



MICROBIOLOGY

TAXONOMIC STUDIES ON THE DAEDALOID AND HEXAGONOID POLYPORES FROM THE FOREST OF WESTERN MAHARASTA

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Abstract

For the present investigation the polypore fungi from the forests of Western Maharashtra were studied. Polypores are the wood rotting fungi that attack wood and play a major role in the processes of its decay. Two kinds of wood decay are distinguished the white rot and the brown rot. The collections were made from twelve different sites and sixty five specimens were critically examined with respect to their macro and micro morphological characters of the basidiocarp, cultural behaviour and enzyme tests. On the basis of these observations four genera, namely *Daedalea* Fr., *Daedaleopsis* Schroetl., *Lenzites* Fr. and *Scinidium* (Klotzsch.) O. Kuntz. and fifteen species namely, *Daedalea africana*, *Daedalea quercina*, *Daedaleopsis nipponica*, *Daedaleopsis sibirica*, *Daedaleopsis confragosa*, *Daedaleopsis flavida*, *Lenzites acuta*, *Lenzites adusta*, *Lenzites vespacea*, *Lenzites kamalensis*, *Lenzites vernieri*, *Scinidium capillaceum*, *Scinidium apiarium*, *Scinidium niam-niamensis*, *Scinidium tenue* are separated. Out of these fifteen species of wood rotting polypores only two species *Daedalea africana* and *Daedalea quercina* are causing white rot and remaining thirteen species causes brown rot.

Keywords: Forest biodiversity, polypores, white rot, brown rot, cultural studies, wood rotting fungi

Introduction

Wood rotting fungi are the important elements of forest ecosystem. They decompose wood and coarse woody debris, and play a primary and central role of degrading organic materials in the forest ecosystem. 75% of the species of fungi, that plays a significant role in timber decay belong to the polyporaceae, and are probably responsible for producing 90% decay of the economically important timbers (Overholts, 1953). The fungus, mostly basidiomycetes are the most efficient lignin degraders in nature (Eriksson et al., 1990). Polypores are the fungi that attack wood and play a major role in the processes of its decay. Numerous species are lignicolous and grow on bark or wood. Two kinds of wood decay are distinguished; one the white rot, where lignin is degraded and cellulose is partially degraded and thus wood is bleached, and Second the brown rot where cellulose is degraded and lignin is left as a brown residue. Lignin degradation capabilities of these fungi are worldwide used in the pulp and paper industry.

Fungi are the group of most diverse organisms, but it is inadequately studied. It is reported that only around 5% of the total estimated 1.5 million species numbers to occur on earth have been identified (Hawksworth, 1991). India is one of the world's mega biodiversity centre. However, we do not know the precise diversity of Indian wood inhabiting fungi, because the lack of mycologist who worked on this particular group, in term of their diversity. Because of

these reasons, it is essential to conduct a research on the wood attacking polypores to examine their diversity.

The bracket fungi or polypores, in the present delimitation are probably polyphyletic and include all Basidiomycetes with persistent, coriaceous, fleshy, corky or woody, mostly pileate basidiocarp. The hymenium lines, tubes, gills or occasionally spines which represent a vast artificial assemblage of macro fungi. They are diverse, not only in their affinity, but extremely polymorphic in their gross morphology. There are about 750 species known distributed in 125 genera with 84 synonyms (Hawksworth et al., 1983), causing decay of standing trees and structural timbers with variable shapes of basidiocarp, consistency, colour, hyphal types and characters of spores.

The polypores can easily be grown in pure culture, are mycelia, but often form distinctive structures. Keys based on these culture characters of numerous species have been prepared by Nobles (1948 and 1965) and Stalpers (1978) which helps for the proper identification of the polypores.

Materials and Methods

For present investigation sixty five specimens (fruiting bodied) of Daedaloid and Hexagonoid polypores were collected from different sites of the Western Ghats and Satpura ranges in the state of Maharashtra. The specimens were conveniently collected in the paper bags, noting the host, locality,

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colour of the material and date of the collection as suggested by Gilbertson and Ryvarden (1986).

From the collection few specimens were used for spore prints, sporocarp culture and a few for macro and micro morphological characters of the basidiocarp. Micro structure has been studied from the sections of fruiting body. Martin's (1934) staining method was used. Lactoglycerin with 1% cotton blue were used for semipermanent slides, which were sealed with a nail polish (Beneke, 1958). Melzers reagent prepared as per the method of Singer (1982) was used for testing the amyloid reaction.

Sporocarp culture was obtained by aseptically transferring a piece of fruiting bodies into to the sterile 2% Malt Extract Agar (MEA) Medium containing 10 ppm Novobiocin and incubated at 25°C for 4-6 weeks in B.O.D. Isolates were sub cultured and transferred to the fresh slant for every fortnight. The pure cultures were obtained and stored on 2% MEA slant.

Culture characteristics of the specimens were described using the terminology of Rayner (1975) and Stalpers (1978), on the basis of characters such as chemical tests for detection of enzymes; growth rate; characteristics of mat; other macroscopic characters; hyphal characters; propagative structures etc. The species were identified with their species code on the basis of a key proposed by Stalpers (1978).

The type of rot was identified by spraying 1% benzidine solution in 90% ethanol (Hintikka, 1970), on decaying wood sample. Oxidase reactions in culture were determined by growing fungi on malt agar medium containing Gallic acid and Tannic acid separately (Gilbertson and Ryvarden, 1986).

Results

All sixty five specimens collected from different sites were critically examined with respect to their external and internal Morphological characters of basidiocarp, cultural behaviour and enzyme tests. On the basis of these observations key is prepared to differentiate the genera and species, and according to key they are placed into four genera, namely *Daedalea* Fr., *Daedaleopsis* Schroetl., *Lenzites* Fr. and *Scinidium* (Klotzsch.) O. Kuntz. and fifteen species namely, *Daedalea africana*, *Daedalea quercina*, *Daedaleopsis nipponica*, *Daedaleopsis sibirica*, *Daedaleopsis confragosa*, *Daedaleopsis flavida*, *Lenzites acuta*, *Lenzites adusta*, *Lenzites vespacea*, *Lenzites karnalensis*, *Lenzites vernieri*, *Scinidium capillaceum*, *Scinidium apiarium*, *Scinidium niam-niamensis*, *Scinidium tenuis*.

Out of these fifteen species of wood rotting polypores only two species *Daedalea Africana* and *Daedalea quercina* are causing white rot and remaining thirteen species causes brown rot.

Key to differentiate genera

1. Pores constantly hexagonal, honeycomb shaped structure with light rust to dark fuscous, context turning dark in KOH.

.....*Scinidium* (Klotzsch) O.Kuntz.

1. Above characters constantly absent2.
2. Cause brown rot, with labyrinthiform hymenophore, presence of typical chlamydospores in addition to basidiospores.

..... *Daedalea* Fr.

2. Cause white rot 3.
3. Dissepiments comparatively thick hymenophore tubular to labyrinthiform to lamelloid, hyphae pale yellow to brown in fruit body and culture, spore print white, cuticular cells and crust area present in culture.

..... *Daedaleopsis* Schroetl.

3. Thin dissepiments, whith sward like branches of binding hyphae more or less lammeloid hymenophore, hyphae in the context and culture more or less hyaline, spore print pallid straw yellow coloured, cuticular cells and crustose area absent in culture. *Lenzites* Fr.

Key to the species of *Daedalea* Fr.

1. Pore layer dull to light grey, light brown to fulvous but always with greyish tint, 10-12 lamellae per cm; context pale brown 3-5mm thick, basidiospores 4-6 μ m long .

..... *Daedalea africana*

2. Pore layer pale yellow to pale woody mostly ochraceous; 6-7 lamellae per cm, context ochraceous to tobacco brown, 9-11mm thick; basidiospores 6-8 μ m long,

..... *Daedalea quercina*

Key to the species based on culture characters

1. Reverse bleached to light yellow showing zonations

..... *Daedalea africana*

2. Reverse darkened with brownish circular area

..... *Daedalea quercina*

Key to the species of *Daedaleopsis* schroetl.

1. Context less than 2 mm thick 2.
1. Context more than 2 mm thick 3.
2. Pileus pale brown to grey, context 1-2 mm thick

..... *Daedaleopsis nipponica*

2. pileus surface cream to dark tan, context 0.2 - 0.5 mm thick
 *Daedaleopsis sibirica*
3. Basidiospore 8 – 11 x 2 – 2.5 μm
 *Daedaleopsis confragosa*
3. Basidiospore 5 -7.5 x 2.2 – 3.3 μm
 *Daedaleopsis flavida*

Key to the species based on culture characters

1. Mat constantly white 2.
1. Mat cream coloured to faint brown *Daedaleopsis confragosa*
2. Mat farinaceous to granular with reverse cinnamon to snuff brown some time ochraceous brown
 *Daedaleopsis nipponica*
2. Above characters constantly absent 3.
3. Mat zonate, margin fringed, reverse bleached to pale yellow to cream coloured
 *Daedaleopsis flavida*
3. Mat azonate, margin even, reverse darkened
 *Daedaleopsis sibirica*

Key to the species of *Lenzites* fr .

1. Pores large 1-4 mm thick, mostly angular mixed with daedaloid to sinuous lamellae, 09-11 lamellae per cm, context 3-6mm thick2.
1. Pores medium 1-3 mm thick typically lamellate, daedaloid to lamelloid, less than 8 lamellae per cm, context up to 3 mm thick 3.
2. Pileus whitish with asporulate tufts of agglutinated hyphae often in zones, context and hymenophore white to cream, basidia 14.7–16.4 x 5.8–6.4 μm
 Basidiospores 6 -9 x2 – 3 μm
 *Lenzites acuta*
2. Pileus pale tan, ochraceous to clay or grey, soft and velutinate smooth by age, hymenophore and context with distinct tan yellowish tints, Basidia 23.5 – 25.8 x5.8 – 7 μm , Basidiospores 4.5 – 7 x 2 – 2.5 μm
 *Lenzites adusta*
3. Pileus straw to ochraceous, margin even sharp, pore surface ochraceous, context whitish grey, Basidiospores 5 – 6.7 x 1.6 – 2.7 μm
 *Lenzites vespacea*
3. Pileus white grey to buff white, creamy to ochraceous to dark brown with greyish tint, margin delicate, pore surface orange buff, context pale yellow, creamy to ochraceous, Basidiospores 6-9 x2.2- 3.3 μm 4.

4. Upper surface of the pileus distinctly radially wrinkled, watery, nodulated, small spherical granules scattered all over the surface, more dense at the base
 *Lenzites karnalensis*
4. Above all characters absent
 *Lenzites vernieri*

Key to the species based on culture characters

1. Mat constantly white 2.
1. Mat white to grey to dark coloured in zones3.
2. Reverse bleached to cream yellow to orange to showing zonation
 *Lenzites vespacea*
2. Reverse darkened to dark brown, zones indistinct
 *Lenzites warnieri*
3. Reverse darkened
 *Lenzites adusta*
3. Reverse bleached to creamy to yellowish 4.
4. Disagreeable smell, terminal swellings up to 18 μm broad
 *Lenzites karnalensis*
4. Odour indistinct, terminal swellings up to 5 μm
 *Lenzites acuta*

Key to the species of *Scnidium* (Klotzsch)

O.Kuntz .

1. Pilear surface pale brown to dark brown, covered with densely to sparsely erect pale brown, brown to black hairs, with large pores 2.
1. Pilear surface ochraceous to snuff brown without hairs, glabrous with small pores..... 3.
2. Pileus azonate, pores 2- 3 mm broad, 4 -6 pores per cm; pseudo-setae with incrustation, Basidia 11 – 15 x 5 – 6.5 μm Basidiospores 9.5 -10.5 x 3.2 – 3 μm
 *Scnidium capillaceum*
2. Pileus concentrically zonate, pores 3 - 5 mm broad, 2 - 4 pores per cm, without pseudo-setae, Basidia 20 -23.5 x 6 – 8 μm , Basidiospores 11 -14 x 3.5 - 5.5 μm
 *Scnidium apiarium*
3. Pores 2 -5 mm broad, 4 – 6 pores per cm, context 1 -2 mm thick, Basidia 17 – 24 x 5.8 – 6.5 μm , Basidiospores 13.8 – 16.6 x 4.4 - 6.6 μm
 *Scnidium niam-niamensis*
3. Pores 1 mm broad, 15 – 20 pores per cm, context less than 1 mm thick, Basidia 11.5 – 13 x 3.5 – 4.1 μm , Basidiospores 10 – 13 x 3.3 – 4.5 μm
 *Scnidium tenuis*

Key to the species based on culture characters

1. Growth rate slow
..... *Scinidium capillaceum*
1. Growth rate fast 2.
2. Basidiocarp formed in culture
..... *Scinidium apiarium*

2. Basidiocarp never formed (up to 8 weeks) in culture3.
3. Reverse bleached
..... *Scinidium niam-niamensis*
3. Reverse darkened with typically dark dotted circular spots
..... *Scinidium tenuis*

Fig.1. *Daedalea* species (PHOTO – P-1 to P-8)

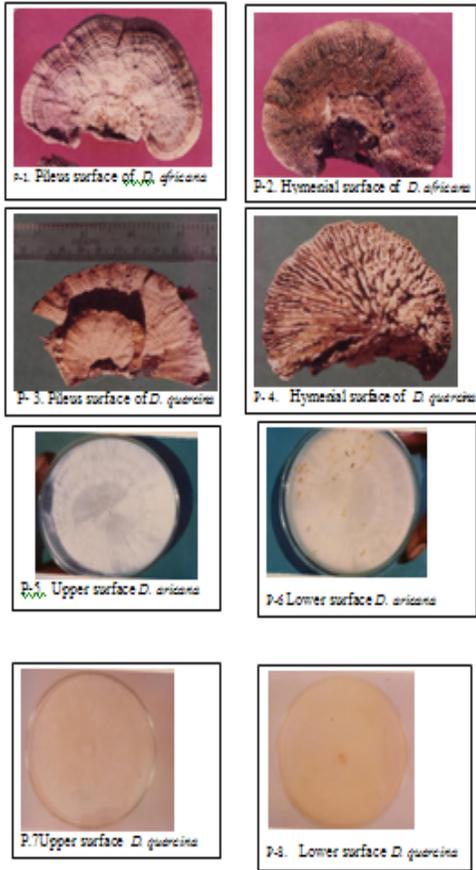


Fig.2. *Daedaleopsis* species (PHOTO – P-9 to P-24)

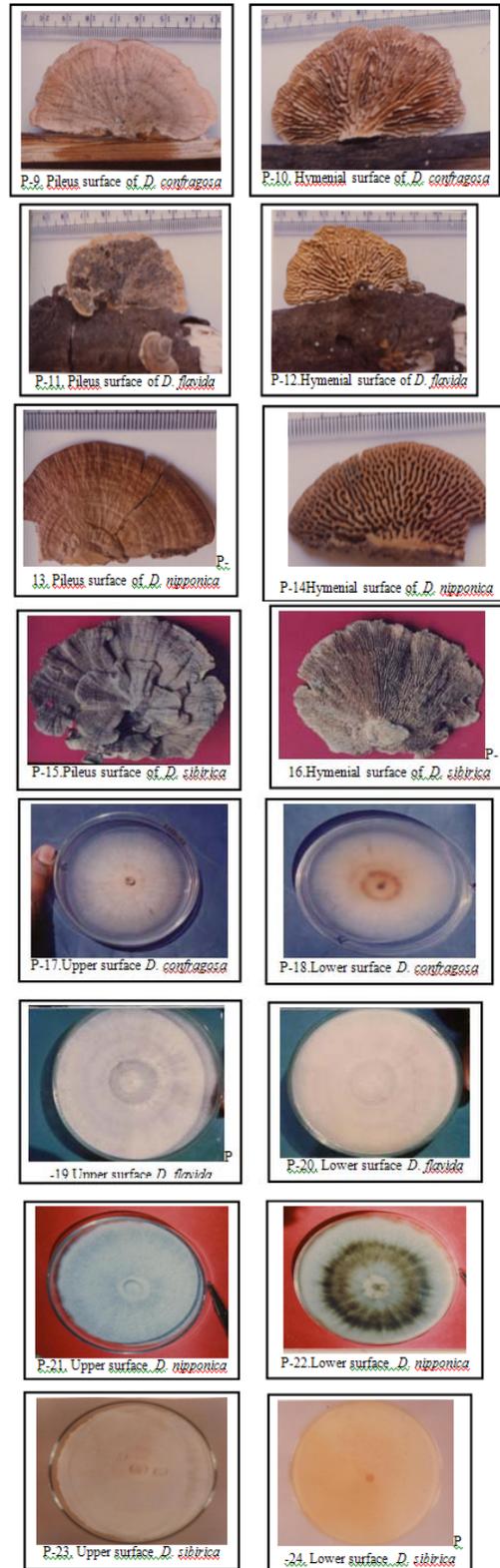


Fig.3. *Lenzites* species (PHOTO – P-25 to P-44)

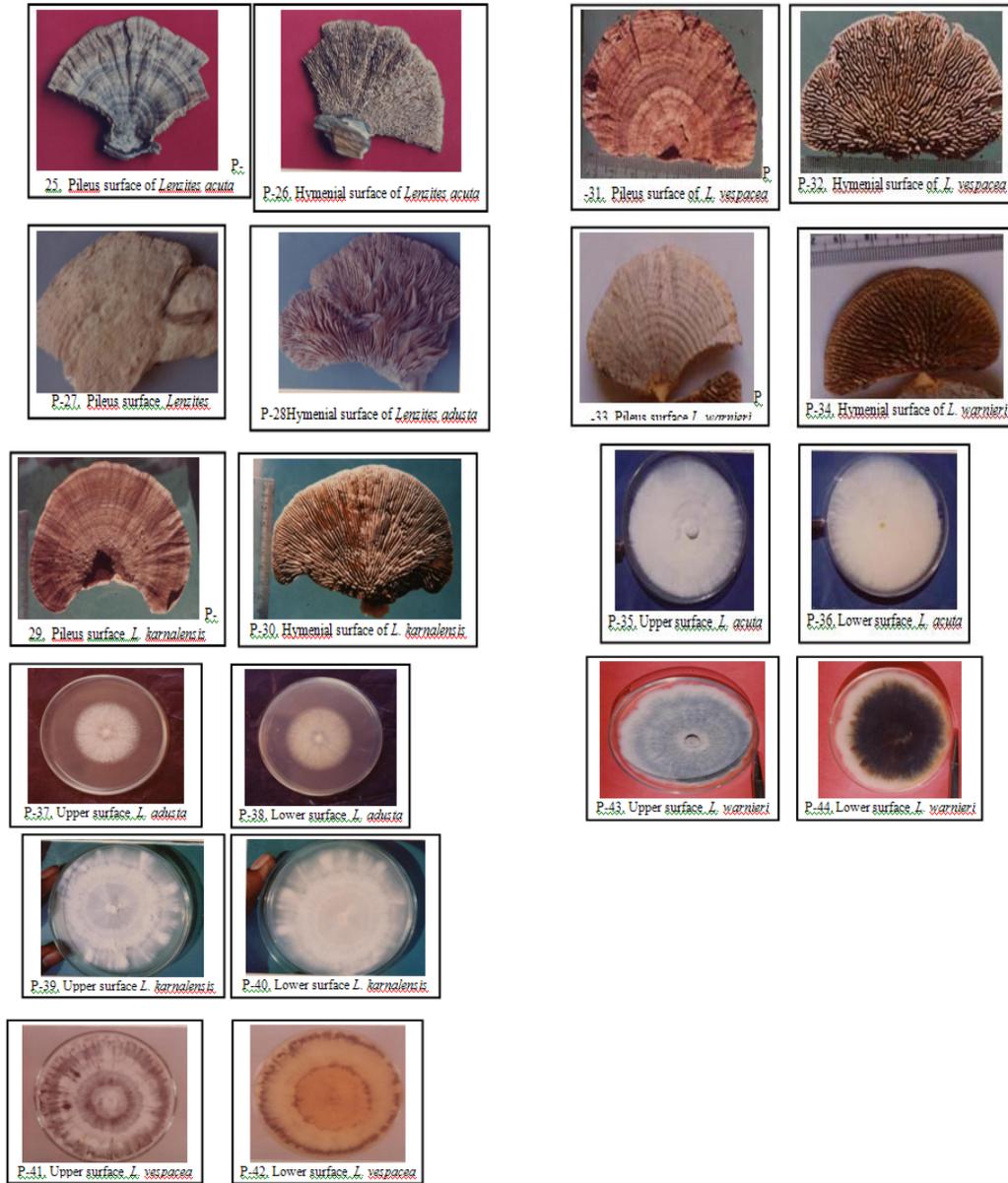
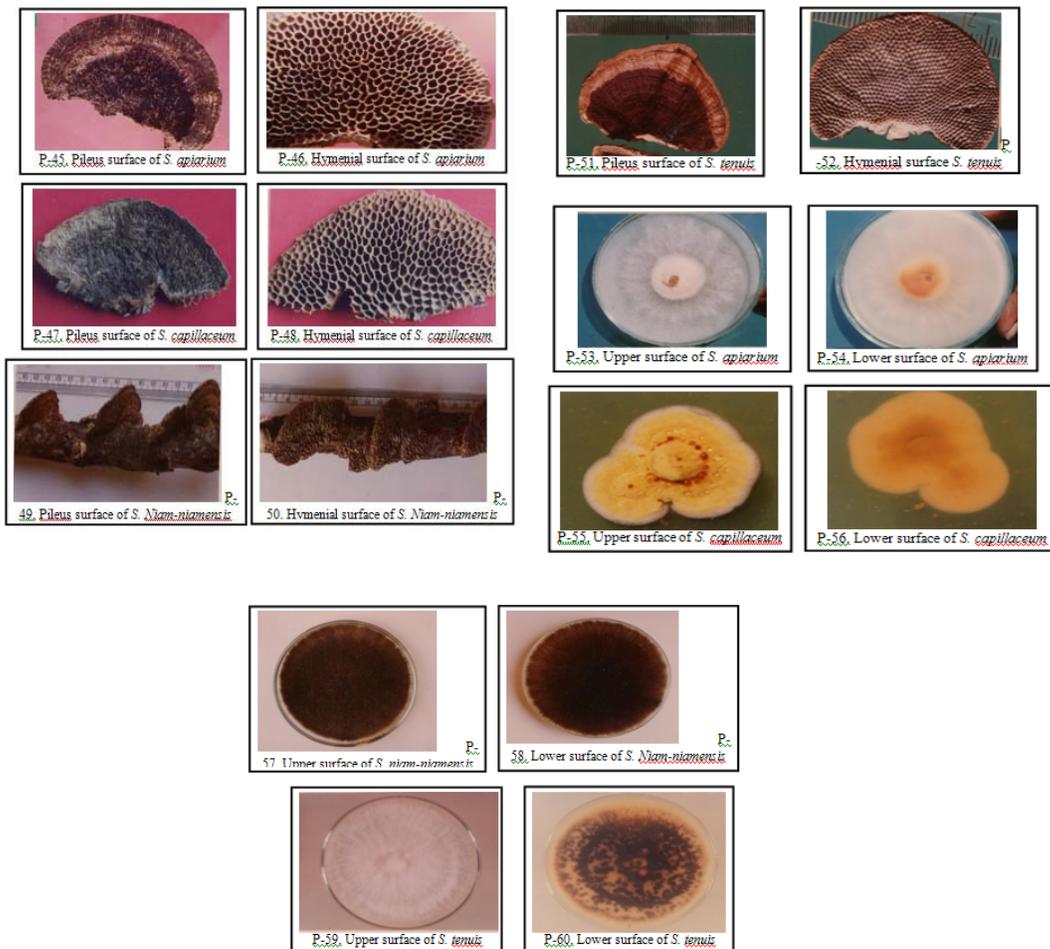


Fig.4. *Scinidium* species (PHOTO – P-45 to P-60)



Discussion

The results of this preliminary study provide evidence that, all the fifteen fungal species studied are having ability to degrade wood, causing either white or brown rot. Which mean that this group of polyporous fungi has an important role in forest conservation, in terms of wood and litter decomposition. It also reveals that many wood rotting fungal polypores from a small part of Maharashtra, have high potential for remediating contaminated soil and water along with lignin degradation. White rot fungi have been widely studied for their ability to degrade variety of environmental soil pollutants, including pentachlorophenol and efficiently degrade lignin, a complex aromatic polymer in the wood (Ch.Ramesh and Manohar, 2009).

The use of wood rotting fungi, especially their enzymes for biopulping, offers many potential

advantages. It requires not only relatively low levels of chemicals and low cost of energy demands, but also eliminate the pollution hazards associated with the use of molecular chlorine pulping process (Akhtar et al., 1992; Turner et al., 1992). The study of biodegradation of lignin by wood rotting fungi is limited not only by lack of taxonomy in referring to genetic variety, but also in their potential for industrial use. Studies are therefore required in order to determine not only variation in fungal species and lignin degradation capabilities but also to establish species or strains that may be suitable for biotechnological applications. Hence it is essential to conduct further research on this aspect.

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