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Larvicidal Activity of Five Medicinal Plants of Zingiberaceae on Cabbage Moth, *Crocidolomia paponana* (F.) in Laboratory Condition

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Cabbage moth, *Crocidolomia pavonana* (F.) is an seriously problem on cruciferous organic farming crop in Chanthaburi province, Thailand. They are heavily destroy on all crop where are organic farming crop. The problem found after use insecticide when controlling cabbage moth which cabbage moth resistance, skin irritation etc. So some herbal is a new choice to control cabbage moth. This study were conducted in the Entomology Laboratory, Faculty of Agriculture Technology, Rambhai Barni Rajabhat University, Chanthaburi province, Thailand. Five plant of Zingiberaceae, including Galanga (*Alpinia galangal*), Ginger (*Zingiber officinale*), Kaempfer (*Boesenbergia rotunda*), Phlai (*Zingiber cassumunar*) and Siam cardamom (*Amomum krevanh*) were preparing to 10 and 20% concentration and used to this study. All treatment were against cabbage moth by leaf dipping method. This research was conducted to investigate LT_{50} values and the mortality rate. Probit analysis was used to analyze the data. The 3rd larvae mortality results were recorded at 12, 24 and 48 hours. The results after 48 hours, The Ginger, Galanga and Kaempfer showed was LT_{50} value were <1, 7.9 and 24.0 hr., respectively and found toxic mortality were 100, 100 and 100%, respectively. The medicinal plant, which ginger, galangal and kaempfer were efficacy to control cabbage moth.

Keywords: medicinal plant, cabbage moth, larvicidal activity

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Introduction

Cabbage moth, *Crocidolomia pavonana* (F.) (Lepidoptera: Crambidae) is an insect pest in vegetable crop. They are destroy plants by feed on stem of growing shoots, sometime they bore into the stem. They feeds on various type of plant in family Brassicaceae such as cabbage, cauliflower, mustard, kohlrabi, chinese kale, brussels sprout, broccoli, chinese cabbage, turnip etc. (Australian wild life, 2016; Plant wise knowledge bang, 2016). Cabbage moth is a world wide distribution and is found in Africa, Australia and Asia where Indonesia, India, Malaysia, Myanmar, Philippines, South Africa, Thailand Zimbabwe etc. (Plant wise knowledge Bank, 2016). In Thailand, the cabbage moth is highly dispersive in northern area (Ek-Amnuay, 2010). Meanwhile, Khao Khitchakut district, Chanthaburi province, was found heavy destroy in vegetable in pesticide fee area. The damage from cabbage moth that was product unsalable and bring farmer who were growth vegetable under pesticide fee to return using chemical. The chemical was found to have a negative effect on farmers, consumers and the environment. Recently, several study had shown some medicinal plant can control insect while the lack of the cabbage moth control are less. The purpose of this study was to study five plants from Zingiberaceae family including galang, ginger, kaempfer, phlai and sima cardamom to control the cabbage moth that the way to reduce chemical in vegetable crop.

Materials and methods

Extraction of medicinal plant materials

This process were follow up Handa *et al* (2008), Rhizome of five medicinal plant including Galanga (*Alpinia galangal*), Ginger (*Zingiber officinale*), Kaempfer (*Boesenbergia rotunda*), Phlai (*Zingiber cassumunar*) and Siam cardamom (*Amomum krevanh*) were collected in Chathaburi province, Thailand, cleaned with tap water before extracted by steam distillation. Two concentration, 10 and 20% were preparation for used and kept in cool temperature before used. (Table 1)

Collection and rearing of Crocidolomia pavonana

Larvae of *C. pavonana* were collected from organic vegetable farm in Klong Plu, Khao Khitchakut, Chanthaburi province in January 2016. Larvae were reared in ventilate plastic boxes (20x28.5x10.5 cm) under laboratory (26±2 °C, 77±13%). Chinese cabbage (*Brassica chinensis* L. *var. parachinensis*

Tsen) were grow under pesticide free area that used larvae feed. The 3rd instar larvae were used for this experiment.

Insecticide bioassay

All essential oils were used as a dissolved in Polysorbate 20 was used as an emulsifier. A leaf-dipping method was used to evaluate the activity of the against larvae. The Chinese cabbage leaved were dipped for 10 seconds and dried for 8 minutes then transferred ten larvae to leaves of each treatment under plastic glass. Recording mortality time after treated 12, 24 and 48 hours when larvae no action and move. Used data were recorded on statistics analysis. Meanwhile, Possitve control was Abamectin, 1.8% w/v

Table 1. List of medicinal plant, part used and active ingredients of essential oils test in this study.

Scientific name	Part used	Formulation
Galanga, *Alpinia galanga*	rhizomes	10, 20% (v/v) essential oil from *A. galanga*
Ginger, *Zingiber officinale*	rhizomes	10, 20% (v/v) essential oil from *Z. officinale*
Kaempfer, *Boesenbergia rotunda*	rhizomes	10, 20% (v/v) essential oil from *B. rotunda*
Phlai, *Zingiber cassumunar*	rhizomes	10, 20% (v/v) essential oil from *Z. montanum*
Siam cardamom, *Amomum krevanh*	rhizomes	10, 20% (v/v) essential oil from *Am. krevanh*

Results

This research studies about cabbage moth mortality and LT_{50} value of five essential oils that were tested against cabbage moth by leaf dipping method under laboratory condition. The result showed that the 10% concentration, After treated at 48 hour, The ginger gave more effective to control cabbage moth of 78.3±16.0%. Galanga, Kaempfer, Siam cardamom and Phlai have

effect in controlling cabbage moth of 60.0±14.1, 48.3±13.2, 31.6±7.5 and 40.0±10.9%, respectively which were significance statistics. And all essential oil showed LT_{50} values of 4.4, 49.0, 71.5, 78.4 and 79.5 hours, respectively. (Table 2)

The 20% concentration, After treatment at 48 hour, The result showed that Ginger, Galanga and Kaempfer have more effective to controlling cabbage moth of 100%. Siam cardamom and Phlai were effect in controlling cabbage moth of 87.6±16.3 and 73.3±24.2%, respectively which significance statistics. And all essential oil showed LT_{50} values of <1, 7.9, 24.0, 48.4 and 58.7 hours, respectively. (Table 3)

Table 2 Larvicidal activity of 10% essential oil concentration from five plants in Zingiberaceae against cabbage moth, *Crocidolomia pavonana* (F.) after 12, 24 and 48 h of exposure period respectively

Treatment	Mortality (%)/ exposure time (h.)			LT_{50}
	12	24	48	(h.)
Galanga, *A. galanga*	28.3±7.5c[1/]	43.3±8.1c	60.0±14.1c	49.0
Ginger, *Z. officinale*	46.6±8.1b	68.3±9.8b	78.3±16.0b	4.4
Kaempfer, *B. rotunda*	0d	20.0±12.6d	48.3±13.2d	71.5
Phlai, *Z. cassumunar*	0d	6.6±5.1e	40.0±10.9e	79.5
Siam cardamom, *Am. krevanh*	0d	0f	31.6±7.5f	78.4
Positive control	100a	100a	100a	<1
Negative control	0d	0f	0g	
CV (%)	16.9	16.8	10.0	

[1/] Mean sharing similar letters in columns do not differ by DMRT test at P=0.01

Table 3 Larvicidal activity of 20% essential oil concentration from five plants in Zingiberaceae against cabbage moth, *Crocidolomia pavonana* (F.) after 12, 24 and 48 h of exposure period respectively

Treatment	Mortality (%)/ exposure time (h.)			LT_{50}
	12	24	48	(h.)
Galanga, *A. galanga*	60.0±33.4b[1/]	70.0±30.3b	100a	7.9
Ginger, *Z. officinale*	76.6±23.3b	85.3±15.0ab	100a	<1
Kaempfer, *B. rotunda*	3.3±8.1c	50.0±10.9c	100a	24.0
Phlai, *Z. cassumunar*	0c	16.6±15.0d	87.6±16.33a	48.4
Siam cardamom, *Am. krevanh*	0c	6.6±10.3d	73.3±24.2b	58.7
Positive control	100a	100a	100a	<1
Negative control	0c	0d	0c	
CV (%)	45.9	32.4	13.8	

[1/] Mean sharing similar letters in columns do not differ by DMRT test at P=0.05

Discussions

The results showed that essential oils from five species of medicinal plants are effective in controlling cabbage worms. The ginger is the most effective. Followed by galanga, kaempfer, phlai and siam cardamom. The analysis of the essential oils of ginger, the major componnets are zingiberene (16.6%), e-citral (12.0%), z-citral (8.8%), camphene (7.6%), ocimene (6.5%) etc. (Raina *et al*, 2013). Galangal have been more component such as eucalyptol (22.63%), (1S)-(1)-β-pinene (14.36%), 1R-α-pinene (10.89%), α-terpineol (8.59%), L(-)-borneol (8.41%) etc. (Wu *et al*, 2014). The main compound of kaempfer are nerol (39.6%), L-camphor (36.0%) etc. (Khairul *et al*, 2015). Phlai were found the major component such as sabinene (36.7-53.5%), Y-terpinene (5.2-7.2%), terpinen-4-ol (21.8-29.9%), butadiene (0.9-16.1%) etc. (Sukatta *et al*, 2009). Siam cardamom were found trans-anethole, 3-phenylpropenol, 1,8, cineole, trans-caryophyllene, geraniol etc. (Simsiriwat, 2004).

Moreover, chemical compound of five Zingiberaceae plants from our study that show more properties to used such as Zingiberene poses repellency activity on whiteflies (Bleeker *et al*, 2011), as well as immunotoxicity on *Aedes aegypti* L. (Moon *et al*, 2011). Camphene were record about to control red palm weevil (*Rhynchophorus ferrugineus*) (Sharaby and El-Dorsay, 2015), high effective to kill adult stage of rice weevil (*Sitophilus oryzae*) (Kim *et al*, 2016). Eucalyptol were found to control cigarette beetle (*Lasioderma serricorne*) and red flour beetle (*Tribolium castaneum*) (Wang *et al*, 2014). Camphor were effect to kill and repellent on fire ant (*Solenopsis invicta*) (Fu *et al*, 2015). Trans-anethole were found property to reple maize weevil (*Sitophilus zeamais*) (Wei *et al*, 2014).

In addition, zingiberaceae plant were our studies that shown similar the other report to control insect, microbial etc. Ginger were many effect on insect such as larvicide activity on *Culex tritaeniorhynchus* and *Anopheles subpictus* (Govindarajan, 2011), repellency on maize weevil (Sitophilus zeamais) (Ukeh *et al*, 2009), antimicrobial on *Aspergillus fumigatus*, *A. niger* (Bansod and Rai, 2008), *Escherichia coli*, *Pseudomonas aruginosa*, *Staphylococcus auesu*, *Vibrio cholera*, *Klebsiella* spp., *Salmonella* spp. etc. (Islam *et al*, 2014). Galanga were report to reple Asian subterranean termites (*Coptotermes gestroil* and *C. curvignathus*) (Abdullah *et al*, 2015) and antibacterial such as *Staphylococcus aureus* and *Escherichia coli* (Oonmetta-aree *et al*, 2006). Kaempfer were larvicidal activity, pupicidal activity and repellency effect on dengue vector mosquito (*Aedes aegypti* L.) (Phukerd and Soonwera, 2013, 2014), antibacterial on *Escherichia coli* (Zainin *et al*, 2013). Phlai were

knockdown effect on houseflies (*Musca domestica*) (Sinthusiri and Soonwera, 2013), repel on *Aedes aegypti*, *Anopheles minimus* and *Culex quinquefasciatus* (Phasomkusolsil and Soonwera, 2010), antimicrobial such as gram-postive bacterial, gram-negative bacterial, dermatophytes, yeasts etc. (Pithayanukul *et al*, 2007). Siam cardamom were report to using reple *Aedes albopcitus* (Shufeng *et al*, 2011), antibacterial such as *Bacillus subtilis*, *Esherichia coli* etc. (Diao *et al*, 2014). Additionally, the other report were found larvicidal effect and anti oviposition on cabbage moth while using *Barringtonia sarcostachys* (F.Lecythidaceae) extraction. (Syahputra, 2013). Similarly, long pepper (*Piper retrofractum*, F.Piperaceae) + star apple (*Annona squamosa*, F.Annonaceae) extraction and chinese perfume (*Aglaia odorata*, F.Meliaceae) + star apple (*A. squamosal*) extraction were gave more mortality rate on cabbage moth. (Dadang and Prijono, 2011)

The approach outlined in this study should be experiment in field cropping as well as in various areas that bring well know to using in the future.

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