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EVALUATION OF SELECTED HERBS EXTRACT AS REPELLENT AGAINST RUBBER TERMITES (*Coptotermes curvignathus*)

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Abstract

Termites encompass a various range of destruction of crops and capable of decomposing woods. The widely being used of hazardous chemical pesticides has develop many health problems to the users. Hence, the aim of this study was to substitute the use of hazardous chemical pesticides to herbs based pesticides as repellent agent against rubber termites (*Coptotermes curvignathus*), which is safer and easier to use. The selected herbs species for this study are lemongrass (*Cymbopogon citratus*), garlic (*Allium sativum*) and wild mint (*Mentha arvensis*). As for *C.curvignathus*, they were obtained from Forest Research Institute Malaysia (FRIM), Kepong, Selangor, Malaysia. Khaya wood (*Khaya senegalensis)* (3cm x 2cm x 2cm) is the woods sample that being used. All woods samples were treated with all the selected herbs extract. The repellent testing was conducted for 21 days. The result obtained showed that the three herbs were effective to be used as repellent when compared to percentage weight loss of control, which is 23.58%. The percentages of weight loss of treated groups using aqueous extraction of herbs were 0.61% (lemongrass), 1.56% (mint), and 1.72% (garlic), whereas for methanol extraction of herbs were 0.52% (lemongrass), 1.13% (mint) and 1.55% (garlic). From Analysis of Variance (ANOVA), there is significant different in mean among group with F=275.49, p-value=0.000<0.05.

Keywords: termites' repellent, repellency activity, herb extraction, *Coptotermes curvignathus*
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Introduction

Termites are one of the important insect that is responsible as wood decomposer in the forest (Aiman *et al.*, 2014). In human perspective, termites are one of the unwanted insect that is categorised as pest insect in home or building. Since termites can cause waste of money many integrated termite managements were arising (Maayiem *et al.*, 2012). Termites are very overwhelming pests of agricultural, some crops and arid wood. Strong inter-communication between termites leads them to be an active pest in forest and other places. They have mutually positive and negative effects on the environment (Qasim *et al*., 2015).

Genus *Odontotermes, Macrotermes* and *Microtermus* are the genus that usually found around the world (Maayiem *et al.,* 2012). A single termite colony can cause severe invasion on the building structure, from 4m to 30 m length (Hafiz and Hassan, 2015). Termite invasion and infestation in South-East Asia were frequently take place on older trees by *Coptotermes curvignathus* and *Microcerotermus dubius.* These two species were known for its specialty on kill dead tree (Kirton and Cheng, 2007). There are also termites' genus which caused damage on seedlings, such as *Odontotermes, Microtermes, Pericapritermes, Macrotermes, Synthermus* and *Cornitermes.* According to Aiman *et al.* (2014), *C. curvignathus* is the main termite species which is pest of agriculture and farm in Malaysia.

Massive number of termites can destroy many parts of building, houses, wood furniture and crops yield. Consequently, they lead to agronomic and economic loss (Maayiem *et al.*, 2012). Chemical pesticide

practices are famous in many agriculture fields. Furthermore, termite chemical control in agriculture is costly and require capable and expert labor but it might not be working in all situation The use of harmful chemical pesticides was widely chosen by the user. This problem also faced by other user too. The extreme practice of chemical pesticides could lead to environmental pollution and might cause dangerous effect of non-target organisms (Sarwar, 2015).

The research would be beneficial to many people especially those who are involved in wood industry. The study outcomes will increase more awareness of public to avoid using chemical pesticide and use naturally plant based repellent as replacement. New wood additives could be exploit to protect wooden structures, agricultural yields, plants and trees because these are safer to the environment and humans. Thus, the usage of chemical pesticide can be avoided.

Methods

Termites collection

Termites trap is the method that was used to trap termites for conducting this project. All cardboards were cut in 10 cm length and the width is cut base on the basin size. The cardboards then were arranged in three rows. All cardboards were rinsed with distilled water thoroughly then placed back in the basin. Termites trap was set up and placed at tree bark in FRIM, Kepong, Selangor, Malaysia (3°14'7.80" N 101°38'9.59" E). All termites were collected and kept alive in a container. The termites collected from the traps were then identified based on their morphology and taxonomy classification to confirm the species is *Coptotermus curvignathus* (Aiman *et al.,* 2014).

Herb samples extraction

Two methods were used to extract the herbs; methanol extraction and infusion methods. For samples collection and preparation, fresh lemongrass, garlics and wild mint were procured from a local supplier in Kuala Pilah, Negeri Sembilan, Malaysia. All the herb samples were washed thoroughly. The samples then were placed in an oven for drying at 40°C for 24 hours. All samples then were kept in a seal bag (Nur Ain *et al.,* 2013). As for methanol extraction, by using electronic weighing balance, 40g of each herb samples were weighted. The samples were chopped and grind using electric blender. Three beakers of 250ml were labeled according to the herbs name. 160ml of 80% methanol solution were poured in each beaker with the herb samples accordingly. The mixtures were mixed by using magnetic stirrer for 15 minutes. The mixtures were then kept in a chiller at 4°C for 48 hours. By using Whatman No 1 filter paper, the mixtures were filtered. Next, Rotary Evaporator was used to concentrate the filtrate at 37°C - 40°C. Lastly, the samples were stored in the chiller at 4°C and kept until it is ready to use (Odey *et al.,* 2012).

As for infusion method, the samples were weighed on an electric weighing balance. All herbs were then chopped and grind using an electric blender. Chopped samples then were placed in 160ml of distilled water. Next, the samples were boiled for 5-10 minutes using a Bunsen burner. Then the samples were filtered by using Whatman No 1 filter paper. After that, the solutions were placed in a chiller at 4°C for 48 hours (Olorunnisola *et al*., 2014).

Repellency test

Khaya wood (*Khaya senegalensis*) of size 3cm x 2cm x 2cm were obtained from FRIM, Kepong, Selangor, Malaysia. The wood blocks were allowed for oven dried in 94°C for 24 hours, three times consecutively. Next, all wood blocks were dip-treated with plant extract for five minutes and untreated wood samples as a control. 120 termites obtained from baiting method were placed in each of four containers which labeled accordingly to herbs species. At the bottom of container, soils were placed. From day one until day 21, each container was sprayed with water on the soil surface so that the termites get their source of water for living. The containers were covered with black colour plastic bag thus protect from any changes weather. After day 21 all wood block samples were clean using brush. Next, the wooden blocks were allowed for complete drying in oven at 94°C for 24 hours, three times repetitively (Verma *et al.,* 2009).

Lastly all the data recorded were analyzed using Analysis of Variance (ANOVA). The percentages of weight loss were calculated using the formula below:

$$\% \text{ weight loss} = \frac{Wi - Wf}{Wi} \times 100$$

Where:
Wi = Initial weight of oven dried wood sample
Wf = Final weight of oven dried wood sample after treated

Result and Discussion

The degree of termites' attack on wood samples was measured in term of weight loss (Olufemi *et al.,* 2011). The weight loss of treated and untreated sample is shown in Table 1. *C. curvignathus* was most active in untreated wood sample as the percentage is the highest compared to all treated samples which is 23.58%. The percentage was considered as high. Thus, termite attack was generally less on treated samples compared to untreated samples. The percentage of weight loss for all treated sample were very small thus, confirmed effectiveness of extract solutions as repellent agent against termites. This proved that, the content in lemongrass, wild mint and garlic contain repellency agent since some herbs content contain insecticidal activity and repellency to pests (Verma *et al.,* 2016).

The results obtained are in accordance with the study by Verma *et al.* (2016). The highest efficiency agent showed by methanol extracts of lemongrass with only 0.52% weight loss. Aqueous extract of garlic treated sample showed the highest percentage of weight loss which is 1.72% compared to other treated sample. Methanol extract of treated sample show higher repellency efficiency compare to aqueous extract. Methanol might be better extraction for repellency. The other factor that might contribute to the repellency efficiency is soil content. The effectiveness of the material and the degree of absorptivity may also influence the variation of weight loss. The lower the percentages of weight loss imply the greater ability on termite repellent activity. The higher percentages of weight loss imply the greater absorptivity of the extract in the wood samples (Olufemi *et al.,* 2011). Apart from that, the strong scent from garlic, lemongrass and wild mint may be the reason termites move away and mostly died on day 5 to 15 as plants contain "natural" smelling repellents (Maia and Moore, 2011). The lower the percentage of weight loss portray that the greater repellent efficiency.

Table 1: The percentage weight loss of treated wood samples

Extract types*	Percentage of weight loss(%)
AL	(0.61±0.02)
ML	(0.52±0.01)
AM	(1.56±0.05)
MM	(1.13±0.02)
AG	(1.72±0.03)
MG	(1.55±0.03)
C	(23.58±0.10)

*All sample are average of 3 replicates except for C which is 5 replicates. *C=Control, AL= Aqueous Extraction of Lemongrass, ML= Methanol Extraction of Lemongrass, AM= Aqueous Extraction of wild mint, MM= Methanol Extraction of wild mint, AG= Aqueous Extraction of Garlic, MG= Methanol Extraction of Garlic

Strong odour content in garlic may be the reason of this effective repellency agent. Garlic plants yield secretions from their roots addition with scents from their leaves (Katsaruware and Dubiwa, 2014). The secretion from the root and garlic itself provide strong odour which unwanted odour for termites. In addition, allicin compounds that present in garlic were also the reason garlic is an effective repellent agent of insect pest (Baidoo *et al.*, 2012). For lemongrass the present of limonene extract were said to be great repellent agent. Lemon essential oil, S-(-)-limonene, citral and (+)-β-

pinene were the best composites content when compared to other content in repellency bioassays of plants (Verma *et al.,* 2016).

Furthermore, as shown in Table 2, there is significant different in mean among group as the p-value is less than 0.05. The F-value is 275.496 while p-value is 0.000. These imply that the variances are significantly different. The significant may lies between treated and untreated group of wood samples (Steven, 2009).

Table 2: Analysis of Variances (ANOVA) weight loss of wood sample

j	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5.453	6	.909	275.496	.000
Within Groups	.053	16	.003		
Total	5.506	22			

As shown in Table 3, there were no significant different when comparing the weight loss between types of extraction. The significant different were only lies between types of extraction and control. Thus, both types of extraction can be used as good repellency activity of *C.curvignathus.* Apart from that, the better types of extraction between aqueos extraction and methanol extraction for repellency test against *C.curvignathus* were not proven.

Table 3: Multiple comparison between types of extraction of wood sample

						95% Confidence Interval	
	(I) Types of extraction	(J) types of extraction	Mean difference (I-J)	Std Error	Sig.	Lower Bound	Upper Bound
Scheffe	Aqueous Extraction	Methanol Extraction	.0139333	.0265431	.872	-.056221	.084088
		Control	-1.1723267*	.0314063	0.00	-1.255335	-1.089319
	Methanol Extraction	Aqueous Extraction	-.139333	.0265431	.872	-.084088	.056221
		Control	-1.18626	.0314063	0.00	-1.269268	-1.103252
	Control	Aqueous Extraction	1.1723267*	.0314063	0.00	1.089319	1.255355
		Methanol Extraction	1.18626	.0314063	0.00	1.103252	1.269268

*The mean difference is significant at the 0.05 level.

At the end of the experiment, *C.curvignathus* were absent in all treated wood sample containers. Thus, indicated that mortality rate of termites are nearly to 100% (Sowmya *et al.,* 2016). This may be due to no other sources of food were present for *C.curvignathus* to survive as the wood has been treated with lemongrass, garlic and wild mint respectively (Donovan, *et al.,* 2011). Different condition shown in untreated woods container, the termites were still present. Thus, the result were strengthen the fact that garlic (*A.sativum*), lemongrass (*C.citratus*) and wild mint (*M. arvensis*) is effective repellent against *C.curvignathus.* Furthermore, the repulsive action of the herbs extract and chlorpyriphos could be attributed to this behavioral movement of termite and could also be responsible for high level of protection offered by chlorpyriphos against termites' attack (Olufemi *et al.,* 2011).

Conclusion

In conclusion the herb based repellents were so effective and harmless to be used. The percentage of weight loss of wood sample after treated with selected herbs can be termed effective. The significant difference in weight loss lies between control and all treated sample. There is no significant difference between the treated group extract. In addition, there were also no significant difference between types of extraction used on the wood sample. Thus, both whether aqueous extraction or methanol extraction are effective in producing termites' repellent. The selected herbs meet the theory of effective repellent agent. Therefore, the use of hazardous chemical pesticide should be reduced. As an alternative use lemongrass (*Cymbopogon citratus*) extract, garlic (*Allium sativum*) extract or wild mint (*Mentha arvensis*) extract can be used as substitute for repellency against termites.

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