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Identify mushroom species on the basis of morphological characteristics in Mahabaleshwar, Koyananagar and Gaganbawada forests of Maharashtra

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Abstract
The present investigation entitled "Biodiversity of mushroom flora of Mahabaleshwar, Koyananagar and Gaganbawada forests of Maharashtra" was carried out at Plant Pathology Section, College of Agriculture, Kolhapur. This survey was carried out with the object to study biodiversity of mushrooms in forests of Mahabaleshwar, Koyananagar and Gaganbawada to identify mushroom species on the basis of morphological characteristics. Collection and Identification of mushroom specimens was conducted during monsoon season, 2019. The survey was conducted in the forest area of Gaganbawada, Koyananagar and Mahabaleshwar for the collection and Identification of mushroom species during July to October (2019). The collected species has showed different among their morphological characteristics i.e. pileus, stipe, lamellae and basal association, edibility and spore prints. Other characteristics include form of mushroom i.e. single, group or connate (united), smell of mushroom (pleasant or odd smell) and mushroom habitat i.e. on soil, grassland, dung, dead tree trunk or wooden stumps or on plant. The environmental factors like light, temperature, nutrients and relative humidity greatly influence the growth. In nature, 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. The commonly found mushrooms at Gaganbawada, Koyananagar and Mahabaleshwar places are *Marasmius* spp., *Lepiota* spp., *Pleurotus* spp., *Psythrella* spp. and *Termitomyces* spp.
Moreover, outcome of the present investigation is the report on occurrence of 50 mushrooms that are morphologically different, some of them are edible and medicinally important and there is a vast scope for documentation of macro fungi from this region in future. This study provides the baseline information on wild edible mushroom diversity. This is a preliminary and basic work carried out to locate and identify the bio prospects of the existing macro fungi which will pave the way for understanding an elaborate study on this aspect.

Keywords: Mushroom species, morphological characteristics, biodiversity

Introduction
Wild edible mushrooms are considered as healthy food, because their mineral content is higher than that of meat or fish and most vegetables, apart from their nutritional value mushrooms have potential medicinal benefits. Protein content depends on the composition of the substratum, size of pileus, harvest time and species of mushrooms. Mushrooms are one of the best sources of vitamins especially vitamin B, wild mushrooms contain much higher amounts of vitamin D2. The high nutritious value of mushroom helps to fight and cure against diseases like lung cancer, breast cancer, lymphoma, diabetes, etc. The mushrooms like *Grifola frondosa*, *Ganoderma lucidum*, *Ganoderma tsugae*, *Lentinula edodes* have proved to have medicinal properties and can be used to treat many diseases. *Fomes fomentarius* acts as anti-inflammatory and for cauterizing wounds. Recently, medicinal actions of mushrooms studied have included antitumor, immune modulating, antioxidant, radical scavenging, cardiovascular, anti-hypercholesterolemia, antiviral, antibacterial, anti-parasitic, antifungal, detoxication, hepato protective, and anti-diabetic effects (Wasser, 2010) [10]. Herbalists use mushroom to cure allergies, arthritis, bronchitis, gastric ulcer, hyperglycemia, hypertension, chronic hepatitis, insomnia, nephritis, neurasthenia, scleroderma, inflammation and immune system health. Presently medicinal mushrooms are mainly used as dietary supplements or functional food. Nevertheless, they have the potential to become real drugs of traditional and evidence-based medicine.

The total forest cover in India according to the latest Forest Report 2019 is 712,249 sq. km. and this constitutes 21.67% of the India's total geographic area (Forest Survey of India). Mahabaleshwar, Koyananagar and Gaganbawada are located about 1353m, 746m and 980m above from the sea level. The climate at these places is cool and heavy rains are received during the rainy season. The average annual rainfall of Mahabaleshwar, Koyananagar and Gaganbawada is about 6000 mm, 2447 mm and 2000 mm, respectively. Range of wild trees is grown in forest areas of these locations. During the rainy season, there is abundant growth of several kinds of mushrooms.

Efforts need to be made to identify and exploit these mushroom floras for utility as their biodiversity and conservation to strengthen the food security of our country (David, 1990) [2]. Through India has rich macro fungal biodiversity, most traditional knowledge about mushrooms come from the far East countries like China, Japan, Korea, Russia where mushrooms like *Ganoderma Lentinus*, *Grifola* and others were collected and used since time immemorial. Recent reports show a tradition of wild picking for their consumption and sale in the market. However, the ecological data available on some of the taxa is still not enough.

Even though, wild edible mushrooms contribute towards livelihood and economy of the rural and tribal folks, information on their diversity and demand are very limited. It is therefore very important to document the diversity, distribution, abundance and economic value of the edible macro fungi to analyze how seasonality and different habitats influence their distribution.

Material and Methods

The survey was carried out during June to October 2019 in forest areas of Mahabaleshwar, Koyananagar and Gaganbawada. The general techniques were followed for the present study as described by many scientists for identification of mushrooms.

Material

Equipments and other appliances

The tools like hunting knife with stout blade, pad of paper, scale, pencil, field note book, hand lens, camera, scissors, forceps and secateurs, hand gloves, GPS-GIS app etc. were used for collection and Identification of mushroom specimens.

Methodology

Collection of Mushroom Samples A detailed survey was conducted during June to October (2019) in the forest areas of Gaganbawada, Koyananagar and Mahabaleshwar and recorded the morphological variability in the mushrooms population. Spotted mushrooms were inspected in their natural habitats with photographs. The collected fleshy fungi were studied for their macroscopic detail, patterning the habit, habitat, morphology and other phenotypic parameters noted in fresh form.

Morphological observations

Data on the following parameters were recorded for identification of mushrooms specimens:

1. Locality
2. Habitat
3. Type of soil
4. Forest type
5. Size of the fructification
6. Umbo
7. Scales
8. Gills: Color, gills edges, gill attachment, gill spacing
9. Stipes : length, width, color, shape
10. Type of veil
11. Annuls (position)
12. Volva
13. Cap color, cap surface, cap margin, cap diameter
14. Spore print color
15. Individual spore characteristics like shape, size and color

The final identification and classification were done by comparing recorded characteristics of mushrooms with the help of color dictionary of mushroom [Dickinson and Lucas, 1982] [3]

Dates of collection

Locality

The Global Positioning System (GPS) and Geographical Information System (GIS) is a new technology, which provides unequalled accuracy and flexibility of positioning for navigation, surveying. The technology seems to be beneficial to the GPS users in terms of obtaining accurate data up to about 100 meters for navigation, meter-level for mapping and down to millimeter level for geodetic position and which help to determine the exact position of an object on the earth surface in term of geographical coordinates (French, 1996). The GPS technologies have tremendous amount of application in GIS data collection, surveying and mapping. The mobile applications are also available to find correct GPS locations. We also used mobile application to record the exact GPS data.

Habitat

Mushrooms are found in a great variety of habitats, found everywhere, but not all mushrooms are found in all kinds of habitat. Where they grow, such as coniferous forest, oak forest, etc., is the mushrooms' habitat. Some mushrooms develop in only one kind of habitat, such as a bog, a forest, or an open lawn or meadow. Some mushrooms are even more particular than that are associated only with limited number of tree species (sometimes only one type of tree). What they actually emerge from, such as peat, a log, or soil, is the mushrooms' substrate. Forests are an ideal habitat for mushrooms. They also grow along streets, roadsides and rail road. Different terms have been given to signify their habitats. i.e. specimen growing on grasslands are known as "praticolous", on woodland "silvicolous", on wood, woody debris, trees, stumps, rotten or burnt wood "lignicolous", on dung "coprophilous", amongst moss "muscicolous", on the site of bonfire "carbonicolous", in dunes "duensis" and on leaf littre "humicolous". Some species have tendency to grow in circle on grassy land called "fairy rings", when a spore falls on suitable substrates under favorable condition and produces a germ tube which gradually develops into mycelium that grows in all direction (Kaul, 1997) [5].

Photography

Finding and shooting mushrooms can be a great challenge both physically and artistically. Mushroom photography can be dirty like a growing in dung kind of dirty and since mushrooms prefer damp, cool places seeking them out can sometimes be a miserable endeavor. But viewed through a

camera lens when the light is just right, a mushroom can have beauty that goes far beyond its dirtiness. The photographs of mushrooms were captured by using NIKON camera having high resolution lenses. The photos were taken from every angle (side view, top view, down side) to see Pileus, Lamellae, Stipe, Scales, Volva and Annulus clearly.

Laboratory Study

Identification of mushrooms

Identifying mushrooms requires a basic understanding of their macroscopic structure. Most are basidiomycetes and gilled. Their spores, called basidiospores, are produced on the gills. Mushroom identification is based on a combination of macro morphological, physiological characters and ecology. For identifying wild mushrooms, the uses of macro morphological characters are practical. Characters differ depending on group of species, but most wild harvested mushrooms can be distinguished from look-alike species by macro-features of their body form, cap, spore-bearing surface, stipe, veils and smell. Important features include shape, size, colour, ornamentation and texture. After field description, detailed examination at laboratory reveals further essential information for identification. In laboratory, collected specimens were studied under hand lens/microscope where features of gill, spores, stipe and other microscopic features were observed. Different books were also referred to identify them. (Singer, 1986., Kirk *et al*., 2008) [9, 6]. By using some computer or mobile applications we can also identify mushroom. We used one of the applications to identify the mushroom. In recent times, use of molecular biology tools also more emphasized in mushroom identification process.

Morphological studies on size, shape and colour of mushrooms

Pileus

Shape

A pileus is characteristic of agarics, boletes, tooth fungi and some ascomycetes. A mushroom lacking a pileus, that is consisting of just a fertile surface with its back attached to or inter grown with the substrate is said to be resupinate. Pileus can be formed in various shapes and the shapes can change over the developmental cycle of a fungus. It can be conical, umbonate, convex, funnel shaped (infundibuliform), uplifted, umbilicate, flat or even spherical. The pileus is convex during early stages of development. At maturity the convex pilei usually become plane or expanded, campanulate (bell shaped) or umbilicate when it has an abrupt sharp depression, infundibuliform to cyathiform when margin is raised much higher than the centre so that cap resembles a funnel, depressed when centre is irregularly sunken, umbonate when the centre of the pileus is raised in the center. The umbo may have the form of sharp elevation at the centre or it may be rounded or obtuse, occupying a larger part of the disc. When it is irregular or indistinct the pileus is said to be gibbous. Length of pileus is measured by using scale. The margin of the pileus may be entire, irregular or split with or without radial streaks; thin or thick; curved outwards, straight (acute, obtuse, rounded) or inrolled; in the beginning it is often inrolled and later becomes flat. Surface of the pileus is described as dry, moist or viscid. A viscid pileus surface is also variable according to weather conditions. Under ideal conditions viscidity can be easily ascertain the presence of a glutinous coating. The surface may also be leathery (Lentinus), rugulose, corrugated or may even develop cracking.

Colour

Colour is one of the noticeable characters which if not noted often leads to misidentification because many mushroom pigments are highly sensitive to environmental influence. The colour of the pileus may be white, creamy, yellowish, orange, pinkish, greyish, brownish or even the mixture of any of these. Green and blue are less common. Standard colour notations are required for noting the colour. Methuen Handbook of colours by Kornerup and Wanscher (1963) [7] is a standard colour book which is used in world for this purpose.

Lamellae/ hymenium/ gills

The lamellae are thin blades on the underside of the pileus, radiating from the stipe to the margin. Their colour, shape, width, spacing, attachment, depth, forking pattern, presence or absence of lamellulae, taste, etc. are highly variable. Some mushrooms will have pores instead of gills. These are tiny tubes packed closely together forming a sponge layer, on underside of the cap may be smooth wrinkled or veined. Whichever form it takes, this is where the spores are produced.

Gill attachment

The gills may be free or attached to the stipe and accordingly these are described as adnate, broadly adnate, decurrent, sinuate or adnexed, etc. This character is of taxonomic significance at generic level and also in broad groupings while preparing the taxonomic keys. The lentinoid and pleurotoid mushrooms have decurrent type of gills.

Gill colour

The colour of the lamellae ranges from white, yellowish white, pale, pale yellow, pinkish, yellow to ochraceous or even light brown, etc. Colour of the gills at the developmental stage of carpophore provides handy taxonomic tool for segregation of closely allied taxa. Any colour change when lamellae are cut or bruised is also of significance in the taxonomic categorization of mushrooms at species and variety level. Lentinoid and pleurotoid mushrooms are light spored.

Lamellae edges

These may be smooth, serrate, crenate, dentate or even fimbriate. Mostly Termitomyces species show serrate to dentate gill edges. In some species of Macrolepiota, the gill edges are differently coloured than the faces. This is an additional character which helps in easier identification of such species.

Stipe/stem/stalk

A stipe is the stem or stalk-like feature supporting the cap of a mushroom. The stipe is composed of sterile hyphal tissue. Mushroom that have stipes are said to be stipitate. A mushroom with a cap but no stipe is said to be sessile. Some characters of the stipe include its size, shape, colour, position, texture, surface characteristics, presence or absence of veil, etc.

Shape, size and position

The stipe may be equal in diameter throughout (cylindrical), or it may be broad above (clavate) or broad below (obclavate), having bulb at the base (bulbous) or even swollen

in the middle (ventricose). It may even taper down to form a pseudorrhiza whose length and colour may also vary from species to species as in termitophilous mushrooms. The length and width of the stipe should be noted carefully at different levels by using scale. With regard to attachment, the stipe may be central (centre of the pileus), eccentric (slightly away from the centre) and in some cases the pileus is not circular in outline but narrow at one side to a stipe-like point of attachment to the substratum and is called lateral. Many of the lentinoid mushrooms have central to excentric stipe as compared to pleurotoid mushrooms in which the stipe is either excentric or even lateral.

Colour

The colour of stipe varies from white to cream, grey, yellowish, pink, brown to reddish, etc. Some species have same colour as like pileus but in many of them it is different. Any colour change on cutting and bruising is taxonomically important.

Surface

The stipe surface offers a number of valuable taxonomic features. It may be viscid to slimy when moist. If it is dry, it may be glabrous, polished, pruinose, fibrillose or even squamulose. All these characters are needed to be recorded carefully for making proper use in broad taxonomic categorization.

Annulus (veil)

The annulus is basically a skirt-like ring of tissue which encircles the stem of mature mushrooms. The ring is the residue of the veil and the veil is the tissue that joins the stem and the cap before the gills are visible and the fruiting body matures. It should be considered that, all mushrooms do not have a ring. Some mushroom species has a ring or skirt below the cap; this is all that remains of the protective cover for the gills called a veil, which protects the gills when young. As the cap expands or grows, the veil ruptures leaving the skirt like ring on the stem. This can be very obvious in some species and barely visible in others. This part supports the cap of the mushroom and evolved for the purpose of spore dispersal. It grows fast as it can absorb a lot of water. In mature stage they have lost their protective function. Just like the other parts, this plays an important role in identifying mushrooms. The shape, size, changes in colour when bruised and its texture. There is another type of veil occurring in some species called a universal veil. This covers whole mushroom as it emerges from the ground, and as it grows, the veil breaks leaving behind the Volva

Cup/base/volva

The volva is a Cup-Shaped structure which is present at the base of the mushroom, either as a cup like structure or as scaly remnants. All mushrooms do not have a Cup or Volva. This macro feature is important in wild mushroom identification because it is an easily observed, taxonomically significant feature that frequently signifies a member of Amanitaceae. A mushroom's volva is often partially or completely buried in the ground and therefore care must be taken to check for its presence when identifying mushrooms. Cutting or pulling mushrooms and attempting to identify them later without having noted this feature could be a fatal error.

Microscopic features

The Spores

The spores are the propagating structures of mushrooms borne exogenously at the tip of sterigmata in the hymenophore. A mushroom produces spores instead of seeds. Their immobility generally leaves only two ways for fungi to extend their range.

They can grow into an adjoining area or disperse spores or seeds. Most fungal spores are single celled. They can travel beyond the physical limits of their parents into more distant territory. The spores are produced on the gills which are present on the underside of the mushroom. These spores are microscopic and can only be seen under a microscope. However, each mushroom produces hundreds of thousands of spores and this mass of spores is easy to see. The only macroscopic character that concerns the basidiospores in hymenomycetes is the formation of spore print and its colour. Introduction of spore print colour is an important taxonomic criterion (Fries, 1821 and Singer, 1986) [4, 9] and fundamental contribution to the systematics of the Agaricals. While a single mushroom spore can't be seen by the naked eye, a pile of many spores and the colour of a mushroom's spores are able to see, so it is a crucial identification feature. Obtaining a mushroom's "spore print" is therefore an essential step in the identification process.

Spore print technique

The spores lie on the gill surface. Cut off the stem and place the cap, with the gills facing down, on a piece of aluminum foil or white piece of paper or index card or a glass microscope slide. Put a drop of water on the top of the cap to help release the spores. Cover the cap with a paper cup or glass and leave for 2-24 hours, depending on the humidity and the freshness of the mushroom. The spores will fall on the paper, foil or glass, making a spore print pattern. If you don't want to separate the cap from the stem, make a hole in an index card, place the card on a paper cup and slide the stem of the mushroom through the hole until the underside of the cap is resting on the card; then proceed as above. When collecting in the field or woods, you can take along some sheets of aluminum foil in your collecting basket, place the mushroom cap on the foil and enclose it, together with the rest of the mushroom, in the foil. In few hours we can get the spore prints.

Spore colour

Spore colour is an extremely useful character, particularly in the gilled mushrooms. These spores come in a variety of colours. Most spores are some shade of white, pink, cream, brown or black. There are also unusual spore colours like orange, yellow and green. In identifying boletes and gilled mushrooms, it can be very helpful to know the colour of the mushroom’s spores. Since the individual spores are microscopic, to see their colour without using a microscope you have to find or create a situation where there are many spores in the same place. Unlike, the colour of the fruit body, it is relatively constant for each species and is not as susceptible to the environmental influence. The colour of the spores can be noted only in mass by taking the spore prints. 18 Standard colour notations as those of Methuen Handbook of Colour and other publications are available, which should be used to ascertain the exact colour tone of the deposit.

Preservation

The specimen that have been drawn, described, labelled and photographed, are to be preserved. Proper preservation is an essential part of the study of mushroom flora of any locality. In many cases, identification of the specimen is not immediately possible, but with a preserved specimen this can be achieved at a future date. Preserved specimens are also required if it is to be referred to an expert for final determination. Preservation can be achieved by any of the three methods- drying, freeze-drying (lyophilization) and liquid preservation (alcohol, formalin). The specimens should be dried as quickly as possible to avoid putrefaction. It is suggested that fleshy mushroom should be dried in an air oven at moderate temperature or oven a radiator. Ventilation must be provided during the process of drying. Small and delicate specimens may be sun dried or be dried at room temperature. Dried specimen is usually packed in waxed paper or brown paper packet and stored in box. The specimen for museum may be preserved in a distilled water, alcohol and formalin solution.

Results and Discussion

Among the collected specimens, most of the samples have central stipe attachment, some are lateral and few are eccentric. Among the collected specimens majority of spp. found on wooden stump or tree trunk and others were found in soil, humus, dung, pasture. The collected mushroom species has flat, convex, umbilicate, depressed, hemispherical to spherical shape and white to creamish yellow, light brown to dark brown cap colour. They showed morphological variation based on pileus, stipe, lamellae. Some mushrooms are having stipe and some not. *Pleurotus* spp. was found at all forests (Gaganbawada, Koyananagar and Mahabaleshwar) *Tremella* spp. and *Polyporus* spp. was found medicinally useful. The morphology of mushroom can be observed from the photographs.

The mushroom species found in Gaganbawada were *Agrocybe* spp.-1, *Coprinopsis* spp.- 1, *Dacryopinax* spp.-1, *Marasmius* spp.-1, *Pleurotus* spp.-2, *Parasola* spp.-1, *Psathyrella* spp.-1, *Lepiota* spp.-2, *Leucocoprinus* spp.-2, *Stereum* spp.-1, *Temitomyces* spp.-2, *Tremella* spp.-1.

Koyananagar forest is rich in mushroom diversity and the species collected were *Cortinarius* spp.-1, *Leucoagaricus* spp.-1, *Lepiota* spp.-1, *Leptonia* spp.-1, *Marasmius* spp.-2, *Psilocybe* spp.-1, *Pleurotus* spp.-2, *Pluteus* spp.-1, *Polyporus* spp.-2, *Psathyrella* spp.-2, *Stereum* spp.-1, *Termitomyces* spp.-1, *Volvariella* spp.-1.

The Mushroom species found in Mahabaleshwar were identified by morphological characteristics and named as *Leucoagaricus* spp.-1, *Chlorophyllum* spp.-2, *Bolbitius* spp.-1, *Ramariopsis* spp.-1, *Cortinarius* spp.-1, *Neolentinus* spp.-1, *Hygrocybe* spp.-2, *Hygrophorus* spp.-1, *Marasmius* spp.-1, *Pleurotus* spp.-1, *Lentinus* spp.-1, *Coprinellus* spp.-1, *Coprinopsis* spp.-1, *Psilocybe* spp.-1.

Table 1: Proforma for identification of collected mushrooms

Sr. No.	Specimen No.	GPS data	Location	Habitat	Cap Colour	Cap diameter (cm)	Cap Shape	Stipe Attachment	Stipe Size & Length (cm)	Identification
1	K-19/01	La-16°30'52.3"N Lo-73°53'43.4"E	Borbet	Humus	Light brown	16.0	Funnel	Central	4.3, 11.7	*Termitomyces* spp.
2	K-19/02	La-16°31'19.3"N Lo-73°53'58.6"E	Borbet	Wooden stump	Orange yellow	0.8	Funnel	Lateral	0.3, 1.8	*Dacryopinax* spp.
3	K-19/03	La-16°31'04.5"N Lo-73°53'54.3"E	Borbet	Wooden stump	White	3.2	Fan	Lateral	-	*Schizophyllum* spp.
4	K-19/04	La-16°30'48.2"N Lo-73°57'17.0"E	Baveli	Wooden stump	White	16.8	Fan	Lateral	-	*Pleurotus* spp.
5	K-19/05	La-16°31'01.1"N Lo-73°54'05.5"E	Borbet	Humus	White	5.1	Flat	Central	2.4, 5.3	*Leucocoprinus* spp.
6	K-19/06	La-16°32'24.5"N Lo-73°50'59.8"E	Katali	Wooden stump	Brown	4.2	Funnel	Lateral	0.3, 4.0	*Stereum* spp.
7	K-19/07	La-16°31'22.4"N Lo-73°54'33.7"E	Borbet	Humus	Light brown	5.7	Conical	Central	0.4, 6.6	*Lepiota* spp.
8	K-19/08	La-16°32'29.5"N Lo-73°50'52.8"E	Katali	Trees	White	5.3	Depressed	Central	0.4, 3.3	*Marasmius* spp.
9	K-19/09	La-16°30'22.3"N Lo-73°54'02.4"E	Borbet	Soil	Creamy white	24.7	Hemispherical	Central	3.5, 15.5	*Termitomyces* spp.
10	K-19/10	La-16°32'47.9"N Lo-73°49'46.9"E	Gaganbawada	Wooden stump	White	5.3	Fan	Lateral	-	*Pleurotus* spp.
11	K-19/11	La-16°30'57.9"N Lo-73°57'34.7"E	Baveli	Wooden stump	White	4.7	Convex	Central	0.2, 6.8	*Parasola* spp.
12	K-19/12	La-16°34'58.9"N Lo-73°54'45.8"E	Palsambe	Wooden stump	White	8.4	Flat	Eccentric	1.0, 5.0	*Psathyrella* spp.
13	K-19/13	La-16°34'57.8"N Lo-73°53'41.1"E	Palsambe	Dung	Brown	6.2	Flat	Central	0.4, 14.4	*Coprinopsis* spp.
14	K-19/14	La-17°23'05.1"N Lo-73°44'42.1"E	Gokul	Soil	Yellow	7.8	Flat	Central	0.3, 5.8	*Psathyrella* spp.
15	K-19/15	La-17°23'40.3"N Lo-73°44'15.7"E	Koyananagar	Soil	Creamy white	20.3	Hemispherical	Central	3.2, 14.5	*Termitomyces* spp.
16	K-19/16	La-17°23'35.8"N Lo-73°44'03.7"E	Helwak	Trees	Creamy white	38.7	Fan	Lateral	-	*Pleurotus* spp.
17	K-19/17	La-17°23'08.7"N Lo-73°44'41.5"E	Gokul	Dung	Brown	1.4	Spherical	Central	0.6, 1.2	*Cortinarius* spp.
18	K-19/18	La-17°23'48.0"N	Rasati	Trees	White	5.8	Convex	Central	0.2, 3.3	*Marasmius* spp.

		Lo-73°45'21.7"E								
19	K-19/19	La-16°33'31.0"N Lo-73°56'37.2"E	Sheloshi	Wooden stump	White	-	Irregular	-	-	*Tremella* spp.
20	K-19/20	La-16°31'18.0"N Lo-73°54'48.2"E	Garivade	Soil	Yellow white	9.3	Umbilicate	Central	0.5, 9.2	-
21	K-19/21	La-17°23'45.4"N Lo-73°44'30.0"E	Koyananagar	Soil	Creamy white	4.6	Umbilicate	Central	0.3, 3.9	*Leucoagaricus* spp.
22	K-19/22	La-17°23'59.3"N Lo-73°44'51.8"E	Humbarli	Soil	White brown	6.1	Convex	Central	0.4, 5.5	*Volvariella* spp.
23	K-19/23	La-17°24'16.7"N Lo-73°44'43.9"E	Humbarli	Trees	Gray brown	7.6	Umbilicate	Central	2.4, 4.1	*Leptonia* spp.
24	K-19/24	La-17°24'06.1"N Lo-73°44'40.0"E	Humbarli	Trees	Yellow brown	6.8	Fan	Lateral	-	*Stereum* spp.
25	K-19/25	La-17°23'36.1"N Lo-73°44'15.1"E	Koyananagar	Trees	Creamy yellow	4.9	Depressed	Central	0.3, 3.9	*Polyporus* spp.
26	K-19/26	La-17°23'38.1"N Lo-73°44'41.1"E	Koyananagar	Humus	White brown	7.8	Convex	Central	0.2, 4.7	*Psathyrella* spp.
27	K-19/27	La-17°23'08.9"N Lo-73°44'58.1"E	Rasati	Humus	White, light pink	6.7	Uplifted	Central	0.3, 6.1	*Pluteus* spp.
28	K-19/28	La-17°22'58.7"N Lo-73°45'05.2"E	Rasati	Trees	Creamy yellow	4.9	Depressed	Central	0.3, 2.8	*Polyporus* spp.
29	K-19/29	La-17°23'32.8"N Lo-73°45'18.0"E	Gadkhop	Humus	White	8.4	Umbilicate	Central	0.2, 3.7	*Marasmius* spp.
30	K-19/30	La-17°23'45.3"N Lo-73°45'28.6"E	Rasati	Trees	White	29.2	Fan	Lateral	-	*Pleurotus* spp.
31	K-19/31	La-17°22'50.5"N Lo-73°45'17.5"E	Rasati	Soil	Cream white	4.7	Conical	Central	0.3, 7.9	*Psilocybe* spp.
32	K-19/32	La-17°23'30.8"N Lo-73°44'11.1"E	Koyananagar	Wooden stump	White pink	6.9	Campanulate	Central	0.5, 4.8	*Lepiota* spp.
33	K-19/33	La-17°55'51.0"N Lo-73°39'06.2"E	Mahabaleshwar	Wooden stump	White	7.4	Umbilicate	Central	0.2, 5.5	*Marasmius* spp.
34	K-19/34	La-17°55'00.4"N Lo-73°39'57.5"E	Mahabaleshwar	Humus	White	3.2	Uplifted	Central	0.4, 3.9	*Leucoagaricus* spp.
35	K-19/35	La-17°56'20.7"N Lo-73°39'32.0"E	Mahabaleshwar	Soil	Red brown	4.4	Conical	Central	0.3, 6.3	*Coprinellus* spp.
36	K-19/36	La-17°54'57.1"N Lo-73°39'59.8"E	Mahabaleshwar	Dung	Yellow brown	3.1	Conical	Central	0.3, 8.2	*Bolbitius* spp.
37	K-19/37	La-17°57'39.4"N Lo-73°39'54.4"E	Mahabaleshwar	Dung	Pink white	2.9	Flat	Central	0.3, 14.6	*Coprinopsis* spp.
38	K-19/38	La-17°56'53.0"N Lo-73°39'49.8"E	Mahabaleshwar	Dung	White pink	6.6	Conical	Central	0.4, 9.6	*Psilocybe* spp.
39	K-19/39	La-17°57'39.0"N Lo-73°39'28.4"E	Mahabaleshwar	lWooden stump	Creamy yellow	9.2	Depressed	Eccentric	0.6, 4.8	*Lentinus* spp.
40	K-19/40	La-17°56'20.1"N Lo-73°40'52.5"E	Mahabaleshwar	Soil	Yellow white	5.1	Spherical	Central	-	*Calvatia* spp.
41	K-19/41	La-17°55'47.0"N Lo-73°43'36.3"E	Mahabaleshwar	Humus	Cream, light yellow	4.9	Depressed	Central	0.6, 5.4	*Hygrocybea* spp.
42	K-19/42	La-17°56'17.9"N Lo-73°40'39.1"E	Mahabaleshwar	Humus	White	7.6	Convex	Central	0.5, 6.3	*Hygrophorus* spp.
43	K-19/43	La-17°56'16.7"N Lo-73°41'20.8"E	Mahabaleshwar	Soil and grassland	Light yellow	3.8	Convex	Central	0.3, 4.9	*Hygrocybe* spp.
44	K-19/44	La-17°55'35.6"N Lo-73°41'11.1"E	Mahabaleshwar	Soil	Light brown	7.9	Convex	Central	2.2, 3.4	*Cortinarius* spp.
45	K-19/45	La-17°55'14.3"N Lo-73°43'29.1"E	Avakali	Soil	White	9.7	Convex	Central	0.8, 6.6	*Chlorophyllum spp*
46	K-19/46	La-17°57'23.0"N Lo-73°40'08.3"E	Mahabaleshwar	Tree trunk, Soil	Yellow brown	10.7	Convex	Central	0.7, 4.3	*Neolentinus* spp.
47	K-19/47	La-17°56'15.8"N Lo-73°41'21.3"E	Mahabaleshwar	Humus	White	-	U shaped forks	-	4.5, 0.3	*Ramariopsis* spp.
48	K-19/48	La-16°32'20.7"N Lo-73°50'46.1"E	Gaganbawada	Dung	Brown	4.3	Convex	Central	0.4, 3.4	*Agrocybe* spp.
49	K-19/49	La-16°32'38.3"N Lo-73°50'47.3"E	Gaganbawada	Soil, humus	Cream white	9.6	Convex	Central	0.5, 5.3	*Lepiota* spp.
50	K-19/50	La-17°57'35.5"N Lo-73°40'08.6"E	Mahabaleshwar	Wooden stump	White	8.7	Fan	Lateral	-	*Pleurotus* spp.

Conclusion

This study provides the baseline information on wild edible mushroom diversity. The survey was carried out in forest areas of Gaganbawada, Koyananagar and Mahabaleshwar

during July to October (2019). The studied area has rich fungal diversity and it has much scope for scientific communities for further study. The mushrooms were collected and identified according to their morphological characteristics. We have found 50 species of Mushrooms from the families as discussed earlier. The commonly found mushrooms at Gaganbawada, Koyananagar and Mahabaleshwar places are Pleurotus spp., Psythrella spp., Lepiota spp., Marasmius spp., and Termitomyces spp. Some mushrooms like jelly mushroom; puffball mushroom was also been collected and identified. Further studies on the production and cultivation of some of these socio-economically important wild species need to be conducted in this region by introducing simple and appropriate low-cost technology. Many people in the urban areas are less interested to consume wild edible mushrooms probably due to perception that considered wild mushrooms to be poisonous. It will help local people to know some wild edible mushrooms and their use in diet. Among the collected species of mushrooms some are edible, contain medicinal properties and nutritionally rich. Thus, these wild mushroom needs to be further investigated for their applications in daily diet as a food or energy source. This reveals the potentiality of indigenous knowledge of ethnic groups and further in sights is necessary to document such aspects explicitly for future benefits.

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