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Study on CCB (Chromated Copper Boric Acid) Dip Preservation of Golpata *(Nypa fruticans)*

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ABSTRAK

Golpata (*Nypa fruticans*) ialah satu sumber atap yang murah di Bangladesh. Bagaimanapun, jangka hayat semula jadi selama 2-3 tahun membuatkannya tidak sesuai untuk penggunaan jangka panjang. Kajian ini dilakukan untuk menyiasat kemungkinan jangka hayat Golpata dipanjangkan melalui rawatan secara celupan ke dalam larutan pengawet kimia CCB (Kuprum berkromat dan Asid Borik). Sampel ujian terdiri daripada daun dan urat-tengah Golpata dengan julat kandungan kelembapan di antara 16.63% hingga 70.67% pada permulaan uji kaji. Sampel-sampel dicelup ke dalam larutan CCB pada 4 kepekatan berbeza selama 2, 4, 6 dan 8 jam setiap satu dan seterusnya diperiksa kemasukan dan kesimpanan CCB di dalam sampel. Kemasukan ditentukan dengan mengguna penunjuk kuprum dan boron sementara kesimpanan dihitung melalui spektroskopi sinar-X. Keputusan menunjukkan yang dua faktor, iaitu kepekatan CCB dan jangka masa celupan, mempengaruhi keberkesanan rawatan Golpata. Kemasukan CCB yang paling baik ialah untuk rawatan celupan 6 jam untuk kedua-dua sampel. Kesimpanan CCB pula adalah paling baik pada rawatan celupan 6 jam untuk daun dan 8 jam untuk urat tengah daun. Masa rawatan menunjukkan keberkesanan bererti pada 5% paras keyakinan. Kajian ini mendapati jangka hayat Golpata boleh dipanjangkan dengan cara celupan dalam pengawet CCB.

ABSTRACT

Golpata *(Nypa fruticans)* is a cheap source of roof thatches in Bangladesh. However, its short life span of 2-3 years makes it unsuitable for long-term use. This study was carried out to investigate the treatability of Golpata by dipping in CCB (Chromated Copper Boric acid) mixture. Samples of leaves and midribs of Golpata with moisture contents ranging from 16.63% to 70.67% at the start of the experiment, were dipped into CCB solution of four different concentrations for 2, 4, 6 and 8 hours and examined for CCB penetration and retention. Penetration was determined by using a copper and boron indicator whereas retention was calculated by X-ray spectroscopy. Results revealed that two factor chemical (CCB) concentrations and duration of dipping period have considerable effect on the preservation of Golpata but not the moisture content. Better CCB penetration was observed after 6 hours of dipping time in

both leaves and midribs but better CCB retention was found for both 6 and 8 hours dipping time for both specimen types respectively. Treatment time showed a significant effect at 5% level of confidence. Chemical (CCB) concentration had a significant effect on penetration of Golpata leaves but had no effect on the retention.

Keywords : *Nypa fruticans*, CCB dip treatment, penetration, retention

INTRODUCTION

Nypa fruticans locally called Golpata is a mangrove palm with a wide variety of uses. It is one of the valuable non-wood forest plant species of mangroves of Asia and the Pacific. Its leaves are made into roof thatches in Bangladesh, India, Burma, Vietnam, Malaysia and the Philippines (FAO 1994). The leaves are also used in the manufacturing of bags, baskets, hats, mats, raincoats, wrappers and such like. Sun-dried Golpata petioles are a source of firewood, whilst the skin of fresh petioles can be turned into ropes for tying purposes. Sap can be extracted from its inflorescence and made into sugar, alcohol or vinegar. The fruits are edible and can be consumed fresh or preserved (FAO 1994). Besides the economic significance, Golpata is also of ecological importance as it protects soil erosion. However, the use of Golpata as thatching material in Bangladesh is mainly confined to people of low income category, particularly those living in the sundarban (mangrove forests) areas (Source : ADB 1992). Golpata is the third most important commercial product from the sundarban forests of Bangladesh. The country has a yearly estimated production of one fortieth million of US dollars. The revenues collected from Golpata showed an increase from 2 to 5.8 million taka between 1980 - 1991, which is an increase of about 200% over a ten-year period (Source : ADB 1992).

The demand for Golpata is expected to rise to commensurate with an increasing population growth; and in due time, it is anticipated that demand will exceed the supply. Besides high demand, a decrease in supply may also be attributed to gradual ecological changes, unplanned harvesting as well as the fast turnover of the product due to its limited life-span. To sustain the supply, planned cultivation and harvesting of Golpata should be implemented. An immediate and short-term approach to overcome this problem would be to prolong the durability period of the thatching material, which is normally between 2 to 3 years, to several times more (Hunt and Garratt 1953). Preservative treatment previously done on thatching materials of sungrass, rice stalk and bamboos showed that the service life could be prolonged 10 to 15 times more than when they were not treated (Anon 1984).

The objective of this study was to investigate the treatability of Golpata leaves by using a mixture of chromated-copper-boric acid (CCB, with modification from FRI 1970) in the ratio of 2:2:1 as a chemical preservative. This study undertakes to determine the optimum preservative concentration and the optimum dipping period of Golpata leaves and midribs.

MATERIALS AND METHODS

Golpata Sample Collection and Preparation

In practice air-dried, wet and fresh or green Golpata leaves and midribs are used and hence these forms were used to investigate the treatability using CCB dip treatment. Air-dried and wet Golpata were collected from the local market, whilst fresh or green Golpata were harvested from the field. Fronds selected for dip treatment were cut into approximately six-inch length pieces. The leaves were separated from the midribs and they were all marked with non-leachable ink for reference. The density and moisture content of leaf and midribs before treatment were determined by oven drying them at 60° C (AWPA 1986). The leaf length, breadth and lamina thickness of Golpata leaves were also recorded.

CCB Preparation and Treatment

The main components of 'CCB' were Sodium Dichromate, Copper Sulphate and Boric Acid. These were purchased from the local market. The compound 'CCB' was prepared by mixing the three chemicals in the ratio of 2 : 2 : 1 respectively (FRI 1970). The basic mixture consisted of 260g Sodium dichromate, 260g Copper sulphate and 130g Boric acid.

The mixture was added to 2.24 kgs (5 pounds) of water to make up a homogenous stock solution from which dilutions of 10%, 8%, 6% and 4% were made. Each concentration was then placed in four separate plastic containers. Samples from each homogenous dilution were taken and each concentration was verified by X-ray Spectroscopy. After verification the solutions were found to be 2.24%, 3.16%, 4.20% and 5.00% instead of 4, 6, 8 and 10% respectively. This happened due to the presence of large amounts of impurities in the chemicals especially in copper sulphate which were unavoidable.

Assay of CCB Penetration and Retention

The dry weights of each of the samples were recorded before they were dipped into the various preservative concentrations. The samples were each submerged for durations of 2, 4, 6 and 8 hours in each of the 4 concentrations. At each time interval, the samples were taken out, dried with tissue papers and weight readings recorded. Penetration of CCB preservatives into the leaves and midribs were checked by using Copper indicator (Chrome-azurol solution) and Boron indicator (solution 1 & 2, as per AWPA, A3-84, 1986). The samples were checked and categorized as "all-through deep" (ATD) penetration or "all-through light" (ATL) penetration. If the penetration was not all-through, they were recorded as "side and end" (SE), "cuticle deep and inner-side light" (CL), "cuticle deep and inner-side no" (CN), or "cuticle deep and inner-side deep" (LD) penetrations. If the penetration is ambiguous, it is categorized as not clear (NC), and "end and middle" (EM) penetration.

Retention of CCB preservatives into the leaves and midribs were determined by using X-Ray Spectroscopy (AWPA 1986) and the reading was expressed in pound per cubic feet (pcf).

RESULTS AND DISCUSSION

The production of Golpata increased approximately 6% but its revenue (price) collection increased to about 200% over a ten - year period between 1980 - 1991. This may be due to the higher demand of Golpata than the production and supply. As an increase in Golpata production is neither easy nor practical at this moment, the use of CCB preservative treatment may increase the life-span (durability) of Golpata to 5 - 10 times more than the normal life-span. This may indirectly help to satiate the demand quickly. The average density of leaves was found to be 0.57 g/cc or 36.197 lb/cft (pcf) and that of midribs was 0.43 g/cc or 26.75 lb/cft (pcf).

CCB Penetration in Leaves

For dry leaves of 16.63% moisture content, ATD penetration of Cu was observed at concentrations 2.24 to 4.2 % of CCB during the first 2 hours (Table 1). However, the penetration became ATL when the duration was more than 2 hours (with one exception of at 8 hours). This indicated that Cu penetration was limited by two factors. Firstly, at concentrations of higher than 4.2 % and secondly, for dipping durations of more than 2 hours where beyond these points, performance decreases. The reason for the good penetration during 2 hours dipping rather than 4, 6 and 8 hours is still unknown from this study.

For wet leaves of 70.67% moisture content, the best penetration results were found in the 2 hours' dipping duration. Here, 75% of samples exhibited ATD penetration for both the Copper and Boron tests and the remainder 25% ATL for 2 hours' dipping period.

For fresh or green leaves of 59.23% moisture, content, ATL and ATD penetration occurred haphazardly for 2 and 4 hours dipping period. For fresh or green leaves, the best preservative penetration was for 6 and 8 hours' dipping duration for all concentrations.

Hence, it is recommended that Golpata treatment of dry and wet leaves be of 2 hours' dipping duration with 3.00% - 4.00% of CCB concentration, and 6 or 8 hours' dipping duration for fresh green leaves with the same chemical concentration.

CCB Penetration in Midribs

For dry midribs which contained 30.03% moisture content, 25% of samples showed only side and end penetration (SE) at 2.24% of CCB concentration for 2 hours in the Copper test (Table 2). However, for cuticle deep and inner-side, no penetrations (CN) were observed in 100% samples at 5% of CCB concentration for all soaking durations in the Copper test. For the Copper test alone, 75% of samples gave an ATL penetration in 4 hours' soaking time, but this was 25% ATD and 25% ATL for other time periods. On the other hand, Boron test exhibited better penetration results than Copper. In all concentrations and time periods it was either ATD or ATL.

For wet midribs having 116.91% MC, ATL penetration was observed in all concentrations for 2, 4 and 6 hours in the Copper test except for one case at

TABLE 1
Penetration of CCB in Golpata leaves at two hourly intervals

Concentration %	Penetration							
	Duration (hours)							
	2 hours		4 hours		6 hours		8 hours	
	Cu	Br	Cu	Br	Cu	Br	Cu	Br
	Dry leaf =16.63% MC							
2.24	ATD	ATL	ATL	ATD	ATL	ATD	ATD	ATL
3.16	ATD	ATD	ATL	ATL	ATL	ATD	ATL	ATD
4.20	ATD	ATD	ATL	ATD	ATL	ATD	ATL	ATL
5.00	ATL	ATD	ATL	ATD	ATL	ATD	ATL	ATD
	Wet leaf = 70.67% MC							
2.24	ATD	ATL	ATL	ATD	ATL	ATD	ATL	ATL
3.16	ATD	ATD	ATL	ATL	ATL	ATD	ATL	ATL
4.20	ATD	ATD	ATL	ATD	ATL	ATD	ATL	ATD
5.00	ATL	ATD	ATL	ATD	ATL	ATD	LD	ATD
	Fresh or Green = 59.23% MC							
2.24	ATL	ATD	LD	ATL	ATL	ATD	ATL	ATD
3.16	CN	ATD	ATL	ATD	ATL	ATD	ATL	ATD
4.20	ATL	ATL	LD	ATL	ATL	ATL	ATL	ATD
5.00	CN	ATL	ATL	ATL	ATD	ATD	CL	ATD

4 and 6 hours in 5.0% and 3.16% of CCB concentration, which gave SE and LD penetration respectively. In the case of 8 hours' soaking time, copper penetration was 75% LD and 25% ATL. No ATD was found for any concentration at any time for the Copper test. Results of Boron penetration were better than Copper in all cases where it was either ATD or ATL. For wet midribs, 2 hours' soaking time in 2.25 to 5.0% concentration is recommended.

For fresh or green midribs containing 66.40% moisture content, 100% samples showed end and middle section (EM) penetration at 2.24% of CCB concentration for all soaking times and at all concentrations for 4 hours in Copper test. Boron penetration was better than Copper. It was found to be either ATD or ATL penetration at all CCB concentrations for all time periods. This study found that for fresh midribs, 4 hours' soaking time with 3.16% to 5.0% chemical concentration may be recommended.

CCB Retention in Leaves

For dry leaves, the best retention at 0.273 pound per cubic feet (pcf) was found in 4.20% of CCB solution for 6 hours and 0.262 pcf retention was found at 5.00% of CCB solution for 8 hours (Table 3). An overall good retention was found for 6 hours of soaking with CCB at all concentrations. So, for dry leaves,

TABLE 2
Penetration of CCB in Golpata midribs at two hourly intervals

Concentration %	Penetration							
	Duration (hours)							
	2 hours		4 hours		6 hours		8 hours	
	Cu	Br	Cu	Br	Cu	Br	Cu	Br
	Dry midribs =30.03% MC							
2.24	SE	ATL	ATL	ATL	ATD	ATD	ATD	ATD
3.16	ATL	ATD	ATL	ATL	ATL	ATD	ATL	ATL
4.20	ATD	ATL	ATL	ATL	LD	ATL	CD	ATL
5.00	CN	ATL	CN	ATL	CN	ATL	CN	ATL
	Wet midribs = 116.91% MC							
2.24	ATL	ATD	ATL	ATD	ATL	ATD	LD	ATL
3.16	ATL	ATD	ATL	ATD	LD	ATL	LD	ATD
4.20	ATL	ATL	ATL	ATD	ATL	ATL	ATL	ATL
5.00	ATL	ATD	SE	ATL	ATL	ATD	LD	ATD
	Fresh or Green midribs =66.40% MC							
2.24	EM	ATL	EM	ATL	EM	ATD	EM	ATL
3.16	EM	ATL	EM	ATD	ATL	ATL	EM	ATD
4.20	NC	ATD	EM	ATD	EM	ATL	NC	ATL
5.00	EM	ATD	EM	ATD	EM	ATD	EM	ATD

6 hours' soaking time with 4.20 - 5.0% chemical concentration may be recommended.

For wet leaves, the best retention of 0.263 pcf and 0.264 pcf were found in 5% solution for 6 hours and 4.20% solution for 8 hours respectively. But the good retention was found as a whole at 2.24%, 3.16% and 4.20% CCB for 8 hours. So, for wet leaves, 8 hours' soaking time with 2.24 - 4.20% chemical concentration or 6 hours with 5.0% chemical concentration might be recommended.

In fresh leaves, the best retention of 0.252 pcf and 0.272 pcf were found at 4.20% and 5.00% of CCB concentrations respectively, for 6 hours' dipping. But the overall good retention was found for all solutions for 4 hours. So, for fresh leaves, 4 hours' soaking time with 4-5% of CCB concentrations may be recommended.

CCB Retention in Midribs

For dry midribs, the best retention of 0.267 pcf and 0.366 pcf were found at 4.20% and 5.00% of CCB solution respectively for 8 hours (Table 4), with an overall good retention found for all solutions during 8 hours of soaking. So, for dry midribs, 8 hours' soaking time with any of the four chemical concentrations, especially 4.20 - 5.0% concentrations, may be recommended.

For wet midribs, the best retention at 0.795 pcf was found at 5.00% concentration for 8 hours. The overall good retention was found for all solutions during 6 hours of soaking. So, for wet midribs, 6 hours' soaking time with any of the four solutions at 4-5% or 8 hours' soaking time with 5.0% solution may be recommended.

TABLE 3
Retention of CCB in the Golpata leaves at two hourly intervals

Retention (pcf)

Concentration %	Duration (pcf)			
	2 hrs	4 hrs	6 hrs	8 hrs
		Dry leaf= 16.63 % MC		
2.24	0.034	0.026	0.198	0.120
3.16	0.027	0.032	0.182	0.092
4.20	0.048	0.092	0.273	0.099
5.00	0.085	0.068	0.241	0.262
		Wet leaf= 70.67 % MC		
2.24	0.081	0.058	0.111	0.228
3.16	0.178	0.087	0.095	0.257
4.20	0.031	0.058	0.163	0.264
5.00	0.033	0.103	0.263	0.012
		Fresh or Green leaf = 59.23 % MC		
2.24	0.021	0.159	0.071	0.238
3.16	0.073	0.120	0.048	0.034
4.20	0.129	0.215	0.252	0.231
5.00	0.025	0.281	0.272	0.000

For fresh or green midribs, the best retention at 0.194 pcf, was found at 5.00% concentration for 8 hours. So, for fresh midribs, 8 hours' soaking time with 3.16 - 5.0% chemical concentration may be recommended.

CONCLUSION

It is obvious from this study that Golpata can be treated with the preservative CCB (Chromated Cupper Boric Acid) mixture. This study recommends that Golpata should be dipped for 6 - 8 hours, in 4 - 5% CCB for optimum preservation. To minimize costs, treatment should be carried out commercially to fulfill the nation's demand for Golpata. As the chemicals are easily available locally at minimum cost, Golpata should be chemically treated so as to increase their durability and hence minimize thatching cost.

TABLE 4
Retention of CCB in the Golpata midribs in two hourly intervals

Concentration %	Retention (pcf) Duration (pcf)			
	2 hrs	4 hrs	6 hrs	8 hrs
	Dry leaf= 30.03 % MC			
2.24	0.046	0.061	0.083	0.161
3.16	0.083	0.095	0.118	0.165
4.20	0.063	0.122	0.230	0.267
5.00	0.079	0.114	0.236	0.366
	Wet leaf= 116.91 % MC)			
2.24	0.088	0.057	0.179	0.093
3.16	0.017	0.027	0.149	0.184
4.20	0.027	0.149	0.203	0.032
5.00	0.048	0.029	0.178	0.795
	Fresh or Green leaf = 66.40 % MC			
2.24	0.054	0.065	0.075	0.096
3.16	0.079	0.079	0.085	0.147
4.20	0.093	0.101	0.116	0.162
5.00	0.077	0.101	0.100	0.194

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