Thai Essential Oils as Botanical Insecticide Against House Fly (*Musca domestica* L.)

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Abstract Presently ,chemical control method popularly used against house fly ,nevertheless, major disadvantages, such as house fly resistance, toxic side effect to human and environment have increased. Botanical insecticides have been increasing evaluated in controlling house fly. In order to search for effective and environmental friendly control agent, Thai essential oils of *Syzygium aromaticum* (Clove) and *Cymbopogon citratus* (lemongrass) were evaluated for their larvicidal, pupicidal, adulticidal, ovposition deterrent and ovicidal activities against house fly and compared them with chemical insecticide (cypermethrin ; Kumakai10^R). The highest insecticidal activity was shown by clove oil with LC_{50} values of 1.20-10.55% and clove oil also exhibited highest oviposition deterrent and ovicidal activities with 100% effective repellency and 0% of hatching rate. These results exhibited higher toxic than cypermethrin and lemongrass oil. Therefore, clove oil should be further used botanical insecticide housefly control.

Keywords: Botanical insecticide, House fly, Thai essential oil

I. INTRODUCTION

House fly (*Musca domestica*L.; Diptera : Muscidae) is an important medical and veterinary insect pests that causes irritation, spoils food and acts as a vector for more than 100 human and animal pathogenic organisms such as enteropathogenic bacteria, enterovirus and protozoa cysts [1,2]. Currently, control of house fly largely relies on chemical insecticides. Unfortunately, house fly have developed resistance to most of chemical insecticides [3] and its also adverse environment and health effect, threat of persistence and biomagnifications through the food chain[4]. Therefore, better alternative to synthetic chemicals, the use of botanicals to control house fly is being looked upon as a main source for safer and eco-friendly insecticide. Moreover, botanical insecticides are Biodegradable, species specific, non side effect toxic to non-organisms, human, animal and environment, however, botanical insecticides from plant oils or essential oils have been used effective to control insect pests including house fly [5,6].

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As a result, the objective of this study investigates the larvicidal, pupicidal,adulticidal ,oviposition deterrent and ovicidal activities of Thai essential oils derived from *Syzyzium aromaticum* (clove) and *Cymbopogon citrates* (lemongrass) against *Musca domestica* (house fly) and to compare them with chemical insecticide (cypermethrin 10% w/v : Kumakai10^R).

II. MATERIALS AND METHODS

Rearing of House fly colony:

House fly were obtained from a colony maintained at Entomological laboratory, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang (KMITL). The ten of adult house flies (5 males : 5 females) were reared in screen cage ,size 30X30X30cm .They were reared at 30.5 ^{0}C and 70.5% RH. Adults were fed with 10% w/v glucose + 10% w/v milk and larvae were fed on mackerel fishes. Larvae, pupae, adults were continuously available for the experiments.

Essential Oils and Chemical Insecticide

Clove oil and lemongrass oil were provided by Medicinal Plant laboratory, Faculty of Agricultural Technology, KMITL. Each essential oil was prepared as 1, 5, 10% solution in ethyl alcohol and stored at 4^{0}C before testing. For the chemical insecticide, cypermethrin 10% w/v (Kumakai10^R) used as standard.

Larvicidal, Pupicidal and Adulticidal Bioassay

The larval and pupal bioassay were evaluated by using dipping method [7,8]. The 10 of 3rd instar larvae or pupae were dipped into 10 ml of each test solution for 30 sec and then transferred them to a filter paper (in plastic box, size 7.5X10.0X7.5 cm). Larval mortality was recorded at 1.0, 6.0, 12.0 and 24.0 h. and pupal mortality also recorded at 7 days. Adulticidal bioassay followed WHO susceptibility test guide lines [7]. The flies were exposed to essential oil treated filter paper for one hour in a tube then transferred to another tube where knockdown rate were recorded at 5, 10, 30, and 60 min. and mortality was recorded at 24 h after treated. The criteria for mortalities were evaluated that larvae, pupae and adults of house flies not responding were considered dead [7,8]. Each test was performed in five replicates with positive control (cypermethrin) and negative control (ethyl alcohol). The data were pooled and analyzed by standard probit analysis to obtain a LT_{50} (median lethal time) and LC_{50} (median lethal concentration).

Oviposition Deterrent and Ovicidal Bioassay

The oviposition deterrent and ovicidal bioassay followed the method of More *et al.* [2]. The ten of house fly females aged 4 days old were introduced in a screened cage where two oviposition boxes lined with cotton pad, size 3X10X0.25cm, were introduced

for oviposition. For the two ovipositiob boxes, the1st box as tested box was filled with 1ml of 10%w/v milk solution and 1 ml of each test solution, while the 2nd box served as control was filled with only 1 ml of 10% w/v milk. The position boxes were switched everyday to avoid the position effects. The eggs laid into each box were collected separately until no further eggs were laid for at least 48 h. Five replicates were carried out with each test solution. The percentage of effective repellency (ER%) and oviposition activity index (OAI) were calculated using the formular of Phasomkusolsil and Soonwera [9].

$$ER(\%) = NC-NT/NC \times 100$$

Where, ER = effective repellency, NC = the total number of eggs in the control solution, NT = the total number of eggs in each test solution

$$OAI = NT+NC/NT-NC$$

Where, NC = the total number of eggs in the control solution, NT = the total number of eggs in each test solution

The OAI ranges from -1.0 to +1.0, with o indicating neutral response. The positive index values indicate that more eggs were deposited in the test boxes than in the control boxes, and that the test solutions were attractive, on the other side, more eggs in the control boxes than on the test boxes results in negative index values and the test solution were deterrent.

III. RESULTS AND DISCUSSIONS

The larvicidal, pupicidal, adulticidal activities of clove oil, lemongrass oil and cypermethrin against house fly as shown in Table 1, 2, 3. On the mortality, LC_{50} values and KT_{50} values, the results revealed that clove oils exhibited highest toxicity against larvae, pupae, and adults of house flies with 35.0, 100 and 100 % mortality of larvae,pupae and adults of house flies at 24 h, 7 days and 24 h, respectively and LC_{50} values of 10.55, 2.50 and 1.20%, respectively, while, cypermethrin showed 30.5, 100 and 85% mortality of larvae, pupae and adults of house flies and LC_{50} values of 11.45, 3.80 and 8.50%, respectively. In addition, lemongrass oils exhibited high toxic to pupae and adults of house flies with LC_{50} values of 2.80 and 2.20%, respectively, unfortunately, lemongrass oils showed non toxic to house fly larvae. For the results of oviposition deterrent and ovicidal activities as shown in Table 4, 5. The house fly female preferred to lay eggs in control boxes than test boxes. The highest percentage effective repellency (ER%) was shown by clove oils and cypermethrin with 100%, -1.0 OAI and hatching rate of 0%. Likewise, lemongrass oils exhibited 87.93 % Effective repellency, -0.78 OAI and hatching rate of 96.0%. Moreover, clove oil and cypermethrin showed 0% of hatching rate and EC_{50} values of 7.75 and 0.50 %, respectively. On the other side, lemongrass oil exhibited 96.0 % of hatching rate and EC_{50} value of 30.32%.

In our study clearly revealed that clove oils sowed the excellent insecticidal, oviposition deterrent and ovicidal activities against all stage of house fly and these results exhibited higher toxic than cypermethrin and lemongrass olis. Moreover, clove oils also exhibited the excellent larvicide, pupicide, adulticide, repellent, oviposition deterrent and ovicide against two mosquito vectors (*Aedes aegypti* and *Culex quinquefasciatus*) [9,10,11]. However , clove oil is commonly has been used in traditional Thai medicide for a long time in dental root canal surgery for its antimicrobial prpperties [12], and eugenol is a natural chemical found in clove oil , is considered safe without risks when used as directed, the US Environmental Protection Agency (USEPA) classified clove oil as minimum risk pesticides [13]. Beside, lemongrass oils exhibited the excellent pupicidal and adulticidal activities against house fly pupae and adults, unfortunately, lemongrass oil showed non toxic to housefly larvae .However, lemongrass oil is considered safer for human health than chemical insecticides and these oil has been traditionally used as tonic and carminative medicine in Thailand [7], and used to repel mosquitoes in jungle regions such as the Bolivian Amazon [14].

IV CONCLUSION

Clove oil and lemongrass oil are the excellent botanical insecticides for house fly control, safe for human health and environmental friendly.

ACKNOWLEDGMENTS

Authors are highly grateful to Faculty of Agricultural Technology, King Monkut's Institute of Technology Ladkrabang (KMITL), Bangkok, Thailand for proving financial assistance to carry out this study, and extend thanks to plant taxonomist and entomologist from KMITL for species identification of Thai herbs and house fly.

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TABLE 1
INSECTICIDAL EFFECT OF CLOVE OIL, LEMONGRASS OIL AND CYPERMETHRIN AGAINST LARVAE OF HOUSE FLY.

Treatment	larvicidal Activity	
	Mortality (%)	LC_{50} (%)[1]
Clove oil	35.0	10.55
Lemongrass oil	0	0
Cypermethrin	30.50	11.45

[1] LC_{50}= 50% Lethal Concentration

TABLE 2
INSECTICIDAL EFFECT OF CLOVE OIL, LEMONGRASS OIL AND CYPERMETHRIN AGAINST PUPAE OF HOUSE FLY.

Treatment	Pupicidal Activity	
	Mortality (%)	LC_{50} (%)[1]
Clove oil	100	2.50
Lemongrass oil	100	2.80
Cypermethrin	100	3.80

[1] LC_{50}= 50% Lethal Concentration

TABLE 3
INSECTICIDAL EFFECT OF CLOVE OIL, LEMONGRASS OIL AND CYPERMETHRIN AGAINST ADULTS OF HOUSE FLY.

Treatment	Adulticidal Activity	
	KT_{50} (min.)[1]	LC_{50} (%)[2]
Clove oil	3.80	1.20
Lemongrass oil	5.14	2.20
Cypermethrin	7.28	8.50

[1] KT_{50} = 50% Knockdown Time
[2] LT_{50} = 50% Lethal Concentration

TABLE 4
OVIPOSITION DETERRENT ACTIVITY OF CLOVE OIL, LEMONGRASS AND CYPERMETHRIN AGAINST FEMALES OF HOUSE FLY.

Treatment	ER (%)[1]	OAI[2]
Clove oil	100	-1.0
Lemongrass oil	87.93	-0.78
Cypermethrin	100	-1.0

[1] ER(%) = Effective Repellency
[2] OAI = Oviposition Activity Index

TABLE 5
OVIPOCIDAL ACTIVITY OF CLOVE OIL, LEMONGRASS OIL AND CYPERMETHRIN AGAINST HOUSE FLY EGGS.

Treatment	Hatching Rate (%)	EC_{50}(%)[1]
Clove oil	0	7.75
Lemongrass oil	96.0	30.32
Cypermethrin	0	0.50

[1] EC_{50} = 50% Effective Concentration