

**CELLULOSE DECOMPOSITION BY SOME WOOD ROTTING FUNGI FROM
JABALPUR DISTRICT**

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ABSTRACT

During survey of wood rotting fungi of Jabalpur district a large number of samples were the substrate. We calculated cellulolysis adequacy index of a large number of wood degrading fungi. Cellulose decomposition ability of 40 isolated basidiomycetous fungi was tested collected from six sites viz. Jabalpur, Kundam, Majholi, Panagar, Patan, Shahpura and Sihora. A total of 40 fungi growing on wood were successfully cultured on artificial culture medium. Cellulolysis adequacy index (CAI) is a measure of cellulose decomposition rate by a saprophytic fungus which indicates that the fungus is able to obtain adequate supply of nutrient from using Cellulolysis Adequacy Index (CAI) method. The maximum cellulose decomposition ability was shown by *Pycnoporus coccineus* with 10.56 CAI value whereas the lowest value 0.53 CAI was shown by *Polyporus arcularius*. Rest isolates showed intermediate activity. The tested fungi caused either increment or reduction of the pH of the growth medium.

Keywords-Wood rotting fungi, Jabalpur district, Cellulolysis Adequacy Index.

INTRODUCTION

Cellulose is the most abundant polysaccharide (of plant origin) on earth apart from chitin and keratin both of which are of animal origin. Degradation of cellulose is carried out by specialized enzymes called cellulases comprising of endoglucanase, cellobiohydrolase and beta-glucosidase (Baldrian and Valaskova, 2008; Payne et al. 2015). Wood decaying fungi are specialized group of fungi that are capable of utilizing cellulose as carbon source. These fungi survive on wood logs that are readily available in all types of forests. India is a tropical country with is rich in natural forests both open and closed and which harbor numerous species of wood rotting fungi. Most of these fungi belong to single order Polyporales. Central Indian state of Madhya Pradesh is very rich in open forest as well as protected forest (having

nine National Parks and 25 Wildlife Sanctuaries) rich in tree species like *Tectona grandis* and *Shorea robusta* which are suitable host to large number of such fungi. Several studies have been conducted in the past on cellulose degrading ability of mostly micromycetes (Garrett, 1966; Garrett, 1976; Singh & Kunene, 1980) but rarely few (Singh et al. 2015; Parihar et al.) has been carried out on basidiomycetes using the Cellulolysis Adequacy Index (CAI) which is a measure of cellulose degrading capability along with nutrient utilization by the fungus. The present study was carried out to study CAI of 40 species of wood rotting basidiomycetes collected from Jabalpur district during rainy season of 2015-2018.

MATERIAL AND METHODS

Collection and isolation of wood rotting fungi

Survey was conducted in seven locations of Jabalpur district in the state of Madhya Pradesh (viz., Jabalpur, Kundam, Majholi, Panagar, Patan, Shahpura and Sihora) during 2015-2018. Samples were collected in paper bags and brought to the laboratory for processing. Isolation of fungi was done by tissue culture method where the fruiting body was first surface sterilized and then split open. Small portion from the inside of fruit body was taken and placed on Potato Dextrose Agar (PDA) plate and was sealed with Parafilm. Pure cultures were transferred onto PDA slants until used.

Estimation of Percentage weight loss of cellulose filter paper

Oven dried and weighed filter paper were kept in 125 ml conical flask containing 25 ml of Nutrient broth (KNO₃-5g, K₂HPO₄-1g, Yeast extract-1g; MgSO₄.7H₂O-0.5g; Thiamine hydrochloride-0.005g; Micronutrient solution -10 ml and distilled water 1000ml, pH 6.0). The medium was sterilized and inoculated with a 5 mm mycelia disc of a 7 days old culture of test fungus growing on PDA medium and one flask kept as a control i.e. without WDF. These flasks were incubated for 4 weeks at 25±2°C. After incubation filter paper was removed, oven dried and weighed. Then weight loss was calculated according to the below formula-

$$\text{Percentage Weight Loss} = \frac{\text{Initial weight} - \text{Final weight}}{\text{Initial weight}} \times 100$$

Measurement of radial growth

For measuring the radial growth rate, all the 40 isolates of Wood Decaying Fungi were inoculated in four replications at the center of 85 mm PDA plates. Inoculum was in the form

of 5 mm mycelial discs taken from margin of colonies grown on PDA plates. The plates were incubated at 27°C and the radial growth was measured (in mm) 1 day, 2 days, 3 days, 4 days and 5 days post inoculation.

Cellulolysis Adequacy Index

Cellulolysis Adequacy Index (CAI) is a measure of percentage weight loss versus linear growth rate of the fungus. For each isolate it was calculated from the weight of cellulose respired by the fungus growing on filter paper (percent weight loss) and its linear growth rate in mm per 24 hrs growing on potato dextrose agar medium at 28°C ± 2°C according to the method of Garrett (1966).

$$\text{CAI} = \text{Percentage wt. loss} / \text{Growth rate test fungus in 24 hrs}$$

RESULTS

Total 216 specimens of wood decaying fungi which occur naturally on logs of different tree species were collected from seven sites of Jabalpur district, India, during survey in rainy season, 2015-2018. These were indentified and brought in pure culture by tissue culture method on Potato Dextrose Agar (PDA) medium. Out of these, 40 species of WDF were screened and tested for biodegradation capability. The ability of host fungus to utilize insoluble from of cellulose was measured at the end of four weeks by using Whatman No. 1 cellulose filter paper.

The maximum percentage weight loss was found to be 45.04 (*Innonotus tabacinus*) and minimum was 1.98 (*Pyrofomes tricolor*). Likewise radial growth rate (in 24hrs) ranged between 13.2 mm (*Flavodon flavus*, *Polyporus arcularius*) and 2.2 mm (*Hapalopilus nidulans*).

The CAI value ranged between 0.53 (*Polyporus arcularius*) to 10.46 (*Pycnoporus coccineus*). Table 1 list the various parameters observed in all the 40 fungi tested for cellulolysis activity. Five fungi showed below unity CAI value while 10 fungi showed CAI value above 5 indicating high rate of cellulose decomposition. Rest all fungi showed intermediate CAI value between 1 and 4.9 (Fig 1.).

There was marked change in pH values of the medium (Table 1) whose initial pH was 6. The maximum pH after 14 days of incubation was 8.2 for *Earliella scabrosa* and the minimum was 2.1 for *Trichaptum byssogenum*.

Table 1: Cellulolysis Adequacy Index of wood rotting fungi.

SNo.	Name of Test Fungus	Initial pH	Final pH	Growth Rate in mm / 24hrs	Weight loss (%)	CAI*
1	<i>Ganoderma lucidum</i>	6	6.4	3.6	21.846	6.07
2	<i>Lenzites elegans</i>	6	5.0	4.6	22.276	4.84
3	<i>Lenzites palya</i>	6	3.0	8.0	25.806	3.22
4	<i>Lenzites palsoti</i>	6	3.0	8.2	26.168	3.19
5	<i>Trametes cingulata</i>	6	5.2	6.4	39.28	6.14
6	<i>Trametes leonina</i>	6	6.2	7.9	36.501	4.62
7	<i>Lenzites stereoides</i>	6	3.2	8.4	41.136	4.89
8	<i>Daedalea sulcata</i>	6	3.2	7.8	45.078	5.77
9	<i>Polyporus brumalis</i>	6	5.2	8.8	44.664	5.07
10	<i>Trametes cubensis</i>	6	7.2	2.6	8.844	3.40
11	<i>Phellinus badius</i>	6	6.2	2.4	3.658	1.53
12	<i>Gloeophyllum striatum</i>	6	3.8	4.0	6.018	1.51
13	<i>Oxyporus cervinogilvus</i>	6	6.6	4.2	7.078	1.68
14	<i>Microporus xanthopus</i>	6	7.2	5.4	5.184	0.96
15	<i>Pyrofomes tricolor</i>	6	6.7	3.2	1.981	0.62
16	<i>Stereum hirsutum</i>	6	5.8	9.0	5.242	0.58
17	<i>Flavodon flavus</i>	6	6.2	13.2	6.954	0.53
18	<i>Polyporus arcularius</i>	6	6.2	13.2	6.956	0.53
19	<i>Trametes cubensis</i>	6	7.2	2.4	8.794	3.66
20	<i>Poria fulviseda</i>	6	5.8	8.2	9.594	1.17
21	<i>Trametes pocas</i>	6	6.6	6.7	12.084	1.80
22	<i>Polyporus grammacephalus</i>	6	6.4	8.4	11.126	1.33
23	<i>Hexagonia tenuis</i>	6	6.8	5.2	10.294	1.97
24	<i>Inonotus patouillardii</i>	6	6.2	2.4	10.2	4.25
25	<i>Hapalopilus nidulans</i>	6	6.2	2.2	18.502	8.41
26	<i>Earliella scabrosa</i>	6	8.2	3.6	19.428	5.39
27	<i>Pycnoporus sanguineus</i>	6	4.2	6.8	19.720	2.90
28	<i>Schizophyllum commune</i>	6	4.8	7.0	27.456	3.92
29	<i>Pycnoporus sp</i>	6	7.2	5.2	43.270	8.32

30	<i>Pycnoporus coccineus</i>	6	6.2	3.8	40.128	10.56
31	<i>Innonotus tabacinus</i>	6	6.1	6.5	45.036	6.92
32	<i>Trametes feei</i>	6	6.2	9.4	24.908	2.65
33	<i>Lycoperdon perlatum</i>	6	3.2	8.8	45.078	5.12
34	<i>Fomitopsis pinicola</i>	6	3.0	4.0	19.428	4.86
35	<i>Pleurotus ostreatus</i>	6	2.2	6.4	12.029	1.88
36	<i>Stereum complicatum</i>	6	3.4	5.2	11.126	2.14
37	<i>Tremella mesenterica</i>	6	4.8	2.4	10.294	4.28
38	<i>Cyclomyces tabacinus</i>	6	3.6	5.8	6.952	1.19
39	<i>Formitopsis pinicola</i>	6	3.2	6.2	8.694	1.41
40	<i>Trichaptum byssogenum</i>	6	2.1	7.2	5.294	5.29

* Cellulolysis Adequacy Index

DISCUSSION

The fungi tested showed growth rate between 2.2 mm /24 hrs to 13.2 mm/24hrs. The percentage weight loss ranged between 1.98 and 45.04 among the fungi tested. When computed in the CAI formula the results showed that most of the fungi (except five species) had above unity CAI value indicating that they have high rate of cellulose metabolism and nutrient utilization. This also suggests that there is faster decomposition of wood in the geographical region sampled. The study indicated that many of these fungi can be utilized for active decomposition of substrate under artificial conditions like composting and industries where cellulose degradation is important.

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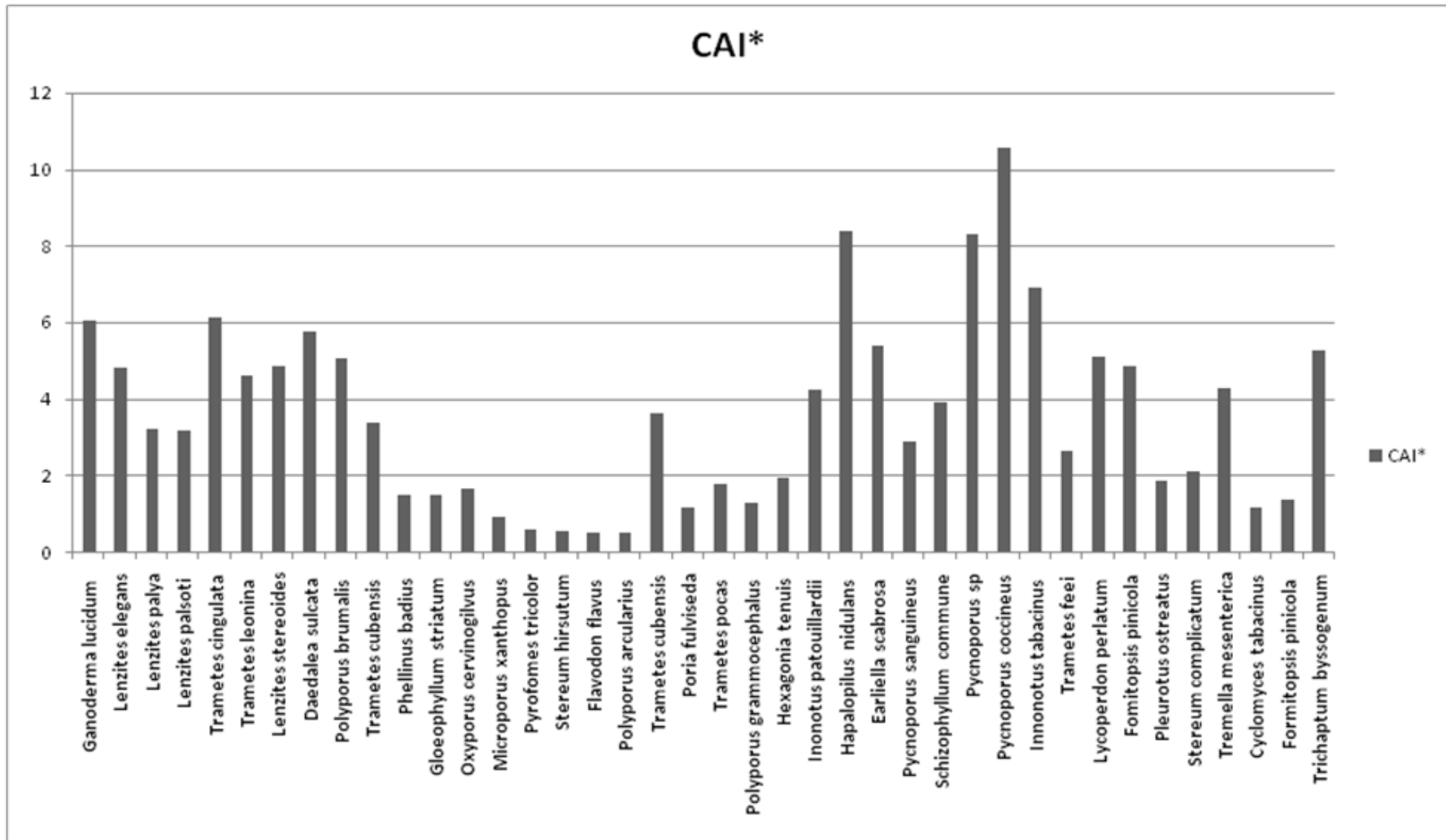


Fig1: Graph showing relative CAI values of forty species of wood rotting fungi.

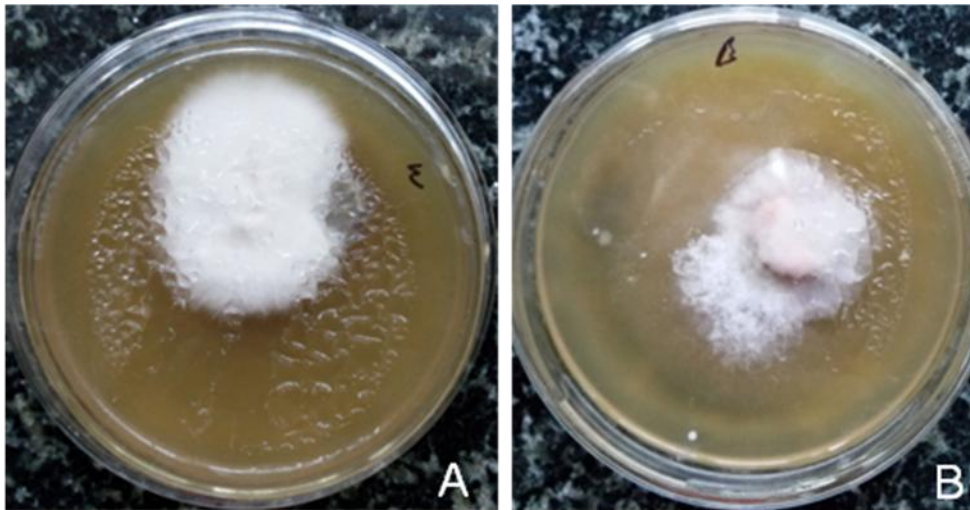


Fig 2: Cultures of wood rotting fungi after 14 days of incubation on PDA medium at 28C. A- *Pycnoporus coccineus* ; B- *Polyporus arcularius*.