International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2015): 78.96 | Impact Factor (2015): 6.391

Durability of Traditionally Treated *Bambusa tulda* towards White Rot Fungus using Vermiculite

Bebija L. Singha[1], Yamin Hassan[2], R. K. Borah[3]

[1]Research Scholar, AdtU, Guwahati-26, Assam

[2]Assistant Professor, Chemistry Department, AdtU, Guwahati-26, Assam

[3]Scientist, Forest Protection Division, RFRI, Jorhat-10, Assam

Abstract: ***Preserving bamboo extends its life and maintains its quality. Bamboo culms are a natural material and will decay with time. They are also susceptible to insect and fungal attack. This will limit the useful lives of the products they are used to produce and may reduce the quality of the raw material to the point that it is no longer useable. The durability of bamboo depends on age, species, moisture content, climatic condition and carbohydrate content. Due to lack of enough toxicity like resins, waxes and tannins to impart natural durability, bamboo need to be treated before putting them into used. The traditional methods of preservation of bamboo by water immersion followed by almost all the rural people of Jorhat are quite effective, economic and most feasible. To decrease the total soluble sugar content immersion of bamboo for a month is sufficient. The durability test was done by inoculating pure culture of Schizophyllum commune - a white rot fungi using vermiculite.***

Keywords: Traditional preservation; durability; total soluble sugar; *Schizophyllum commune*; vermiculite

1. Introduction

We are well aware that the increasing demand of wood could not be fulfilled by the indigenous forest resources in India. To some extend this problem can be solved by using renewable resources like bamboos. It is one of the most useful natural resources in many parts of world. It is fast in growth, has excellent strength, high elastic behavior and difficult to abrade. Due to their versatility properties they have been named as the most important sustainable and environmentally helpful crop on the earth (Brystriakova *et al*. 2003).

At present there are about 1575 accepted bamboo species plus several other species with incorrect names (Ohrnberger, 1999). They are widely used for house constructions, bridges, fencing, for basket making, furniture, mats, agricultural tools, handles for tools, musical instruments, fishing rods, scaffolding, weaving material, pole and post, paper and pulp making, food for humans and livestock (Sanyal *et al*. 1981). Bamboos are also becoming more popular worldwide for ornamental and economic purposes (Bezona and Rauch, 1997). Some bamboo species are grown for ecological purposes such as stabilization and prevention of erosion.

However, bamboo has been limited in use because it contains high carbohydrates content, low tannins, resins and waxes which makes it so susceptible to insect and fungi (Mathew and Nair, 1990 and Gnanarahan *et al*. 1993). Therefore, it is very important to develop the preservation technology of bamboo that is economic and environmental friendly to extend the application scope. Bamboos can be preserved either by using chemicals i.e., chemical methods or without using chemical i.e., traditional methods to prolong their service life (Abd. Rajak *et al*.1995).

Chemical treatments which include washing, coating, brushing, swabbing, spraying, boucherie process, steeping, sap displacement, hot and cold bath, diffusion process, butt treatment, open tank process, pressure process have been studied (Liese, 1980; Sulthoni, 1987; Kumar *et al*. 1990; Zaidon *et al*. 2000). These methods are effective but expensive and hazardous to health particularly during handling, storage and disposal if proper precautionary measures are not taken. On the other hand, traditional methods of preservation are age old methods followed by indigenous communities and farmers of Asia and Latin America. It includes water soaking, curing, smoking, whitewashing etc. Water soaking is the most popular methods which cost almost nothing and during the process starch is depleted from the bamboo and reduces the degree of insects and fungi attacks (Sulthoni, 1987 and Kumar *et al*. 1994)

The resistance to borer and other biodegradable agents depends on the species, its starch content, age of the culm, felling season and the physical properties of the bamboo (Plank 1950). Further studies done by some of the workers like Purushotham *et al*. 1953; Beeson, 1961; Liese, 1980; Tamolang *et al*. 1980 and Sulthoni, 1987, indicate that the damage caused by borer has been proportional to the starch content of the bamboo. This paper reveals the effectiveness of bamboo preservation by soaking in water and thereby decreases the fungal attack.

2. Methods and Materials

Bambusa tulda locally known as Jati bah, from Jorhat district of Assam was used in this study. To analyse total soluble sugar content (TSS) quantitatively in the culm, five matured culms of 3-4 years old *B. tulda* were extracted randomly. The culms were cut into three equal portions, i.e., basal, middle and apical portions. Each portion was further cut into 5 pieces of 100 cm long for uniform analysis.

Licensed Under Creative Commons Attribution CC BY

Therefore, 60 samples were prepared (5 replications for each portion) and out of these 15 samples of basal, 15 samples of middle and 15 samples of apical were submerged in water for 1, 2 and 3 months. Another 15 samples (5 replications for each portion) from basal, middle and apical portion were kept as control samples where no treatment was given.

Before treatment all the bamboo samples were leveled giving prefixes like 0 (control), 1 (month), 2 (months) and 3 (months) for different treatment period of soaking and A (Apical), M (Middle) and B (Basal) for different portion of the culm and suffixes like 1, 2, 3, 4 and 5 as replication numbers. Accordingly, control samples were leveled as 0A1 to 0A5, 0M1 to 0M5 and 0B1 to 0B5. Similarly, the other portions were also leveled as 1A1 to 1A5, 1M1 to 1M5 and 1B1 to 1B5 for samples with 1 month treatment ; 2A1 to 2A5, 2M1 to 2M5 and 2B1 to 2B5 and 3A1 to 3A5, 3M1 to 3M5 and 3B1 to 3B5 for samples with 2 and 3 months treatment respectively.

The samples were collected from water after the completion of each treatment period and air dried under shade till a stable value of moisture content were obtained. For determination of starch content a small section from each sample was cut, powdered and sealed in polythene bags with proper level.

Analysis of total soluble sugar (TSS) content: At the end of 1 month of soaking in water 15 samples of culms (5 samples from each portion) were taken out from water and dried under shade. For analysis of TSS, samples in the form of saw dust were collected and TSS was estimated in the samples by Anthrone method (Sadasivam and Manickam, 1996). Similarly, at the end of 2 and 3 months, 15 samples were taken out from the water respectively and TSS was also estimated. Saw dust of control samples was also taken and TSS was estimated so that we can compare the TSS content in treated samples to those of untreated samples. The optical density of the colour absorption was measured against a reagent blank (prepared in a similar way with the omission of the sawdust extract) at 630 nm on a UV-Vis spectrophotometer (Model: Spectrascan UV 2700-Thermo Scientific).

Culture of *Schizophyllum commune*: For obtaining true culture of *S. commune*, spore present in living fruits were collected and culture in PDA medium supplemented with streptomycin. 5 day old actively growing *S. commune* was taken inoculation and incubated in an incubator for 7 days. When the pure culture of fungus was established, the culture was multiplied by subculturing in the PDA medium supplemented with peptone for obtaining highest growth. Once the culture was obtained, the cultures were stored in freezer for getting the strains whenever necessary.

Durability test: Samples of both water-treated and untreated were cut into 10cm by 2cm by 1 cm piece and weight of each samples were taken after oven dried as initial weight. Growtek jars were used as test jars where vermiculite and 5 samples (for replication) of both treated and untreated culms were put in separate jars according to their period of treatment and autoclaved (Wei, *et. al*., 2013). Inoculums of 5mm of *S. commune* was taken using a cock borer from culture plates and put on top of vermiculite not on the bamboo samples. This whole process was done in sterile condition inside a laminar air flow. The same procedure of inoculation was done on all treatments of the bamboo samples. The jars were incubated in dark condition for 16 weeks. The percentage weight loss $(W_a\text{-}W_b) / W_a \times 100$ of weight before (W_a) and after exposure (W_b) was calculated. All the data thus obtained were estimated statistically and analyzed using ANOVA (Gomez and Gomez, 1984).

3. Results and Discussion

Total soluble sugar content in *B. tulda*: The average TSS content values in the untreated and water-treated bamboo culms are shown in **Table 1.** The highest average TSS content (4.16%, w/w) was recorded in the untreated bamboo culms ad the lowest average TSS content (1.55%, w/w) was recorded in the 3 month water-treated culms. The TSS content reduces as the soaking period increases. Climatic condition and season influences the amounts of water soluble material in the bamboo culms (Tamolang *et al*., 1980).

Durability test: The highest biomass loss was calculated in the untreated culms as compared to water-treated culms (**Table 2**). The lowest biomass loss was calculated in the water-treated culms for 1 month. However, there is no significant difference in the number of % biomass loss and the duration of treatment but there is significant difference between the treated and untreated samples. From the above observation it can be concluded that the treatment of bamboo with water is significantly effective against white rot fungus.

Table 1: Average total soluble sugar content (%) of *B. tulda* samples treated by water soaking treatment method

Sl. No.	Portion of Bamboo	TSS content (%)			
		Control	1 month	2 month	3 month
1	Basal	4.54	3.48	2.31	1.92
2	Middle	3.92	2.96	1.68	1.52
3	Apical	4.01	2.58	1.49	1.21
	Average	4.16	3.01	1.83	1.55
P-value = 0.00026					
SED = 0.094					
CD = 0.18					

Table 2: % Biomass loss recorded in the treated and untreated bamboo samples after inoculation of *Schizophyllum commune* (white rot fungi) for 16 weeks

S. No.	Portion of bamboo	% biomass loss			
		Control	1 month treated	2 month treated	3 month treated
1	Basal	16.81	9.02	10.44	12.74
2	Middle	19.04	10.19	11.58	14.23
3	Apical	21.94	13.22	13.31	16.11
	Average	19.26	10.81	11.78	14.36
P-value = 0.000141					
SED = 0.43					
CD = 0.84					

Licensed Under Creative Commons Attribution CC BY




4. Conclusion

The Average total soluble sugar content of the *B. tulda* studied ranged from 1.21% w/w to 4.45% w/w. Soaking of bamboo culm in water significantly reduced the carbohydrates content. The reduction of carbohydrates in bamboo is positively related with the period of soaking. Three months of soaking managed to reduce 60-80 % of carbohydrates in the bamboos. Even though untreated bamboos have some resistance towards decay fungus, the durability of bamboos increases as the sugar content decreases. Deterioration of bamboo caused by decay fungi on water-treated bamboo culms was much slower than on untreated samples. Therefore, bamboo must be treated before use to sustain the longest service life.

5. Acknowledgement

I do hereby acknowledge the authority of RFRI, Jorhat, Assam for permitting me to do Ph.D. in AdtU, Guwahati-26. I also would like to acknowledge the management of AdtU for providing me the all round facilities for carrying out my Ph.D. work. Especially I would like to thank the authority of RFRI, Jorhat, Assam and Assam Agriculture University, Jorhat for allowing me to use their laboratories for various research work related parameters.

References

[1] Brystriakova, N., Kapos, V., Lysenko, I. and Stapleton, C.M.A. 2003. Distribution and conservation status of forest bamboo biodiversity in the Asia-Pacific Region. Biodiversity Conservation, 12: 1833-1841.

[2] Ohrnberger, D. 1999. The Bamboo of the world: Annotated Nomenclature and Literature of the Species and the Higher and Lower Taxa; Elsevier: Amsterdam, The Netherlands.

[3] Sanyal S. N., Gulati, A. S., Khanduri, A. K. 1981. Strength properties and uses of bamboos – a review. Indian Forester, 114: 367-649.

[4] Bezona, N.C. and Rauch, F.D. 1997. Bamboo for Forest and Garden; Hawaii Cooperative Extension Service, College of Tropical Agriculture and Human Resources, University of Hawaii at Menon: Honolulu, HI, USA.

[5] Mathew, G. and Nair, K. S. S. 1990. Storage pests of bamboos in Kerala. In "Bamboos: Current Research". I. V. R. Rao, R. Gnanaharan, and C. B. Sastry (Eds) Proc. International Bamboo Workshop, KFRI/IDRC, pp. 212-214.

[6] Gnanaharan, R., Mohanan, C and Chand Basha, S. 1993. Post-harvest technology for reed bamboo. BIC India Bulletin, 3(1): 1-6.

[7] Abd. Rajak, O., M. Abd. Latif, W. Liese, and H. Norini, 1995. Planting and Utilization of Bamboo in Peninsular Malaysia, Research Pamphlet No. 118, Forest Research Institute of Malaysia (FRIM), pp. 117.

[8] Liese, W. 1980. The preservation of bamboo. In: Bamboo Research in Asia. Proceedings of IDRC sponsored Workshop held in Singapore, May 1980: 165-178, IDRC, Singapore.

[9] Sulthoni, A., 1987. "Traditional preservation of bamboo in Java, Indonesia". In Rao, A.N.; Dhanarajan, G.; Sastry, C.B. (Ed.), "Recent research on bamboos", Proceedings of the International Bamboo Workshop, Hangzhow, People's Republic of China, 6 - 14 October 1985. CAF/IDRC, pp. 349-357.

[10] Kumar, S., Shukla, K.S. and Dobriyal, P. B. 1990. Management of Biodegradation of Timber Logs and Bamboo during Storage. A review for Indian Conditions, Journals of Timber Development and Association, (India), 36: 5-14.

[11] Zaidon, A., Razali, A. K., Hamami, S. Mohd. and Norzaliza, Y. 2000. Improvement of Bamboo Resistance against Stain Fungus by Water Soaking. Paper to be presented at International Bamboo seminar, 2-4th August 2000, Chiangmai, Thailand, Kasetsart University and Royal Forestry Department, Thailand.

[12] Kumar, S., Shukla, K.S., Dev, I.; Dobriyal, P.B. 1994. Bamboo preservation technique: A review. Indian Council of Forestry Research & Education, Dehra Dun & International Network for Bamboo and Rattan, International Development Research Centre, Canada, pp. 59.

[13] Plank, H. K. 1950. Studies of factors influencing attack and control of the bamboo powder post beetle. Fed. Exp. Sta. Mayaguez, Puerto Rico. Bulletin no. 48: 39 p.

[14] Purushotham, A., Sudan, S. K and Vidya Sagar. 1953. Preservative treatment of green bamboos under low pneumatic pressures. The Indian Forester, 79(12): 652-672.

[15] Beeson, C.F.C. 1961. The Ecology and Control of the Forest Insects of India and Neighbouring Countries. Government of India. First Reprint, pp. 767.

[16] Tamolang, F. N., Lopez, A. R., Semara, J. A., Casin, R. F., and Espiloy, Z. B. 1980. Properties and utilization of Philippine erect bamboo. In International Seminar on Bamboo Research in Asia held in Singapore, May 28-30: proceedings edited by G.

Licensed Under Creative Commons Attribution CC BY

Lessard and A. Chouinard. Singapore: International Development 44 Research Center and the International Union of Forestry Research Organization, pp. 266-275.
[17] Ashaari, Z. and Mamat, N. 2000. Traditional treatment of Malaysian bamboos: Resistance towards white rot fungus and diversity in service. Pakistan Journal of Biological Sciences, 3: 1453-1458.
[18] Sadasivum, S and Manickam, A. 1996. Biochemical methods. A biochemistry manual published by New Age International Pvt. Ltd. Publishers.
[19] Gomez, K. A and Gomez, A.A. 1984.Statistical procedures for agricultural research (2 ed.). John Wiley and Sons, New York, 680p.
[20] Wei, D.; Schmidt, O. and Liese, W. 2013. Method to test fungal degradation of bamboo and wood using vermiculite as reservoir for moisture and nutrients. Maderas, Ciencia y tecnologia 15 (3): 349-356

Licensed Under Creative Commons Attribution CC BY