

## **The Efficacy of Organo-Complex Based Wood Preservatives Formula against Drywood Termite *Cryptotermes cynocephalus* Light**

by

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### **Abstract**

The utilization of pesticides often leaves residues which potentially pollute the environment. This issue has been encouraging some researchers to find an environmentally friendly insecticide with cheaper wood preservative method. International Standard for Phytosanitary Measures 15 (ISPM 15) adopted in wood packaging protection in Europe is not suitable for tropical countries like Indonesia. Therefore, the treatment by Organo-complex based wood preservation which consists of copper chromium combined with natural organic compound, is proposed for effective treatment at lower cost. The bioassay test was subjected toward dry wood termite *Cryptotermes cynocephalus* Light. The result showed that wood materials treated by 10 ppm Organo-Complex formula gave good results which were indicated by the low consumption and the fast killing mechanism of termites. The toxicity analysis of C-C organic compound solution classified in the classification of toxicity by category was not harmful, namely grade IV (WHO, 2003). Analysis of residual content in the fourth week after spraying treatment showed a significant reduction, in which the composition of inorganic content (copper chromate complex) in the range of 35% and extract composition of natural materials (natural extracts compounds) was above 80%.

**Key words:** Organo-Complex formula, drywood termite *Cryptotermes cynocephalus* Light.

### **Introduction**

Methods of wood packaging product protection differ in each country. As a tropical country, Indonesia has higher humidity than European countries, so that the wood packaging protection differs among those countries due to their climate. Beside that, there are differences in raw materials used in wood packaging product. In Indonesia, wood packaging manufacture is a home industry which having wood supply from several local supplier with various kinds of wood species and unknown age, meanwhile the wood packaging product in Europe is made from softwood with similar age (e.g pine wood of 5 years). Furthermore, International Standard for Phytosanitary Measures 15 (ISPM 15) adopted in wood packaging protection in Europe is not suitable for Indonesia. Thus, it is necessary to find a new preservative method of wood packaging product in accordance with climate conditions in Indonesia with relatively cheaper cost.

Environmental pollution issues encourage some researchers to find environmentally friendly insecticides. Further study is required regarding the toxicity levels and residual contains in treated wood product. Toxicity test of insecticides is done generally by oral and dermal toxicity in order to

know the effect on digestion and their toxicity on contacts with skin. The content analysis of these residuals will provide information on how much residual material left in the wood packaging products after treatment. These residual contents should not exceed the required standard since it can be harmful to human health and can cause environmental pollutions.

The aim of this research was to evaluate efficacy of Organo-Complex Based Wood Preservatives Formula against drywood Termite *C. cynocephalus* Light and to study about its residual contains on wood product treated as well as its toxicity.

## Materials and methods

### *Dry wood termite test*

The chemical solution consisted of the combination of sodium bichromate, copper (II) sulphate, *Nicotiana tobaccum* and *Eugenia carryophyllata* extracts. The test blocks were subjected to dry wood termite by forced-feeding test according to Indonesian National Standard (SNI) 01-7207-2006. Wood plate samples (2 cm x 2 cm x 1 cm ) treated by chemical substance solution, 10 ppm CC-organic compound (1:1), were subjected into glass box size 4 cm x 4 cm x 4 cm with 50 workers of drywood termite in laboratory scale. Termite mortality was observed per week until 6 weeks of observation, the weight loss of wood sample (rubber wood) was also determined in the end of observation. Samples preference after test was characterized by test scale below, and test value was obtained from average value of sample preference.

Table 1. Durability of wood sample based on weight loss

Grade	Durability	Weight loss (%)
I	High Resistant	<2.0
II	Resistant	2.0 – 4.4
III	Moderate	4.4 – 8.2
IV	Non-Durable	8.2 – 28.1
V	Susceptible	>28.1

### *Toxicity test of organo-complex based wood preservatives formula*

Toxicity test consisted of oral and dermal toxicity test was conducted in Faculty of Veterinary Medicine, Bogor Agricultural University, Indonesia.

### *Residual contains test of wood treated by organo-complex based wood preservatives formula*

#### a) Analysis of metal content (Cu and Cr)

Cu and Cr metal content was analyzed by atomic absorption spectroscopy analysis method (Atomic Absorption Spectrophotometry, AAS) using Perkin Elmer Zeeman AAS instrument 5100. The preparation wet destruction was using aquaregia, HNO<sub>3</sub>: H<sub>2</sub>SO<sub>4</sub> = 1:1

#### b) Analysis of organic content

The testing of organic content and natural ingredients extractive was performed by high performance liquid chromatography (HPLC) using Shimadzu HPLC instrument. The test specimens were prepared by soxletation method using methanol solvent.

## Results and discussion

The results of bioassay test of C-C organic compound solution are presented in Table 2 and Figure 2. In this study, rubber wood (*Hevea brasiliensis*) with less durability was used as control.

There were significant differences on weight loss percentage between untreated wood and control. The average value of untreated wood weight loss was 8.6% showing low resistance against dry wood termite. Meanwhile, wood treated by C-C organic compound solution was showing high resistance against dry wood termite with average value of 1.4%. It can be concluded that C-C organic compound solution can be classified into Grade I as high resistant with termicide activity against dry wood termite *C. cynocephalus* Light.

Table 2. The result of weight loss percentage of drywood termite test

Wood Specimens	Average Value (%)	Grade Level
Untreated wood	8.6	IV (Non-Durable)
Wood treated by CC-organic compound (1:1)	1,4	I (High Resistant)

Termicide activity of C-C organic compound solution also presented by percentage of termite mortality. Figure 2 shows the average value of termite mortality on treated and untreated wood. On the second day of testing, treated wood showed a quick response of C-C organic compound solution treatment presented by 100% termite mortality. A rubber wood as control showed 17% of termite mortality which was less than the termite mortality at the end of observation.

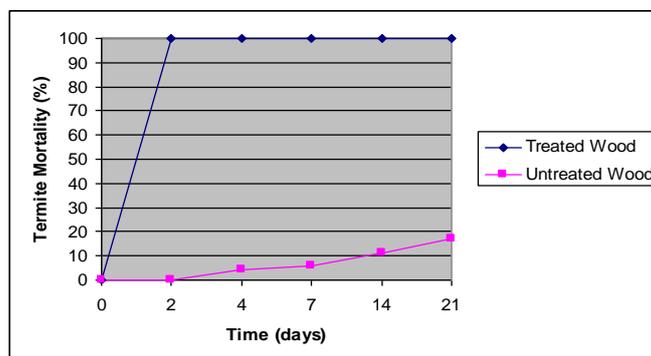


Figure 1. Termite mortality rate of essential oil evaluated

The result of termite bioassay in Table 2 and Figure 1. shows that C-C organic compound solution has a termicide activity against *C. cynocephalus* Light. These results were supported by the previous study of C-C organic compound solution having insecticide activity toward *Coptotermes gestroi* and Powder Post Beetle *Heterobostrychus aequalis* (Ismayati et al., 2009; Setiawan et al., 2010). However, further analysis was necessary particularly in toxicity and residual contains analysis for field applications.

Toxicity test of C-C organic compound solution was conducted on oral and dermal toxicity. In oral toxicity test, C-C organic compound solution was treated in 5 male mice with single dose (5000 mg/kg body weight and observed changes in behavior and physiological reactions in 1 hour, 2 hours, 3 hours, 4 hours and 24 hours after treatment). Observations in this test consisted of body weight, mortality and clinical symptoms of mice until the fourteenth day of testing. The results showed that there were no mortality of mice after C-C organic compound solution was treated during test and there were changes in mice behavior showed by symptoms excitation, hyperlacrimation, weakness and hair stood.

Table 3 Average body weight groups of Sprague Dawley rats receiving treatment of acute oral toxicity, after treated by C-C organic compound solution with a dose of 5000 mg / kg.

Test period (day)	Weight body (WB) of mice (gram)	
	Untreated mice	Treated (5.000 mg/kg WB)
0	208,84	211,28
1	210,51	202,32
2	211,28	205,74
3	213,49	208,11
4	215,85	209,94
5	216,71	210,51
6	218,49	212,30
7	220,06	213,63
8	222,77	215,58
9	224,51	217,61
10	226,26	219,29
11	227,48	221,84
12	229,95	223,53
13	231,61	224,47
14	234,25	226,59

During 14 days of observation, treated mice by C-C organic compound solution were showing weight loss until the sixth day and were increasing again until the end of test periods. Results of body weight of mice for 14 days are shown in Table 3.

The macroscopic observations on visceral organ groups on mice treated with C-C organic compound solution showed changes of anatomical pathology such as dilatation on right and left ventricular hypertrophy in the heart, pneumonia and congestion of the lungs, congestion in the kidneys, lever and lymph and degeneration of the liver.

As well as oral toxicity test, dermal toxicity test was conducted on mice treated by maximum dose of 2000 mg/kg body weight. In 14 days of observation, there were no mice mortality and hair stood behavior of mice has been seen until second hour and after third hour of observation there were no abnormal behavior. As long as observation skin of mice was normal and did not found any abnormal behavior such as skin irritation, redness and another of hypersensitivity symptoms. During test observation, body weight of mice treated by C-C organic compound solution still increased as reported in Table 4. The macroscopic observations on visceral organ groups of mice treated with C-C organic compound solution showed changes of anatomical pathology such as congestion in lungs and liver. However, generally the damage on organ or tissue on a macroscopic observation of the visceral organs was not found.

Analysis of residual content was conducted to determine the extent of pesticide content of the material left in the wood product packaging treated by a C-C organic compound solution. The protection of wood products was conducted by spraying system (spray), adjusted for insecticide application in the field. The used specimen was wood sengon with size of 2 cm x 2 cm x 1 cm. Analysis of inorganic materials content (copper chromate complex) using atomic absorption spectroscopy measurement methods (AAS) was started with the preparation of test specimens of the treated wood, and wood specimens of the control test. The analysis was conducted with flame AAS (flame) using a standard Cu and Cr at concentrations of 1.25, 2.5, 5.0, 7.5 and 10.0 ppm manifested in the standard curve. The result of inorganic contents shows on Table 5:

Table 4 Average weight loss group Sprague Dawley rats receiving treatment of acute dermal toxicity, after treated by C-C organic compound solution with a dose 2000 mg / kg.

Test period (day)	Weight body (WB) of mice (gram)	
	Untreated mice	Treated (2.000 mg/kg WB)
0	208,84	206,94
1	210,51	207,51
2	211,28	209,29
3	213,49	211,50
4	215,85	212,73
5	216,71	214,48
6	218,49	215,59
7	220,06	216,71
8	222,77	218,29
9	224,51	221,07
10	226,26	223,84
11	227,48	225,57
12	229,95	228,31
13	231,61	230,22
14	234,25	232,48

Table 5. Inorganic compound (copper chromium complex) of treated wood specimens

Sample Specimens	Cu (mg/l)	Cr (mg/l)
Control (Untreated wood)	0,075	0,020
CC-Organic compound solution	4603	3963
Wood treated by CC-Organic compound solution	2,4	2,060

Analysis results of organic content, natural extractives materials, using high performance liquid chromatography (HPLC) are presented in Table 6. Preparation of test specimens was made with soxletation method using methanol as solvent.

Table 6. Percentage of organic content on wood samples

Sample specimens	Initial Intensity	Residual intensity (after 4 weeks)	Decreasing percentage
Acetic acid	9186,81	-	100%
Tobacco extract	29464,18	4467,968	84,835%
Citric acid	17315,82	545,390	96,85%
Clove extract	7832,53	54,422	99,305%

Table 6 shows that extract content of tobacco has the highest residues indicated by a relatively high peak intensity (peak retention 3.640). Results of chromatographic analysis (HPLC) showed decrease in the content natural extractive materials of wood packaging products for more than 80% in the fourth week. In fact, acetic acid decreased 100%, or does not leave residue at all after the fourth week after spraying a solution of C-C organic compound solution. This can be understood, because extract natural ingredients such as citrus and clove are a volatile compound.

### Conclusion

1. The present study has confirmed that CC-Organic compound solution have a potential termiticidal activities against drywood termite *Cryptotermes cyanocephalus* Light.

2. The CC-Organic compound solution classified in the classification of toxicity by category is not harmful, namely grade IV (WHO, 2003).
3. Analysis residual content in the fourth week after spraying treatment has showed a significant reduction, in which the composition of inorganic content (copper chromate complex) in the range of 35% and extract composition of natural materials (natural extracts compounds) above 80/

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