewhat brownish on the umbo and becomes almost white towards the edge. The ring is white, loose and muff-like. The stem surface is finely felty, but lacks a distinct snakeskin pattern. The spores measure  $11-17 \times 8-11 \mu\text{m}$ . Occurs in dry grassland and is not very demanding. Rather common and widespread; June-November.

***Macrolepiota Mastoidea***

Large, elegant, distinctly umbonate, rather pale brown *Macrolepiota* with a smooth, brown cap

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centre and flaky/patchy scales radiating outwards. The stem has a pale snakeskin pattern on an even paler background and carries a loose, muff-like, double ring. The flesh stains slightly yellow or Red. The dextrinoid spores and measure  $11-18 \times 7.5-12 \mu\text{m}$ . Occurs on open forests or in dry, open habitats, but rarely in sand dunes. Widespread and common; June-november.

#### ***Macrolepiota Procera***

Very large, stately *Macrolepiota* with a distinct brown snakeskin pattern on the stem and a very large, muff-like, complex double ring. The umbonate cap has concentric, brown recurved scales. The gills are free and cream or have a pink tinge. The flesh only reddens slightly in the stem cortex. The dextrinoid spores have a small and measure  $5-18 \times 8-12 \mu\text{m}$ . Found mainly in sandy, open places, e.g. in coastal grasslands, including old dunes. Widespread and rather common; June-November.

#### ***Chlorophyllum Brunneum***

Constrasty *Chlorophyllum* with a very brown cap centre and scattered, coarse scales that radiate outwards, revealing the white flesh underneath. The ring is loose, muff-like, thick and brown underneath, but not distinctly double. The flesh is reddening, as is typical for the genus. The dextrinoid spores measure  $10-12 \times 7-8.5 \mu\text{m}$ . Occurs on disturbed, rich soil, e.g. old compost in gardens and parks, rarely in forests. Mainly June-November.

#### ***Chlorophyllum molybdites* Figure 2. (g)**

*Chlorophyllum* with olive-green gills and spore deposit. The ring is loose and double. The spores measure  $9-11 \times 7-8 \mu\text{m}$ . Summer-Autumn.

#### ***Chlorophyllum Rhacodes***

Very constrasty *Chlorophyllum* with large, coarse cap scales. The ring is loose, muff-like and distinctly double with a greyish, felty underside. The stem base is onion-shaped. The flesh reddens, as is typical for the genus. The cheilocystidia are almost balloon-shaped and measure  $10-35 \times 8-25 \mu\text{m}$ . The dextrinoid spores measure  $9-12.5 \times 5.5-8 \mu\text{m}$ . Occurs on disturbed soil in gardens, scrub, parks and forests. Rather common and widespread; June-December.

#### ***Agaricus Bohusii* Bon**

Distinctly clustered and rooting species with a brown, densely scaly cap surface. The scales are pointed and recurved. The tapering and strongly rooting stem has brownish tinges and a thick, upwards-sheathing ring. The flesh reddens to some extent but may also stain somewhat yellow. Has cheilocystidia and 4-spored basidia. The spores measure  $5.5-7 \times 4.5-6 \mu\text{m}$ . Occurs on disturbed soil in parks. Mainly June- November.

#### ***Agaricus Brunneolus* Figure 2. (e)**

Giant among the dwarfs, with a relatively compact and fleshy fruitbody, purple, hair-like scales on the cap and a thin, hanging, white stem ring. The flesh smells aniseed-like and yellows, particularly at the stem base, which is clavate and typically about 10mm wide. The spores measure  $5-6 \times 3.5-4 \mu\text{m}$ . Occurs on rich, often clay soils in both deciduous and coniferous forests. Widespread but occasional to rather rare; June-November.

#### ***Agaricus Californicus***

Carpophores 2.2-4 cm height, campestrid. Pileus convex when young, appalunate at maturity, 2.5-4.6 cm broad; umbo absent; surface moist, white when young reddish white at maturity; margin irregular reflexed; cuticle fully peeling, not extending beyond the gills; flesh pinkish white, changing to brown on exposure; taste spicy; odour mild. Pileal veil floccose along the margin. Lamellae free, unequal, subdistant, broad up to 0.7 cm broad, pinkish white when young, turn to flesh coloured then to greyish brown and finally dark brown at maturity, lamellae edges smooth. Spore deposit dark brown. Stipe central, 1.8-3 cm long, 0.5-0.6 cm broad, cylindrical, equal in diameter through, concolourous with pileus, hollow, smooth, annulate, annulus single, superior, membranous.

### ***Agaricus Cupreobrunneus***

Red-brown, appressed scaly/hairy, rather small, compact *Agaricus* with a floccose, pale cap margin and a somewhat tapering stem that lacks a hyphal cord. The stem ring is white, floccose and upwards-sheathing and the flesh is slightly reddening. The odour is sour. The spores measure  $7-10 \times (4-)5-6 \mu\text{m}$  and have a germ pore. Occurs in dry grassland, including dunes. August-November.

### ***Agaricus Dulcidulus* Figure 2. (a)**

Dwarf, with yellowing flesh and an aniseed-like smell. The cap fibres are distinctly tinged wine-red, especially near the cap centre. The stem ring is rather narrow, thin and hanging. The spores measure  $5-6 \times 3.5-4 \mu\text{m}$ . Occurs on soil and litter, mostly on disturbed mull soils along road verges in forests, but also as fairy rings on needle debris and in lawns. Widespread and rather common; June-December.

### ***Agaricus Flavistipus* Atri**

This *Agaricus* species are campestroid structure; pileus applanate, margin neither splitting nor appendiculate, with radial folds; pileus context unchanging; stipe bruising bright yellowish then brown; gill edges serrate, sterile with claviform to clavate; cheilocystidia and Carpophore 4.7 cm in height, campestroid. Pileus 7.2 cm broad, applanate, with depressed brown apex, exumbonate; surface dry, scaly, scales reddish brown on white background, appressed fibrillose, arranged to form concentric pattern on the surface, more aggregated along the apex; margin regular, not splitting, non-striate, non appendiculate, with radial folds; cuticle fully peeling Lamellae free unequal.basidiospores  $6-7.6 \times 4.3-5 \mu\text{m}$  in size.

### ***Agaricus Langei***

Rather large, appressed, buffish, scaly *Agaricus* with strongly reddening flesh and cap surface when bruised. The stem is smooth and bears a large, thin ring; the base is widened. The cheilocystidia are almost balloon-shaped, one-celled, and  $10 \mu\text{m}$  wide. The spores measure  $5-9 \times 3.5-6 \mu\text{m}$ . Occurs on mull soils, mainly deciduous forests. Widespread and common; April, June-January.

### ***Agaricus Parvitiginus***

Carpophores 3.1-8.5 cm in height, placomycetoid. Pileus convex while young, planoconvex to expanded at maturity with low to a flat umbo, 1.5-6 cm broad, surface white with greyish brown to blackish grey centre, moist, scaly, scales breaking up into appressed fibrillose squamules, covering the entire pileus, margin irregular, incurved in young, slightly extending beyond the gills and splitting at maturity; cuticle fully peeling; flesh 0.5-0.7 cm thick, white, changing to yellowish white on exposure; taste and odour spicy. Pileal veil white, cog-wheel very clear when young. Lamellae free, unequal, not in series, crowded, narrow, pinkish white when young, greyish brown at maturity, unchanging on exposure where bruised; gill edges smooth. Stipe central, 2.8-8.0 cm long, up to 0.6 cm broad at apex, up to 1 cm broad at the base, distinctly bulbous base with rhizomorphs and a white mycelial mat; stipe off white to yellowish white changing to brownish grey on handling, base turning turmeric yellow on injury or exposure; annulate, annulus white, single, present as a cog wheel in young fruit bodies, superior to median finally evanescent in mature carpophores, with scaly undersurface, scales greyish brown.

### ***Agaricus Phaeolepidoytus***

Medium-sized *Agaricus* with small, adpressed, hair-like, pinkish –buff to grey-brown cap scales. The smooth stem has a large double ring. The stem base especially stains somewhat yellow when bruised or cut. The stem surface may turn brown or redden somewhat. The odour is ink-like. The spores measure  $4.5-6 \times 3-4 \mu\text{m}$ . Occurs on calcareous, light soils in gardens, scrub and forests. July-November.

### ***Agaricus Stellatus-cuticus***

This *Agaricus* species has a unique radial splitting of chocolate brown pileus cuticle which extends

all around uniformly from the margin towards the pileus center. Carpophore 5 cm in height, campestroid. Pileus 4 cm broad, appanate with slightly raised apex; surface dry, scales appressed fibrillose, aerolate in the center, covering the entire pileus surface, chocolate brown; cuticle radially splitting from margin towards the pileus center thereby exposing the white flesh underneath giving stellate appearance to the cuticle on the pileus surface; margin irregular, radially splitting along the split pattern of the cuticle, non-striate, extending beyond the gills, upturned, appendiculate; flesh thin, up to 0.3 cm thick in the center. Lamellae free, unequal. It differs from the other *Agaricus* Species in both pileus and stipe context lacking color changes when cut or bruised, pileal scales aerolate in the center, gill edges sterile, taste and odor mild and basidiospore  $6.8-7.6 \times 4.3-5(6) \mu\text{m}$  in size.

### ***Agaricus Subfloccosus***

Medium-sized, non-rooting, brown, appressed-scaly *Agaricus* with reddening, sour smelling flesh and a thick double ring with an upwards-sheathing part. The basidia are 4-spored. The spores measure  $5.5-7.5 \times 4-6 \mu\text{m}$ . Occurs in parks, gardens and deciduous forests, on rich, disturbed soils. Mainly May-October.

### ***Agaricus Subrutillescentes***

Carpophores 2.8-6.3 in height, placomycetoid. Pileus convex, 1.9-4.8 cm broad, broadly umbonate, white to light yellow where bruised, surface moist, scaly, scales covering the entire cap, more concentrated in the centre reddish brown; margin irregular, changing from creamish to somewhat slightly pinkish; cuticle fully peeling; flesh up to 0.4 cm thick, white, unchanging; taste and odour mild. Pileal veil appendiculate, white, Lamellae free, unequal, narrow; dull red in immature carpophores, grayish brown in mature carpophores; gill edges smooth. Spore print dark brown, Stipe central, 2.5-5.9 cm long, upto 0.7 cm broad, cylindrical, white, pale yellow on bruising; smooth above the annulus, scaly below, scales fibrillose, velvety, white; annulate, annulus membranous, superior. Basidiospore ellipsoid, dark brown, double walled.

### ***Leucoagaricus Melanotrichus* var. *Septentrionalis*. Figure 2. (h)**

Rather small, thin-fleshed, finely black-haired *Leucoagaricus*. The stem has a small, rather ephemeral, dark-edged muff-like ring with dark hairs below. The flesh stains reddish-brown when bruised. Lacks clamps. The somewhat thick-walled, non-dextrinoid spores measure  $5.5-7.0 \times 3.5-4.5 \mu\text{m}$ . Occurs in scrub, deciduous and coniferous forests, on litter or very decomposed wood. Mainly September-October.

### ***Leucoagaricus Meleagris***

Rather large, clustered *Leucoagaricus* with small, dark red brown scales that create a dark brown umbo; the flesh stains yellow and then red. Cap surface red. The stem has small, dark scales and is cylindrical to fusiform and may have a small, dark ring. Spores thick-walled, ellipsoid,  $(7.5-8-10(-11.5) \times (5.5-6-8) \mu\text{m}$ . Cap surface with very narrow, pointy elements. On composting wood chips, etc. Very rare and meteoric; mainly July-October.

### ***Leucoagaricus Nympharum***

Magnificent, large *Leucoagaricus* with recurved, pale grey to somewhat darker grey-brown scales and a complex, loose, muff-like ring. The stem base is widened. The cap centre is wide, smooth and greyish. The flesh stains somewhat yellow, and later brown. The cheilocystidia are large and rather variable. The dextrinoid spores measure  $8-12 \times 6-8 \mu\text{m}$ . Occurs on needle debris on rich soils, including on anthills. Rather common and widespread; May-December.

### ***Leucoagaricus Sericifer***

Small, almost completely white *Leucoagaricus* with a rather narrow, muff-like ring situated below the middle of the stem. The cap centre may be somewhat buff. The cheilocystidia are very variable, lageniform and lack crystals. The narrowly almond-shaped to fusiform, dextrinoid spores measure  $6-9.5 \times 3-5 \mu\text{m}$ . Mostly on light, calcareous soils in scrub and forests. Rather rare and local; Autumn.

***Bovista Aestivalis***

Pear-shaped puff-ball with obvious and extensive yellow-brown sterile tissue at the base, and tiny convergent spines or granules on the peridium. The base of fruitbody is often tinged orange. Spores spherical, lack sterigamal remnants, finely ornamented and measure 3.5-4.5  $\mu\text{m}$ . Occurs in dry grassland or in warm sites in open forests. Widespread, occasional, mainly September-October.

***Bovista Nigrescens***

Large, at maturity smooth and dark brown puffball that has a somewhat irregular opening. The warty spores measure 4-6  $\mu\text{m}$  and have a straight to slightly curved sterigamal remnant that is up to 10  $\mu\text{m}$  long. Typically found in fertilized grassland, often together with species of *Agaricus*. Widespread and common; mainly June-October, but may be found year-round.

***Bovista Paludosa***

Medium-sized, gummy to smooth, eventually grey-brown puff-ball with compact, grey-brown sterile tissue at the base. The fruitbody has a simple opening. The spherical, very finely ornamented spores measure 4-5  $\mu\text{m}$  and have a sterigmal remnant up to 15  $\mu\text{m}$  long. Occurs on rich fens. Late summer-Autumn.

***Bovista Pusilla* Figure 2. (d)**

Small, non-rooting puffball that lacks sterile tissue at the base. When mature, dark-brown with a faint violet tinge and a simple, floccose opening. Spores 4.5-5.5  $\mu\text{m}$  in diameter with a 3-9  $\mu\text{m}$  long sterigmal remnant. Occurs on dry, sandy, calcareous soils. Widespread, rather rare to fairly common; mainly autumn.

***Lycoperdon Molle***

Relatively large, rather pale, short-stemmed puffball with small, grains and small, fragile, convergent spines. The capillitium is elastic with only a few pores. The spores are rather coarsely verrucose and measure 4-4.5(-5)  $\mu\text{m}$  preparations mixed with free sterigmal remnants. Mainly in open forests on rich soils. Widespread, occasional; mainly August-October.

***Lycoperdon Utriforme* Bull**

Very large puffball with a wide stem that becomes scaly with age. At maturity the upper peridium disintegrates to produce a bowl-like fruitbody. The capillitium has comma-shaped pores. The almost spherical to ellipsoid, smooth spores measure 4-5  $\mu\text{m}$ . Occurs in sandy grasslands. Widespread, rather common; mainly June-December, but can be found in weathered condition all year.





**Figure 2.** (a) *Agaricus dulcidulus*, (b) *Lepiota cristata*, (c) *Lepiota procera*, (d) *Bovista pusilla*, (e) *Agaricus brunneolus*, (f) *Lepiota erminea*, (g) *Chlorophyllum molybdites*, (h) *Leucoagaricus melanotrichus*

## CONCLUSION

In conclusion, a comprehensive survey of fungal diversity within the Agaricaceae family in Dharampur and Kaprada Taluka, Valsad District, revealed a total of 45 distinct species. These species encompassed representatives from various genera, including *Cystolepiota* (3 species), *Lepiota* (12 species), *Leucocoprinus* (2 species), *Macrolepiota* (3 species), *Chlorophyllum* (3 species), *Agaricus* (12 species), *Leucoagaricus* (4 species), *Bovista* (4 species), and *Lycoperdon* (2 species).

The observed species predominantly thrived in diverse substrata such as soil, sandy soil, decomposed organic matter, dead leaves, and cow dung, highlighting their adaptability to varied ecological conditions within the study area. This investigation underscores the remarkable fungal diversity present in Dharampur and Kaprada Taluka and contributes valuable insights into the ecological roles and distribution patterns of Agaricaceae fungi within this region.

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