

Diversity of Polypores (Polyporales, Basidiomycotina) in Punjab, India

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Abstract: Polypores are wood inhabiting macro-fungi belonging to order Polyporales, phylum Basidiomycota. Basidiocarps of 9 Polypores belonging to different families were collected from various localities of Punjab. 2 species from genus *Lentinus*, 2 from *Polyporus*, 1 from *Sparassis*, 1 from *Ganoderma*, 1 from *Tyromyces*, 1 from *Onnia* and 1 from *Trametes* were collected and studied for their macroscopic and microscopic features.

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1.Introduction

Punjab harbors in North-east India with GPS coordinates 31°8'49.668" N and 75°20'28.385"E and provides a wide range of opportunity to flourish diverse mushroom flora. Its humid climatic conditions, plant distributions and field features are very suitable for the growth of macro-fungi. During the rainy season, different species of both edible and non edible species usually grow on various natural substrates such as garden soil, decaying wood, tree trunk, termite nest, agricultural residues, and leaf litters, under the shade provided by Mango, teak, Jamun and Shisham plantations.

Polypores are wood-inhabiting bracket mushrooms and fungi (order Polyporales, phylum Basidiomycota) of economic and medicinal importance. Based on the Index Fungorum database, they include about 2300 species from 13 families and 405 genera worldwide. Polyporales is one of the most intensively studied clades of Fungi. According to MycoBank, there have been 577 taxonomic proposals in Polyporales, including 42 new genera and one new

family, Fragiliporiaceae (Zhao et al. 2015). Polyporales account for only about 1.5 % of all known species of Fungi (Kirk et al. 2008). The common ground of what constitutes a *Polyporus* today refers to white-rotting, wood-degrading, pore-bearing fungi with dimitic hyphal construction (generative hyphae + skeleto-ligative hyphae) at maturity of carpophores. Basidiospores are cylindrical, and there are no cystidia in the hymenium.

They can be cultured axenically, grow rapidly, many can be fruited and mycelium typically can be germinated from basidiospores. Because of these benefits, a large number of species have been investigated (Whitehouse 1949, Nobles et al. 1957). Polyporales is also of practical importance because the group contains several model species, such as *Phanerochaete chrysosporium* and *Gelatoporia subvermispora* that produce ligninolytic enzymes with applications in industry. As biodestructors, polypores have powerful lignocelluloses degrading activity, which makes their usage promising in biotechnology and bioremediation. 13–16

Among polypores are white-rot (e.g., *Fomes fomentarius*, *Ganoderma lucidum*, *G. applanatum*, *G. adspersum*, *Trametes versicolor*) and brownrot species (e.g., *Fomitopsis pinicola*, *Piptoporus betulinus*, *Laetiporus sulphureus*).¹⁷ Polypores are widely appreciated for their medicinal properties, as well (Badalyan et al 2015).

In present study, Polypores of Punjab were collected and investigated for their macroscopic and microscopic features.

2. Material and Methods

The field survey was conducted for collection of polypores from different localities of Punjab during the month of July-September in the years 2015-2018. The standard methods of collection, preservation and description of agarics were followed using the terminology by Singer (1986), Atri et al (2005). The colour terminology used for macroscopic description is that of Kernerup & Wanscher (1978). Photographs of wild mushroom were taken in their natural habitat. The map of collection locality was sketched with GPS coordinate and wild mushrooms were carefully handled, packed in brown paper bags and carried to Mushroom Research Complex, Punjab Agricultural University to record macroscopic features used for identification. Mushroom samples were dried in hot air dryer at 40° C and preserved to study microscopic features.

3. Result and discussion

Basidiocarps of 9 Polypores belonging to different families were collected from various localities of Punjab. 2 species from genus *Lentinus*, 2 from *Polyporus*, 1 from *Sparassis*, 1 from *Ganoderma*, 1 from *Tyromyces*, 1 from *Onnia* and 1 from *Trametes* were hunted and studied for their macroscopic and microscopic features.

Description of each Polypore is given below:

Lentinus sajor-caju (Family: Polyporaceae)

Pileus- 5-7 cm diameter, broadly convex, shallowly and narrowly depressed when young, surface colour off-white, brownish squamules at the centre, margin incurved. Lamellae was observed as shortly decurrent, crowded, white to yellowish white, margin entire not forked. Stipe 2-4 cm, central to eccentric, solid, white, smooth, equal, somewhat flattened. Annulus present, volva absent. Spore print was white in colour. Spores 7-8×3-4μ, cylindrical in shape, inamyloid. (Fig. a)

Sample examined: This mushroom was observed growing gregariously on dead wooden log in village Dhar kalan, Dstt. Pathankot (GPS coordinates: 32°22'17" N, 75°46'30" E).

Lentinus levis (Family: Polyporaceae)

Pileus was observed to be 4-5 cm, off-white in colour, convex in shape with a shallow shallow depression and an inrolled margin. Lamellae decurrent, subdistant, white in colour, yellow with age. stipe was eccentric, 2-5 cm, glabrous. Annulus and volva absent. Spore print was off-white and spores were 9-10×4-5μ, cylindrical, hyaline and inamyloid. (Fig. b)

Sample examined: This mushroom was observed growing saprophytically on tree trunk at Nangal Dstt Rupnagar (GPS coordinates: 31° 22' 27" N , 76° 22' 25" E), usually found in groups.

Polyporus tenuiculus (Family: Polyporaceae)

Pileus was white to off-white, convex to fan shaped with wavy margins, 5-10 cm broad, pores were large in size, hexagonal in shape, and pores can be seen clearly and in large amounts (2-3/mm). Pileus was recorded as hard, fleshy, dull and non sticky. Sessile

fruit bodies, spore print was white in colour and spores were $10-12 \times 4-5 \mu$, oblong in shape, hyaline and inamyloid. (Fig. c)

Sample examined: Samples were collected from Village Dhindsa, Distt. Ferozpur (GPS coordinates: $30^{\circ}88'887''N$, $74^{\circ}85'752''E$), observed growing gregariously, saprophytic in nature, found on tree trunk.

***Polyporus tuberaster* (Family: Polyporaceae)**

Pileus was 6-10 cm broad, round to semicircular in shape became plane, depressed, incurved margin, surface buff to brown, covered with dark coloured scales, tough and hard. Off white coloured pores were seen on surface which was round to angular in shape, 2-3/ mm. Stipe was 3-7 cm long, thick, solid, equal to enlarged, central in attachment. Pores were present on the stipe as well. Spore print was white in colour and spores were $11-12 \times 4.5-5.5 \mu$, oblong, hyaline and inamyloid. Sclerotium was present. (Fig. d)

Sample examined: Sample was collected from village Awankha, Dstt. Gurdaspur (GPS coordinate: $32^{\circ}8'52''N$, $75^{\circ}29'0''E$). Found scattered or singly on dead wooden log.

***Tyromyces chioneus* (Family: Polyporaceae)**

Commonly known as the white cheese polypore.

Cap was 5-8 cm broad, convex; semicircular to kidney-shaped; crusty, wrinkled surface, white to off-white. Pores were white in colour became yellow after age, circular-angular pores, 3-5 mm/ mm. Stipe was absent, white and soft flesh. Spore print was white and spores were $4-5 \times 1-2 \mu$, cylindrical, hyaline, inamyloid. (Fig. e)

Sample examined: Sample were collected from tree trunk from Jallalabad, Dstt Fazilka

(GPS coordinate: $30^{\circ}39'31''N$, $74^{\circ}17'9''E$). 2-3 fruit bodies were observed on tree trunk.

***Trametes pubescens* (Family: Polyporaceae)**

Cap was 6-10 cm broad, semicircular, irregularly bracket-shaped, or kidney-shaped, velvety, often finely, radially lined and furrowed, especially on the margin; cream colored with faint textural zones but without contrasting zones of color. Pores were off-white in colour, became yellowish with age; with 3-5 angular pores per mm. Flesh was observed to be white and tough. Spore Print was observed as white in colour. Spores $5-6 \times 1-2 \mu$, cylindrical, inamyloid. Stipe was absent. (Fig. f)

Sample examined: Sample was collected from village Gamewala. Distt. Ferozpur (GPS coordinate: $30^{\circ}85'752''N$, $74^{\circ}55'736''E$), village Dodra, Distt Mansa (GPS coordinates: $29^{\circ}51'20''N$ $75^{\circ}38'14''E$), village Ranipur, Dstt. Pathankot (GPS coordinates: $32^{\circ}20'7''N$, $75^{\circ}39'26''E$). It was observed on tree trunk/ wooden log, growing gregariously.

***Sparassis crispa* (Family: Sparassidaceae)**

Commonly known as cauliflower mushroom

Fruiting Body: 10- 35 cm broad; composed of tightly packed branches which arise from a large underground base, branches short and contorted, whitish to yellowish or tan. Spore print was observed as white in colour. Spores $4-6 \times 3-4 \mu$ broadly elliptical; inamyloid. No visible pores were present. (Fig. g)

Sample examined: Sample was collected besides Malabar neem from Sujampur, Dstt Pathankot (GPS coordinates: $32^{\circ}19'19''N$, $75^{\circ}35'10''E$) and village Dharkalan, Dstt.

Pathankot (GPS coordinates: 32°24'18" N, 75°47'21" E)

***Ganoderma lucidum* (Family: Ganodermatceae)**

Cap was around 5-20 cm; at first irregular in shape or elongated, fan-shaped at maturity, with a shiny, hard, varnished surface often roughly arranged into lumpy zones, red to reddish brown when mature; when young often with zones of bright yellow and white toward the margin. Pores were observed as white, became brown with age, circular in shape, very tiny pores, not clearly visible to naked eye. Stipe was absent, flesh was soft and brown in colour. Spore print was brown in colour. Spores 9-10 x 5.5-6 µ, elliptical in shape, sometimes with a truncated end. (Fig. h)

Sample examined: Fruit bodies were collected from wooden log in Punjab Agricultural University, Ludhiana (GPS coordinates: 32°3'36"N, 75°30'13"E) and village Sanghera, Distt. Barnala (GPS coordinates: 30° 24' 44" N, 75° 33' 10" E)

***Onnia tomentosa* (Family: Hymenochaetaceae)**

Commonly known as the **woolly velvet polypore**.

Pileus was 6-10 cm broad, irregular round to convex shape, colour is off-white when young turn brown at maturity, Stipe was very short and thick, brown in colour. No concentric zones, sharp margin. Pore surface grayish yellow, angular, 2-3 per mm, slightly lacerate. Surface was spongy, pores decurrent on stipe. Pores were decurrent on stipe. Spores ellipsoidal, hyaline, 4-5.5 × 3-4 µ. (Fig. i)

Sample examined: Sample was collected from Bhangala, Distt. Hoshiarpur (GPS coordinate: 32° 1.0' 0" N, 75° 36' 28" E), growing on wooden log.

Discussion: The study documented the diversity and distribution of Polyporales from different regions of Punjab. The species identified during the study were also reported by earlier workers (Chipp (1921), Oldridge et al. (1985), Lim (1972), Kuthubutheen (1981), Lee et al. (1995); Salmiah and Thillainathan (1998), Salmiah and Jones (2001), Hattori et al. (2007) and Noorlidah et al. (2009) but very less work was done in Punjab, India. Our identified specimens do not suffice all the species of Polyporales from Punjab. The occurrence of Polyporales in the various localities can be attributed to several factors such as rainfall, quantities of suitable substrate, damp forests with constant high air humidity and type of forest (Salmiah & Jones 2001). This study, however, was undertaken during rainy season which is the most suitable season for proliferation of fruit bodies of macro-fungi. For identification of any macro-fungi, a complete knowledge of the fungi for any locality would require continuous observation and collection over many years as it was hypothesized that species diversity and occurrence increased with the increasing number of visits over a longer period (Pegler 1997, Corner 1983).

Many researchers documented mushrooms from Order Polyporales. The xeromorphic lentinoid species, *Lentinus* and *Panus* belonging to *Polyporaceae*, are widely distributed through tropical, subtropical, temperate, and boreal regions (Pegler 1983, Corner 1981). The genera are well represented in India, with 20 species of *Lentinus* (Bilgrami et al. 1979, Sathe & Daniel 1980, Manimohan et al. 2004, Natarajan et al. 2005, Senthilarasu and Singh 2012, Senthilarasu 2015).

Onnia leporine, *Onnia triquetra*, *O. subtriquetra*, *O. microspora*, *O. tibetica* and *O. tomentosa* have a broad distribution in temperate and boreal forests of Asia, Europe, and North America (Ji et al. 2016). Study on diversity and distribution of Polyporales in Punjab is very scarce. There is need of continuous and long-term research to be undertaken for a better knowledge and understanding of Punjab macrofungal diversity in particular. Large areas of Punjab remain completely unexplored or underexplored for collection of wild macro-fungi and these fungi can be exploited for their usage in industry, pharmaceutical application, ornamental display or food security. Polyporales are wood decaying fungi, can be used to degrade the variety of lingo-cellulosic waste generated through forestry and agricultural practices, paper pulp industries, timber industries and many agro-industries which are often disposed of by biomass burning.

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Figure: a) *Lentinus sajor-caju* b) *L. levis* c) *Polyporus teniuculus* d) *P. tuberaster* e) *Tyromyces chioneus* f) *Trametes pubescens* g) *Sparassis crispa* h) *Ganoderma lucidum* i) *Onnia tomentosa*

