

Preservation of Durian Timber by Kecubung Fruit Extract Againsts Termite Attack

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1 Research Article

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3 Preservation of Durian Timber by Kecubung Fruit Extract Againsts Termite Attack

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13 Abstract

14 Durian wood is a type of wood that grows in abundance the region of Gunungpati Semarang,
15 Indonesia. Unfortunately Durian timber is included in the type of wood that is not resistant to
16 termite attack, so they need to be preserved in order to increase the durability. One of the plants
17 that can produce natural preservatives is the Kecubung fruits (*Datura Metellim*) containing
18 very strong toxins (alkaloids). This research used experimental method, by cold soaking
19 method preservation with concentration of preservative extract of Kecubung fruits 0%, 15%,
20 20%, and 25%, duration time 120 hours. The result of the experimental research showed that
21 the termite endurance test on durian timber at 0% concentration of preservative (control test
22 specimens) the weight had decreased by 17.89%, while the concentration of preservation at
23 15%, 20%, and 25% had decreased the weight by 10.49%, 8.78%, and 3.63% respectively.
24 Therefore, preservation of durian timber using cold soaking method at 120 hours by using the
25 Kecubung fruits extract with 25% concentration gives the best result and the Kecubung fruits
26 can be the alternative solution for the wood preservation which is the form of organic
27 compound and environmental friendly.

28 **Keywords:** Wood preservation, Durian timber, Termite, Kecubung fruit

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30 1. Introduction

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31 Indonesia is a country with natural resources, one of which is wood. Wood is a material
32 used in the daily life, whether used as home furnishings or as a construction material. The
33 national demand for timber is expected to increase by more than 60 million m³ per year [1].
34 While the Indonesian forest timber production reaches 35 million m³ [2]. In order to ensure
35 that there is enough supply of timber for the nation, the people are encouraged to be involved
36 in the wood plantation sector. Currently the demand for wood that has high quality and
37 durability is increasing, although the price is high. Therefore, action need to be taken to
38 improve the quality of wood that can be used as an alternative building material that is safe and
39 economical. Most of the local people in the region used such wood as a building material
40 because the price is relatively cheap and easy to be obtained, such as sengon wood, rambutan
41 wood, durian wood, jackfruit wood, and coconut wood.

42 The Gunungpati district area is a plateau, consisting of agricultural and plantations areas.
43 Gunungpati District is the potential area to be a center for farming garden and fruits in the
44 Semarang city [3]. According to BPS in [4] the population of fruit trees that exist in Gunungpati
45 consists of eighty thousand rambutan trees, fifty thousand durian trees, and ten thousand mango
46 trees. Durian wood with the Latin name *Durio Zibhetinus* including the wood type with the
47 average weight of 0.4 - 0.6. Durian timber has a specific gravity of 0.57 and includes the class
48 category II-III. Generally Durian timber has a low durability value, medium hardness, coarse
49 texture, and straight fibrous. The weakness of durian wood is that it is easily attacked by
50 termites, so action is required to ensure that the wood is resistant to termite attack and has a
51 long lasting durability in its use [5].

52 According to Indonesian National Standard [6], preservation of wood is a process inserting
53 preservatives into wood to extend its service life. The research on fresh bamboo pickling on
54 dry wood powder can resist attack by giving 10% zinc chloride solution is able to yield salt
55 retention of 18.3 kg/cm³ [7]. Borates prevent fungal decay and are deadly to termites, carpenter
56 ants and roaches – but safe for people and the environment. Boron is not fixed chemically
57 to wood, and it will be leached out if wood used is subjected to a wet environment [8].
58 According to Lesar [9] a wood preservation with the addition of montane wax emulsion and
59 boric acid prevent wood decay fungi. However leaching test performed that addition of
60 montane wax decrease boron leaching from impregnated specimens for 20% up to 50%.

61 Syaswan et al. [10] managed to overcome the leaching problem by determining the amount
62 suitable for the rubber wood. Converting acetic and butyric acids derived from landfill leachate

1

into acetate and butyrate salt, leachate can be fermented and potentially turns into a valuable wood preservative. The research of preservation of sengon timber using a mixture of boric acid and borax, by 9% of concentration for a duration of 120 hours, can increase the physical properties of sengon timber [11].

Types of preservatives can made of natural ingredients. The Kecubung plants are wild shrubs that grow in lowland areas up to an altitude of 800 m above sea level [12]. As grown in the Gunungpati region, because of its location at an altitude of 300 m above sea level. Kecubung (*Datura Metellina*) plant resembles a trumpet and is white or violet. The fruit is almost round with thorns on the outer side of the fruit and the inner side containing small seeds. The Kecubung is one of the plants that can produce vegetable pesticides, which contains toxins (alkaloids) that are strong enough [13]. According Palopo [14] Kecubung is a kind of pesticide plant which have a chemical content of alkaloids that are potentially toxic if entered in the body of mice through the metabolism system. The most alkaloid content is found in the seeds of the Kecubung plant, which produce the hormone that causes metamorphosis failure [15].

This research is an experimental study of the use of the Kecubung plant extract as natural preservatives in durian timber. The aim of this study is to determine the effectiveness of using the Kecubung extract as the preservative for durian wood, to resist termite. Thus, need to identify the concentration on the Kecubung fruit that is suitable for the wood preservation

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2. Materials and methods

2.1. Material Preparation

This study used a durian timber from Gunungpati Semarang. The specimen was taken from one-third part of timber [16]. The sampling methods and requirement for physical and mechanical testing was performed according to Indonesian National Standard [6]. The durian timber was cut into smaller fragments using a saw the size of 30 x 30 x 30 mm (Radial x Tangential x Longitudinal) for 40 pieces for physical test and 25 x 25 x 5 mm for 20 pieces for termites attack test, shown in Figure 1.



Figure 1. The Making of Specimen Test

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2.2 Wood Preservatives

The Kecubung fruit is cut into small pieces and dried in the sun for about 3 days until dark brown, then mashed into a powder form. The extract is then made into a preservative solution with concentrations of 15%, 20%, and 25% as illustrated in Figure 2.

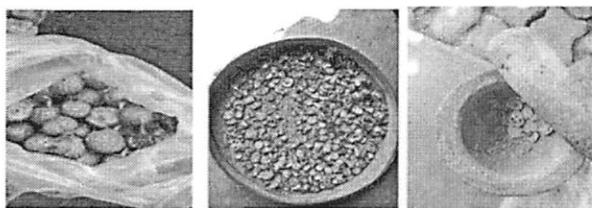


Figure 2. The Making of Kecubung Preservatives

2.3 The Soaking of Durian Timber

The method of preservation used the cold soaking method. Before the soaking process, the specimens were dried until the weight is constant, then weighed. The test specimens were soaked into a glass containing aqueous solution and the Kecubung powder with concentration of 15%, 20%, and 25%, respectively with volume sufficient to cover up the whole the specimen. This soaking process occurs for a duration of 120 hours or less for 5 days as presented in Figure 3.

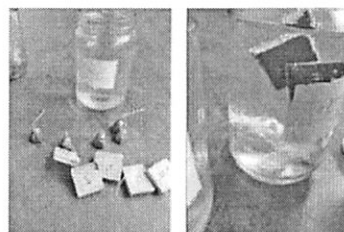


Figure 3. The Soaking Process of Specimen

2.4 Termites Attack Test

For the termite attack test, five specimens from each concentration were inserted in a glass containing 200 grams of soil, placed by standing on the bottom of a glass, as shown in Figure 4. As much of fifty healthy and active termite (*Coptotermes curvignathus Holmgren*) were inserted in each of the glass containing the specimens, then the samples were kept in a dark place for 6 weeks. The dead termites were removed from the glass to avoid being eaten by other termites. After the termites attack period, the specimens test were removed from the glass and their surface were carefully cleaned off from the termites. Next, the percent weight loss of specimen is calculated using the following equation:

$$P = \frac{w_1 - w_2}{w_1} \times 100\%$$

Where :

P : Weight loss (%)

w₁ : Weight of specimen before feeding to termites (grams)

w₂ : Weight of specimen after feeding to termites (grams)

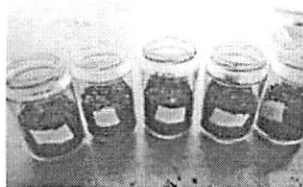


Figure 4. Termites Attack Test

3. Results & Discussion

3.1 Water Content

The result of the average water content shows that the amount of preservatives has a significant effect on the water content of the durian timber. Greater percentage of preservatives leads to lower water content, as shown in Figure 5. The lowest water content is 9.01% on the concentration of preservative 25 %.

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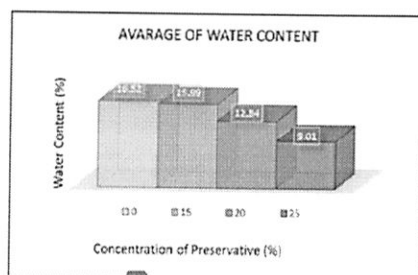


Figure 5. Water Content of Durian Timber

3.2 Specific Gravity Of Durian Timber

The Result of the specific gravity of the durian timber shows that the greater the percentage of preservatives, the greater is the specific gravity too, as shown in Figure 6. In the soaking process, the preservative solution permeated into the wood cells through the cell walls. When the condition of the wood was saturated, the absorption of the preservatives in the wood were stopped, and all parts of the wood were filled by preservatives.

The relationship between with the specific gravity and water content in Figure 7 shows that the higher specific gravity and the lower the water content of the durian timber can be found at the concentration of 25% preservative. The water content and the specific gravity of durian timber by 9.01% and 0.578 is found at the concentration of 25% preservative respectively. The wood cell pores were getting denser because it was filled with the Kecubung extract. The denser wood cell pores lead to a higher the specific gravity.

The preservatives that filled in the wood cells cause the pores of the wood cell to be dense. As a consequence, the water content of the wood were reduced (the hygroscopic natural of wood).

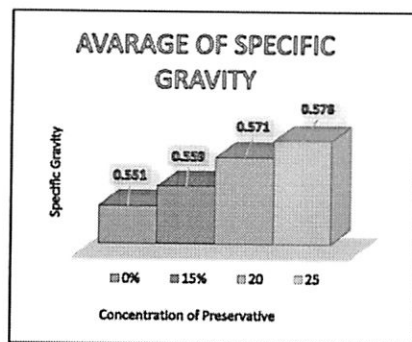


Figure 6. Specific Gravity of Durian Timber

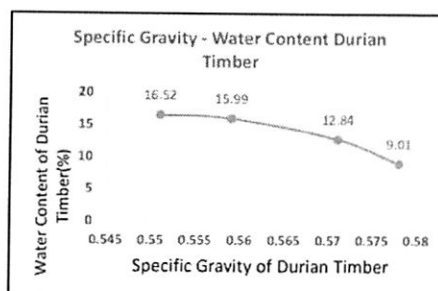


Figure 7. The Relationship of Specific gravity and Water Content

3.3 Termites Attack Test

The result of the water content test shows that the greater percentage of preservatives lead to the lower weight loss of the durian timber, as shown in Figure 8. Based on the Table 1 classification, the durian timber is categories as class IV which is bad to the resistance to termites and the findings is similar to Febrianto [17].

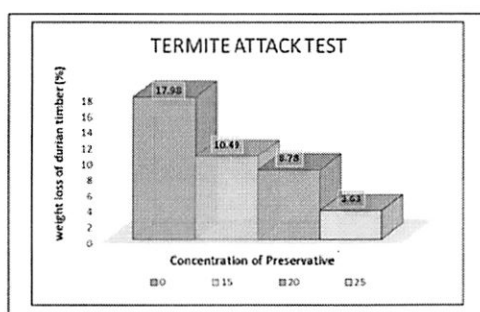


Figure 8. Weight Loss of Durian Timber

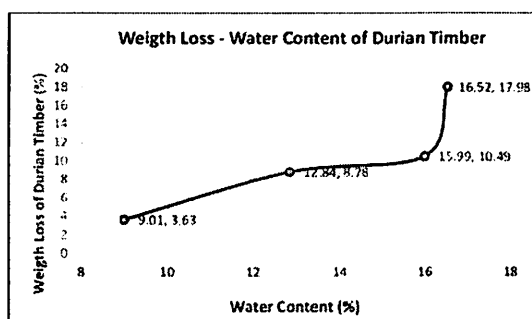
The effectiveness of preservatives was indicated by observing the weight loss of the specimen. The smaller weight reduction of the specimen means the higher level of effectiveness of the preservative and vice versa. The classification of wood resistance to termites was based on the weight loss of wood according to Indonesian National Standard [18]. The durability test of the wood was conducted by using wood destroying organisms as shows in Table 1.

The relationship between the water content with weight loss of durian wood after the termite test was higher water content lead to greater weight loss of the durian timber, as shows in Figure 9. When the timber had the low water content which was 9.01%, the cell pores on the timber was denser. On preservative concentration of 25%, the pores in the wooden cells were getting denser because it was filled by the permeation of the Kecubung extracts that contained toxins (alkaloids) so the termite attacks were reduced and the value of weight loss was at the lowest at 3.63%. Therefore, it was classified in class II according the classification in Table 1.

Table 1 The Classification of the wood resistance to termites based on weight loss

Class	Resistance	Weight loss (%)
I	Very good	< 3.25
II	Good	3.25-7.50
III	Medium	7.50-10.96
IV	Bad	10.96-18.94
V	Very Bad	18.94-31.89

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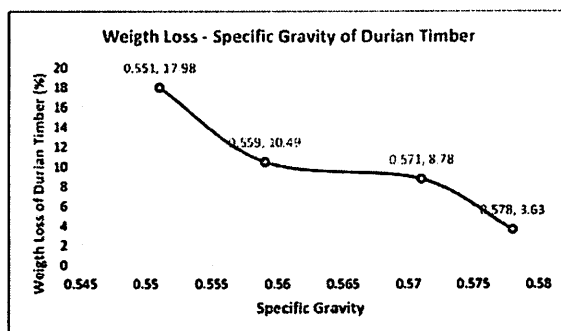
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221 Figure 9. The Relation of Weight Loss and Water Content of Durian Timber

222

223 Figure 10 shows that the relationship between the water content with weight loss of
 224 durian timber after the termite test and it can be seen that the higher water content in durian
 225 timber, the greater the value of weight loss durian timber. This happens because when the
 226 timber in the low water content of fiber on the timber is 9.01% relatively stable and the cell
 227 pores on the timber is more tightly, on preservative concentration of 25%, hence the pores in
 228 the wooden cells are getting closer because it is filled by the retention of the Kecubung extracts
 229 that contain toxins (alkaloids) so the termite attacks are reduced and the value of weight loss is
 230 lowest at 3.63%

231



232

233 Fig 10. The Relation of Weight Loss and Specific Gravity of Durian Timber

234

235 ¹³ Figure 10. presented the relationship between the water content with the termite test and it
236 can be seen that the higher the water content in durian wood, the greater the value of weight
237 loss in the durian wood. While the pores in the wooden cells are getting closer because it is
238 filled by the retention of the Kecubung extracts that contain toxins (alkaloids) and the wood
239 become more dense thus, the value of weight decreases smaller.

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241 4. Conclusions

242
243 As conclusion, the Kecubung fruit can be an alternative preservative for durian timber as a
244 substitute for the chemical preservatives. The greater use of concentrations of the Kecubung
245 extract fruit lead to the greater durability of the durian timber against the attack of termites.
246 The natural preservative of the Kecubung extract fruit has been effective in preventing the
247 attack of dry wood termites which can be indicated from the percentage reduction of weight
248 loss was 79.8 % for 6 weeks. Kecubung fruits extracts contain toxin that is more sustainable
249 for the environment because it contains natural pesticides which is free from environmentally
250 damaging chemical pesticides.

252 5. References

- 253 [1] Suwandi. National Wood Needs Last Five Years. Forestry Plant Notification, 2015. [In
254 Indonesia].
- 255 [2] BPS. Statistics of Forestry Production 2015. Central Bureau of Statistics, Indonesia, 2015.
256 [In Indonesia].
- 257 [3] Mustikaningtyas D, Wiyanto W, Habibah NA. The Potential of Gunungpati Semarang
258 Subdistrict as the Center for Organic Agriculture through Science and Technology
259 Activities for Communities of Farmer Women Groups. Jurnal Abdimas. 2017 Mar
260 1;20(2):77-82. [In Indonesia].
- 261 [4] BPS. Statistics of Forestry Production 2014. Central Bureau of Statistics Semarang, 2014.
262 [In Indonesia].
- 263 [5] Martawijaya A, K, Tasujana I, Kadir K, Among SP. Indonesian Wood Atlas Third Volume
264 I Mold (revised edition). Bogor Forestry Research and Development Agency, Ministry of
265 Forestry. CV. Miranti Bogor. 2005. [In Indonesia].
- 266 [6] Indonesian National Standard, 7973-2013. Design specification for wood construction.
267 National Standardization Agency of Indonesia. Jakarta, Indonesia. 2013. [In Indonesia].

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Commented [H14]: Conference proceedings

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- [7] Findlay GW. Preservation of Timber in the Tropics. Springer Science & Business Media; 2013.
- [8] Caldeira F. Boron in wood preservation. A review in its physico-chemical aspects. Silva Lusitana. 2010;18(2):179-96.
- [9] Lesar B, Kralj P, Humar M. Montan wax improves performance of boron-based wood preservatives. International Biodeterioration & Biodegradation. 2009; 63(3):306-10.
- [10] Syazwan M, Azmi B, Wai LC, Yhaya MF, Ismail N, Tajarudin HA, Abdulaziz H, Azan H, Tajarudin B, Ng KK. Preservation Of Rubber Wood Against Biological Decay By Salts Derived From Leachate. Wood Research. 2017 ;62(6):863-72.
- [11] Pangestuti EK, Lashari L, Hardomo A. Sengon Wood Preservation Through Cold Immersion Using Enbor Sponges Preserved On Mechanical Properties. Journal of Civil Engineering and Planning. 2016;18(1):55-64. [In Indonesia].
- [12] Dalimartha S. Atlas of Indonesian medicinal plants. Niaga Swadaya; 2008. [In Indonesia].
- [13] Rinaldi NA, Listyanto T, Karyanto O, Lukmandaru G. Preservation of Sengon Wood Hot Immersion Method with Amethyst Fruit Extract Against Dry Wood Termite Attack. Journal of Forest Product Technology, Faculty of Forestry, Universitas Gadjah Mada. 2012. [In Indonesia].
- [14] Palopo PP. Toxicity of Amethyst Seed Extract (Datura Metel L.) Against Mice (Mus Musculus Gazeensis) Albino Swiss Webster Line. Faculty of Biobiology (Doctoral dissertation, Universitas Atma Jaya Yogyakarta) 2009. [In Indonesia].
- [15] Aminah NS, Sigit SH, Partosoedjono S, Chairul. 2001. S. rarak, D. metel dan E. prostate as Larvisida Aedes aegypti. Mirror of the World of Medicine.; 131:7-9. [In Indonesia].
- [16] Ircuw. B, Reynold PK, Josephus I, Johan AR. Some Physical Properties of Angsana Gubal (Pterocarpus indicus). COCOS. 2013; 3(6): 1-14. [In Indonesia].
- [17] Febrianto F, Pranata A, Septiana D, Arinana, Gumilang, A, Hidayat W, Jang JH, Lee SH, Hwang WJ., Kim NH. Termite resistance of the less known tropical woods species grown in West Java, Indonesia. Journal of the Korean Wood Science and Technology. 2015; 43(2): 248-257.

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Commented [H24]: Database on the Internet

296 [18]Indonesian National Standard. 01-7207-2006. Test the durability of wood and wood
297 products against wood-destroying organisms. National Standardization Agency of
298 Indonesia. Jakarta, Indonesia, 2006. [In Indonesia].

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