# Toxic Potential of Papaya (*Carica papaya*) Leaves as Termicidal Against *Coptotermes curvignathus* Holmgren

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**Abstract**—Papaya leaf (*Carica papaya*) contains secondary metabolite compounds such as terpenoids, alkaloids, saponins and plavonoids. Those compounds have been known as toxic in most insects and have potential to regulate termite *Coptotermes curvignathus*. This research aims to analyze the potential of *Carica papaya* leaf as bioinsecticides and to find Lethal Concentration  $LC_{50}$  methanolic extract of papaya on *C. curvignathus*. The test was carried out by treating paper disc with extract at the concentration 6% 8% 10% w/v (g/ml). The effect of termites has been investigated in seven days and  $LC_{50}$  determined by probit analyze. The bioassay showed that  $LC_{50}$  methanolic extract of Papaya leaf (*Carica papaya*) an has an effect to *Coptotermes curvignathus*  $LC_{50}4,5\%$ .

*Keywords*—*Coptotermes curvignathus*, Methanolic extract, Mortality, Papaya leaf.

## I. INTRODUCTION

Termite belong to order Isoptera, which have been known or a destroyer to the building, and also attack the community plantation such oil palm, especially the young palm [1][2][3]. Termites play role in ecological of many ecosystems, particularly in nutrient-poor arid and semi-arid environments [4]. There are three major species of termites in Indonesia which become pests such as *Coptotermes curvignathus* Holmgren, *Macrotermes gilvus* Hagen, as well *Schedorhinotermes javanicus* Kemner and one type of dry wood termites, *Cryptotermes cynocephalus* light [5].

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R.C.Hidayat Soesilohadi<sup>6</sup>, Associate Profesor in Laboratory of Entomology Faculty of Biologi ,Universitas Gadjah Mada, Yogyakarta, Indonesia (e-mail: hidayat@ugm.ac.id). Coptotermes is the only genus of sub Family Coptotermitinae spread in tropical regions [6]. The few tropical and subtropical locations where termites are found at high altitude (700–2500 m) [7][8]. Termites live in soil and remnant of wood, thus they difficult to be controlled. In there, termites can hide and breeding and find their food [9]. This insect can cause direct physical damage to crops and causing significant economic losses [10].

Nowday, the method which is used to reduce termite is insecticide that has chemical compound, such as organophosphate and pyrethroid. This compound could be harmful to the environment and animal especially insect [11][12]. An alternative that could be used as biotermicide is organic insecticide from plant such as papaya leaf [13].

*Carica papaya* (papaya) is a tree-like herbaceous plant [14]. *Carica papaya* is the member of the Family Caricaceae widely found in India, Philippines, Sri Lanka, Bangladesh, Malaysia and other countries in tropical America[15]. Recent studies said that the leaves of *Carica papaya* discovered compounds as a potential anti-sickling [16].

Papaya leaves contain active ingredients such as papain, chymopapain, cystatin, à-tocopherol, ascorbic acid, flavonoids, cyanogenic glucosides, and glucosinolates [17]. The contents which have potential as insecticide are papain enzyme, saponins, flavonoids and alkaloids karpain. These compounds cause many various reactions in the body of larvae which can inhibit the growth and development of them [18].

## II. MATERIAL AND METHODS

## A. Time and place of research

This research was conducted on September until February 2017. The determination of methanol extraction from papaya leaf was done in Pharmacology Laboratory, Faculty of Pharmacy. Rotatory evaporation process did in the Laboratory of Falitma, Universitas Gadjah Mada. Testing termites with

the extraction was conducted at the Laboratory of Entomology, Faculty of Biology, Universitas Gadjah Mada.

#### B. Leaf methanolic extract and determination

The fresh papaya leaves were obtained from the garden community that located in Bantul district, Indonesia. This leaves were washed to remove contaminant and dried in a room without direct sunlight. Then, the completely dried leaves were blended. 200 grams of blended were used for extraction added 1000 ml methanol for 6x24 hours in Erlenmeyer 1000 ml. Each three days, extract solution was filtered using filter paper and filled by 1000 ml methanol. The filtered extract was evaporated using a rotary evaporator at  $45^{\circ}$ C in 60 rpm. Condensed extract were stored in a porcelain dish for maceration process. Total secondary metabolite content was determination using thin layer chromatography.

## C. Mortality test of termites

Papaya leaf extract was taken with concentration of 6%, 8%, and 10% w / v (g / ml). To make this concentration, used papaya leaf extract, in which 0.6 grams, 0.8 grams and 1 gram, then dissolved in 10 ml of 10% DMSO (dimethylsulfoxide). Soil was taken from the Forest Biology, Faculty of Biology, Universitas Gadjah Mada, was sterilized using autoclave for 1 hour.

Three filter papers (Whatmann No. 41) with diameter of 4 cm, soaked in leaf extract solution for 1 hour. Then, the filter paper was dried for 24 hours in room temperature. Two other papers were soaked in water and fibronil as control. The filter papers were weighed to determine the mass of paper. 10 g of soil was put in a plastic cup and 2 ml of water dripped to soil. Circular filter paper (modified) placed on top of pedestal inside the plastic cup. Fifty termites comprising 45 soldier and five worker termites released into each cup. The plastic cup was placed in a dark room in 7 day, checked each day. Four replications were made for each treatment and control.

#### D. Mortality termites observation

Termites were observed in each day for all treatments and counted the number of dead termites. Percent mortality each treatment is calculated using formula [19]

M (%) =  $\frac{N_2}{N_1}$  x 100%

where :

M is mortality percentage of termites (%)  $N_1$  is number of termites before treatment  $N_2$  is number of termites after treatment

 $N_2$  is number of termites after treatment

Test of the filter paper weight between before and after observation. Then calculate the weight loss filter paper with the following formula [19]

with the following formula [19] Weight loss (%) =  $\frac{W_1 - W_2}{W_1} \ge 100\%$ where :

 $W_1$  is weight of filter paper before treatment (g)  $W_2$  is weight of filter paper after treatment (g)

### E. Statistical Analyses

The percentage of termite mortality and calculation of weight loss filter paper were analyzed by analysis of variants (ANOVA) with a 95% confidence level. This analysis showed significantly different results, so continued use Duncan test. Then, the alleged death value of 50% ( $LC_{50}$ ) was determined using probit analysis by linear regression equation between log concentration and probit mortality.





Fig 1. Chromatography test for Secondary metabolites compounds a) Alkaloids b) Flavonoids c) Saponins d) Terpenoid in Methanolic Extract *Carica papaya* 

We analyzed the influence of methanolic extract *C. papaya* on termites mortality. Result testing shows and served on the table below.

TABEL I
MORTALITY PERCENTAGE C. CURVIGNATHUS (%), LOSE WEIGHT METHANOLIC
EXTRACT OF $C$ . PAPAYA (%) IN SEVERAL CONCENTRATION IN 7 DAYS.

Treatment	Mortality (%)	Lose the weight of the paper test (%)	LC <sub>50</sub>
Solvent	32,77 <sup>a</sup>	33,1	
6%	73,88 <sup>b</sup>	41,57	
8%	97,00 <sup>b</sup>	41,95	4,52 %
10%	95,00 <sup>b</sup>	42,38	
Termicide 0,5%	98,88 <sup>b</sup>	45,58	

Explanation: Number with same information (<sup>a</sup> or <sup>b</sup>) shows significance in 95% confidence interval.

Based on the result of ANAVA testing, negative control (distilled water) was significantly different with the treatment in concentration 6%, 8%, 10% and termicides. The other way, concentration 6%, 8% and 10% were not significantly different with positive control (termicides). Probit analyze to determine Lethal Concentration ( $LC_{50}$ ) used software SPSS 21.0. The result shows that using methanolic extract C. papaya againts *C. curvignathus* has  $LC_{50}$  at the concentration 4,25%. On the graph below shows relation the number of mortality and consumption toward the decrease of the concentration.



This research shows that different level concentration of methanolic extract papaya leaf influenced to mortality and number of consumption (Fig. 2). Mortality will be higher along with increasing the concentration and the consumption will be lower. It has related to the toxicity in papaya leaf. Plants produced a high diversity of natural products or secondary metabolites with a prominent function in the protection againts the predator. Secondary metabolites such as tannins, saponins, alkaloids, steroids, and terpenoid could cause death in termites and have potential as bioinsecticides. Secondary metabolites compound in papaya leaf was tested using Thin Layer Cromatography (TLC), and the result showed in Fig. 1. There are four main compound which have potential as bioinsecticides in papaya leaf such terpenoids, flavonoids, saponins, alkaloids. Each compound has capabilty as toxic in termites. Flavonoid compounds that have a polar nature is able to penetrate the peptidoglycan also have polar properties in bacterial cells that can cause damage to cells [20]. Flavonoids are cyto-toxic and interact with different enzyme through complexation. Falvonoids againts insect pest by influencing the behaviour and growth and development of insect. Phenolic compounds capable to forming a complex with the protein (constituent of cell membranes) trough hydrogen bonds. So, that toxic subtances from the extract get into the cells and attack the nucleus, and causing the nervous system disrupted.

Papaya leaf extract has terpenoids compound which have role as protector to resist insects as well as a stomach poison to insects [21]. Extractive substances bioactivity against termite death also influenced by the habits of termites like licking, delivering food from the caste of workers to other members of a colony of termites. Based on the research done, papaya leaf extract containing secondary metabolites have potential as biotermicide. The highest mortality reached 97% in testing time for 7 days and LC<sub>50</sub> probit analysis obtained concentration 4,25 %, which means that is effective as termicides.

#### IV. CONCLUSION

From this research, we can conclude that *C. papaya* extract leaf can use as biotermicide and  $LC_{50}$  in the concentration 4,25%.

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