

A STUDY ON NATURAL DURABILITY OF LESS UTILIZED WOOD SPECIES GROWN IN AZAD JAMMU AND KASHMIR, PAKISTAN

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ABSTRACT

A laboratory study was carried out to assess the natural durability of eight hardwood species against a white rot fungus *Ganoderma lucidum*. For this purpose wooden blocks (4.5x2.5x1.5cm) prepared from each species were infested with fungus for 120 days. The endurance was calculated based on the mean percentage of weight loss of the wooden blocks. Results revealed that *Sapindus mukorossi* was most subjected to decay with a maximum average weight loss whereas the maximum natural resistance was found in *Olea cuspidata*. Among these hardwood species, *Prosopis cineraria*, *Albizia lebbek* and *Olea cuspidata* were categorized in moderately durable class against this fungus while the rest species were kept in non-durable class. From results it can be concluded that the wood of Kao (*Olea cuspidate*), Black Siris (*Albizia lebbek*) and Jand (*Prosopis cineraria*) may be more resistant to *Ganoderma lucidum* than the other studied species.

INTRODUCTION

The endurance of a wood species to be attacked by degrading organisms such as termites, powder-post beetle, marine borer and fungi ascertains its natural durability (Martawijaya, 1996). Some others factors that can influence wood resistance include growth rate, portion of wood (heartwood or sapwood), extractive contents in wood and the environment the wood is being exposed to (Suprapti, 2010). This natural resistance of wood is determined based on data obtained through field trials i.e. graveyard test. Such field tests, however, have certain disadvantages, of which the most obvious is the length of time involved. Moreover, in places where termites are present it is often difficult to decide whether these or fungal decay is responsible when the test stakes fail. In order to avoid all these difficulties laboratory methods have been developed by which the durability of wood can be assessed in a matter of months (Yamamoto, 1994; Findlay, 1985).

Ganoderma lucidum (Fr.) Karst, is a basidiomycete belonging to the family Polyporaceae, also known as "Ling zhi" in China and "Reishi" in Japan. It has been widely used as a traditional medicine in the Orient for more than 2000 years (Ricardo *et al.* 2003). This white rot-fungus has been reported as the casual organism of heart rot diseases of several hardwood tree species like *Albizia lebbek*, *Butea frondosa* and *Acacia nilotica* (Fernando, 2008; Shakil *et al.*, 2011; Vishal *et al.*, 2012). During infestation it removes both the lignin and polysaccharides components of the wood elements by inducing a combination of

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selective delignification and simultaneous decay which ultimately results in the weight losses of the subjected wood samples. Moreover, the range of the percent weight losses also varies with the wood species used as substrate by this fungus (Adaskaveg *et al.*, 1986, 1990; Maria *et al.*, 2004).

In this study, in vitro assessment on the resistance of wood to fungal decay was made based on the mass loss value of wooden blocks against a white rot fungus *Ganoderma lucidum* under laboratory conditions.

MATERIALS AND METHODS

To conduct the research work, the wood samples of Ritha (*Sapindus mukorossi*), Chachra (*Butea frondosa*), Phawar (*Ficus palmata*), Lasura (*Cordia myxa*), Jand (*Prosopis cineraria*), Black Siris (*Albizzia lebbek*), Toon (*Cedrela toona*) and Kao (*Olea cuspidata*) were collected from Azad Jammu Kashmir, Pakistan. Three wooden blocks of dimension 4.5x2.5x1.5 cm from each species were prepared from heart wood of butt log. The blocks were dried in oven and weighed (W1) at 12±2% moisture content. These wooden blocks then sterilized at 121C°, 120kPa in High pressure steam sterilizer (Tomy ES-315) for 12 minutes before infestation with fungus.

Fresh isolates of test fungus *Ganoderma lucidum* (Fr.) Karst provided by Forest Pathology Branch of Pakistan Forest Institute, Peshawar was cultured on solid malt agar (pH5.7) by tissue culture method (Booth, 1971; Nasreen *et al.*, 2005) (Fig.1&2). The wooden blocks were infested from the cultured medium and kept under aseptic conditions for four months in sterilized glass bottles (Fig.3&4). Filter paper was placed at the bottom of the glass bottle to provide the humidity with sterilized distilled water during infestation (Wada *et al.*, 1984).



Fig.1. Culture of *Ganoderma lucidum* on solid malt-agar medium

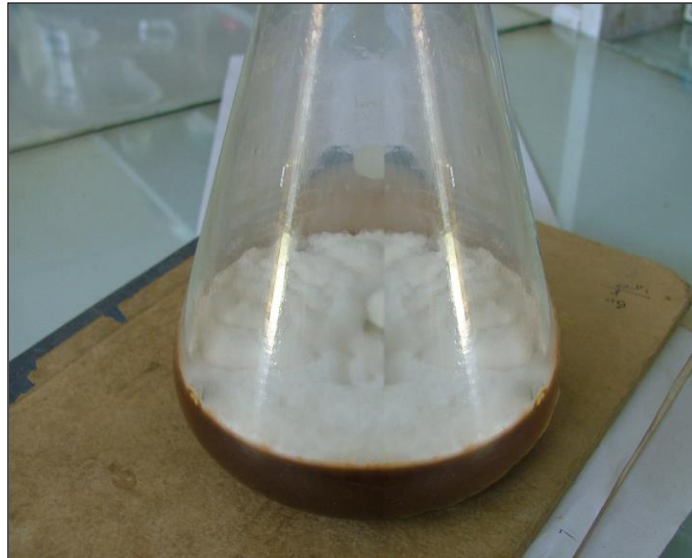


Fig.2. Fungal tissue bed on malt- agar



Fig. 3. Complete infestation of fungus on wooden block of Ritha



Fig.4. Wood species under decay experiment

After 120 days, the wooden blocks were removed from the bottles, scraped and cleaned the adhering medium and fungal mycelium. They were again dried in oven, shifted to desiccator and then re-weighed (W₂). The weight losses were calculated according to the given formula;

$$\text{Weight loss percent} = (W_1 - W_2 / W_1) \times 100.$$

Data was statistically analyzed for mean values and standard error using Microsoft Excel Programme 2007 and the classification of durability was made according to Findlay, 1985.

RESULTS AND DISCUSSION

Results given in the table 1 represent that the maximum mean percentage of weight loss among the studied species was found in *Sapindus mukorossi* whereas maximum natural resistance against fungal decay was offered by *Olea cuspidata* where 93% residual weight was recorded. Among these hardwood species, *Prosopis cineraria*, *Albizia lebbek* and *Olea cuspidata* were categorized in moderately durable class against this fungus while the rest species were kept in non-durable class. Furthermore, it was found that weight losses among these species did not exceed 23% of the total.

Table 1. Weight losses and classes of durability

Wood species	Mean(IW)±SE (g)	Mean(FW)±SE (g)	Mean (WL) ±SE (%)	Durability class*
<i>Sapindus mukorossi</i>	15.11±0.06	11.76±0.31	22.17±2.88	Non-durable
<i>Butea frondosa</i>	9.75±0.28	7.95±0.23	18.46±1.02	Non-durable
<i>Ficus palmata</i>	11.00±0.14	9.19±0.15	16.45±0.38	Non-durable
<i>Cordia myxa</i>	11.10±0.04	9.76±0.05	12.07±0.30	Non-durable
<i>Cedrela toona</i>	15.37±0.32	13.66±0.10	11.14±0.09	Non-durable
<i>Prosopis cineraria.</i>	12.53±0.05	11.24±0.15	10.29±2.00	Moderately durable
<i>Albizia lebbek</i>	12.90±0.15	11.81±0.13	8.44±1.16	Moderately durable
<i>Olea cuspidata</i>	20.90±0.09	19.41±0.10	7.46±1.08	Moderately durable

IW=Initial weight FW=Final weight WL=Weight loss
SE=Standard error.

*Nil or negligible: Very durable upto 5%:
Durable 5-10%: Moderately durable 10-30%:
Non-durable over 30%: Perishable (Source: Findlay, 1985)

The decay resistance in the individual species reported here is a preliminary evaluation, since each species represented by wood from only one tree. Decay resistance typically varies from among trees of the same species. This may be due to either to a varying proportion of sapwood, or to differences in the inherent decay resistance of the wood. Differences exist even of the heartwood between one tree and other of the same species. Such differences, which are generally associated with variation in the content of extractives, are probably inherited. The practical significance of these findings is that one can not define precisely the inherent natural durability of any kind of wood but can only classify timbers broadly into classes of durability, on the basis of their known performance in use and from the results of carefully controlled tests.

CONCLUSION

Based on the results it can be concluded that the wood of Kao (*Olea cuspidate*), Black Siris (*Albizia lebbek*) and Jand (*Prosopis cineraria*) may be more resistant to *Ganoderma lucidum* than the other studied species. Further, the data on percentage weight losses obtained in the study may also be helpful to evaluate the class of durability of these wood species through further research work on other decaying fungi, the amount of wood extractives and the analysis of other allied chemicals on laboratory scale and in the field trials where such data are required before field exposure tests.

RECOMMENDATION

The wood of Kao, Black Siris and Jand being moderately durable should never be used in direct contact with the soil unless given preservative treatment, but for short period they may withstand exposure to damp conditions. Woods categorized as non-durable should always receive treatment if there is any risk of their becoming damp in use. Further, the data on percentage weight losses obtained in the study may also be helpful to evaluate the class of durability of these wood species through further research work on other decaying fungi.

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