Asian Journal of Chemistry Vol. 15, Nos. 3 & 4 (2003), 1845–1847

NOTE

A New Chemical Method of Wood and Bamboo Preservation Based on Bis(2-methylpiperazinedithiocarbamato) Cu(II) and Di(2-methyl-5-chlorophenyl) Dithiophosphinato Triorganotin(IV) Compounds

PRADIP K. GOGOI*, RUBY BARUAH and JUTHIKA SONOWAL
Department of Chemistry, Dibrugarh University, Dibrugarh-786 004, India
E. mail: dr_pradip@yahoo.com

A new method of wood and bamboo preservation has been developed. Treatment of DMF solution of bis(2-methylpiperazinedithiocarbamato) Cu(II), Cu(2-Mepipzdte)$_2$ and ethanolic solution of di(2-methyl-5-chlorophenyl) dithiophosphinato triorganotin(IV), R_3Sn(MeCldtpi), for 24 h followed by drying and treatment with kerosene oil prevented wood and bamboo from attack by fungus, bacteria and common white ants. MIC values of these compounds against *E. coli* and wood degrading fungi *Clostridium cumeni* were evaluated. R_3Sn(MeCldtpi) was found to be a more effective antifungal and antibacterial compound.

Key Words: Wood, Bamboo, Preservation, Bis(2-methylpiperazinedithiocarbamato) Cu(II), Di(2-methyl-5-chlorophenyl) dithiophosphinato triorganotin(IV).

Bamboo and wood are the two most important forest products of the tropical regions and extensively used as house building materials and also used in making furniture, fencing, handicrafts and host of other items. However, they are susceptible to degradation and decay due to several factors such as attack by fungus, bacteria and white ants in presence of moisture. If by the use of some appropriate methods, the self-life of these materials can be enhanced it will be a boon to our rural economy and in conserving the ecology as well. There are reports of the use of copper sulphate, chromium, arsenic and boron compounds as antifungal and antibacterial wood preservatives[1, 2], but of these chromium and arsenic are not environmental friendly. As dithiocarbamates and dithiophosphinates are known as established antifungal and antibacterial compounds, we have used their Cu(II) and triorganotin(IV) complexes in a modified way as bamboo and wood preservatives against fungus, bacteria and common white ants. Some preliminary results were earlier reported from our laboratory[3, 4]. We now report here the detailed procedure and probable mechanism of action of bis(2-methylpiperazinedithiocarbamato) Cu(II) and di(2-methyl-5-

chlorophenyl)dithiophosphinato derivative of triorganotin(IV) chloride as bamboo and wood preservatives.

The sodium salts of 2-methylpiperazinedithiocarbamate, (2-Mepipzdte) and di(2-methyl-5-chlorophenyl)dithiophosphinate (MeCldtpi) were prepared and purified by reported methods[5,6]. The copper(II) and triorganotin(IV) compounds were synthesized as reported earlier[4,6]. For evaluation of antifungal, antibacterial and anti-white ant activity of these compounds, one year old bamboos (*Bambusa tulda*) were cut in 6 cm long and 2 cm wide pieces while second class wood pieces of *Gaumori* (*Foericulum vulgare*) of same length with 3 cm × 3 cm dimension were taken. The wood and bamboo pieces were then dipped in a 5% solution of either $Cu(2\text{-Mepipzdte})_2$ (dissolved in DMF) or $R_3Sn(MeCldtpi)$ (dissolved in ethanol) for 24 h. They were then dried in air and dipped again in kerosene oil for 1 h and dried. Similar pieces of bamboo and wood originally from the same piece were also taken and kept untreated with either of these compounds. Both normal and control types of bamboo and wood pieces were then exposed to fungus and common white ants by keeping them half buried in moist soil for 3 months and then were examined visually. Separate antifungal and antibacterial tests against wood degrading fungus *Clostridium cumeni* and *E. coli* bacteria were also performed by standard plate dilution method[7].

From the antifungal and antibacterial screening data (Table-1) it is observed that both the compounds inhibit fungal and bacterial growth. Compared to $Cu(2\text{-Mepipzdti})_2$, triorganotin(IV) derivative of di(2-methyl-5-chlorophenyl) dithiophosphinate was a more effective inhibitor, which is expected because this compound is a combination of two biocidal groups, the triorganotin(IV) moiety and dithiophosphinate group, in the same molecule and it is likely to produce more potent and lasting biocidal effect. Further, organotin(IV) compounds are used as antifungal and antifouling agents for quite a long time[8].

TABLE-1
ANTIFUNGAL AND ANTIBACTERIAL SCREENING DATA

Inhibition (%)	*Clostridium cumeni*		*E. coli*	
	Concentration (μg/mL)		Concentration (μg/mL)	
	$Cu(2\text{-Mepipzdte})_2$	$R_3Sn(MeCldtpi)$	$Cu(2\text{-Mepipzdte})_2$	$R_3Sn(MeCldtpi)$
25	38	10	45	18
50	62	25	68	22
100	86	35	110	28

The effectiveness of these compounds as fungal and bacterial growth inhibitors could be due to the interaction of the nucleic acid components of these organisms with the sulphur ligands[9], which contains lone pairs and are good reducing agents, or the metal moiety which are good acceptors.

On exposure of the bamboo and wood pieces to fungal and other bacterial and white ant attack it was observed that those treated with the compounds as described earlier were not degraded by fungus, bacteria or eaten by white ants

but those untreated were heavily degraded and eaten by white ants. After treating with the dithio compounds, the use of kerosene has twofold effect. First, it is a mild termite deterrent and secondly it fills the pores of the bamboo and wood fibre and being a mixture of aromatic and aliphatic hydrocarbons it acts as a hydrophobic agent and prevents water from entering the pores. In the absence of moisture and air inside the pores, the fungal and bacterial growth is further retarded. Similar studies with boric acid, sodium borohydride and sodium fluoroborate in presence of these sulphur compounds are in progress and encouraging results are obtained.

ACKNOWLEDGEMENT

Thanks are due to Dr. A.C. Phukan, Assistant Director, Regional Medical Research Centre (ICMR), Lahoal, Dibrugarh for his assistance in antibacterial screening of the compounds in his laboratory.

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(*Received*: 30 January 2003; *Accepted*:12 May 2003) AJC-3121