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Full Length Research Paper

Ethanolic extract of melgota (*Macaranga postulata*) for repellency, insecticidal activity against rice weevil (*Sitophilus oryzae*)

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Ethanolic extract of Melgota is used for repellency, insecticidal activity against rice weevil (*Sitophilus oryzae)* with emphasis on chemical investigation. Fruits of Melgota (*Macaranga postulata*) were extracted on different solvents as in ethanol, acetone, petroleum ether, distilled water and the extracts were concentrated and dried. The ethanol extracts of Melgota (*M. postulata*) of different concentrations were investigated for their repellency and insecticidal activity against *S. oryzae*. Average mortality percentage indicated that the extracts caused significant mortality and repellency on the target insects and bioassays indicated that the toxic and repellent effect was proportional to the concentration and higher concentration has stronger effect. Observed mortality percentage increased with increase in time intervals after treatment. Mortality percentage at 0.25, 0.50, 0.75, 1.00, and 1.50 h after treatment (HAT) indicated that 4% solution showed the highest mortality (34.0%) in *S. oryzae* at 1.50 HAT compared to *pediculus humanus*. Mortality percentage showed parallel response to the level of concentration at different time intervals after treatment. 1% fruit extract of Melgota (*M. postulata*) showed the lowest repellency 9.84 % in case of rice weevil. On other side, 2% showed 12.76% and 4% showed 22.43% respectively. TLC of crude ethanol extract of Melgota (*M. postulata*) showed six distinct compounds at uv-visible light.

Key words: *Macaranga postulata*, *Sitophilus oryzae,* mortality, repellency.

INTRODUCTION

Insect pests have mainly been controlled with synthetic insecticides in the last fifty years. The protection of stored grains from insect damage is currently dependent on synthetic pesticides. Most insecticidal compounds fall within four main classes, the organochlorines, organophosphates, carbamates and pyrethroids. There are problems of pesticide resistance and negative effects on non-target organisms including man and the environment. The use of organochlorine insecticides have been banned in developed countries and alternative methods of insect pest control are being investigated. Botanicals are a promising source of pest control compounds. The pool of plants possessing insecticidal substances is enormous. These have generated extraordinary interest in recent years as potential sources of natural insect control agents. In the middle of the 17th century, pyrethrum, nicotine, and rotenone were recognized as effective insect-control agents (Silva-Aguayo, 2004).

Roy et al. (2005), established leaf extracts of Shiyalmutra (*Blumea lacera*) as botanical insecticides against lesser grain borer and rice weevil. Kabaru and Gichia (2001) revealed that the insecticidal and antifeedant activity of extracts derived from different parts of the mangrove tree *rhizophora mucronata (rhizophoraceae*) Lam. Khan and Wasim (2001) revealed results that neem extract in benzene was most effective repellent of red

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pumpkin beetle, followed by Bakain extract in benzene. These two extracts were found non-significantly different from each other. Hermal extract in ethanol was found significantly least effective, followed by Hermal extract in benzene, Bakain and Neem extracts in ethanol. All of these plants extracts were found significantly effective in the repellency of red pumpkin beetles compared to control. Haque (2002) analyzed chemically Bankalmi, Polygonum hydropiper and evaluated against rice hispa beetle. Hot water extracts of Bankalmi (*Ipomoea sepiaria)* and Bishkatali (*Polygonum hydropiper*) (1:10; W/V) can efficiently be controlled by the hispa beetle and Bankalmi leaf extract with 25-95% ethyl alcohol. Nadi (2001) showed the toxicity of aqueous, methanolic and acetonic extracts of three plants *Rhazya stricta,*, *Azadirachta indica*, and *Heliotropium bacciferum* to the khapra beetle (*Trogoderma granarium Everts*) larvae. All extracts showed remarkable toxicities.

The melgota (*M. postulata*) is locally used to kill fishes and earth worms in Boalkhali upazilla under chittagong district, Bangladesh. As per our knowledge of this plant, plant fruits have not been studied yet for insecticidal activity or repellent action. The present work is being carried out to study ethanolic extract of melgota (*M. postulata*) for repellency, insecticidal activity against rice weevil (*S. oryzae*) with emphasis on chemical investigation.

MATERIALS AND METHOD

Plant material

Matured fruits Melgota (*M. postulata*) were collected from a village of Boalkhali upazilla under chittagong district, Bangladesh. The fresh leaves were taken to the laboratory of the department of chemistry, Shahjalal University of Science and Technology and cut into small pieces and dried. The air-dried materials were then further dried in an oven at 40°C. The dried leaves were macerated and powdered in blender machine. 100 g of the dried powders of fruits extracted with four different solvent, they are 80% ethanol, acetone, petroleum ether, and distilled water of 300 ml for three consecutive terms.

The extracts were concentrated using a rotary evaporator at a maximum temperature of 45°C. The weight of dried crude extract was 11.4 gm from 100 grams of the dried powder in 80% ethanol as a solvent. The crude extract was then dissolved in distilled water to prepare solutions of different concentrations (1.0, 2.0, and 4.0%). Thin layer Chromatography and column chromatography of effective crude extracts were performed with silica gel at stationary phase and mixture of ethyl acetate and hexane. The bioassays of the extracts were done for repellency and direct toxicity (mortality) test. All the solvent and reagents (e.g. ethyl acetate, acetone, methanol, hexane) were used either from E. Merck (Germany) or BDH (England) and were either laboratory grade or analytical grade. Commercial grade of ethanol, petroleum ether were used after distillation and further purification.

Method for toxicity test

Direct toxicity test with rice weevil was done following the method of Talukder and Howse (1993). Insects were chilled for a period of 10 min. The immobilized insects were individually picked up and one-milliliter solutions of different concentrations (0.0, 1.0, 2.0 and 4.0% w/v) were applied to the dorsal surface of the thorax of each insect by using a micro capillary tube. Ten insects per replication were treated. The insects were then transferred into a 9 cm diameter petridishes containing food. Insect mortality rate was recorded after 0.25, 0.50, 0.75, 1.0, 1.5 h after treatment (HAT). All the experiments were conducted in completely randomized design with four replications and turned to statistical analysis. Finally, the mean values were compared using DMRT, Duncun (1957).

Method for repellency test

Repellency test was conducted following the method of Talukdar and Howse (1993), Amin et al. (2000). The dried extracts were dissolved in distilled water to make solutions of different concentrations. For the experiment, we prepared solutions of three different concentrations as 1.0, 2.0 and 4.0% (w/v). Only Melgota (*M. postulata*) showed repelling effect on the experimental insects. Nine-centimeter diameter filter papers (Whatman No. 40) were marked into two portions. One-milliliter solution of each extract was applied to one half of the filter paper (treated half) and on the other half one milliliter of distilled water was applied (controlled half). The treated disks were then air-dried and placed in a petridish. Twenty (20) insects were placed there, 10 on the controlled half and 10 on the treated half. Number of insects on each side was counted at 30 min intervals up to the second hour after treatment. Percent repellency was calculated by using the following formula from Abbott (1925):

$$\text{Percent Repellency} = \frac{A - B}{A} \times 100$$

Here,

A = Average number of insects present on untreated portion. B = Average Number of insects present on treated portion.

The percentages of repellency were then categorized according to the following scale by the method of B. Roy et al (2005) and R. Amin et al. (2000).

Class	Repellency Rate (%)
0	>0.01-0.10
I	0.10 to 20.00
II	20.10 to 40.00
III	40.10 to 60.00
IV	60.10 to 80.00
V	80.10 to 100.00

RESULTS AND DISCUSSION

Toxicity test

With the ethanol extract of *M. postulata* (fruit) average mortality percentage indicated that 4.00 % concentration resulted in the higher toxicity 34.00% in *S. oryzae*. It is also notable that 1.00% showed a toxicity of 22.00% whereas 2.00 % showed the average toxicity of 23.00% in *S. oryzae*. The order of toxicity of three different concentrations were 4.00 > 2.00 > 1.00 percentage. Observed mortality percentage increased with increase in time intervals after treatment. The comparison of mortality on

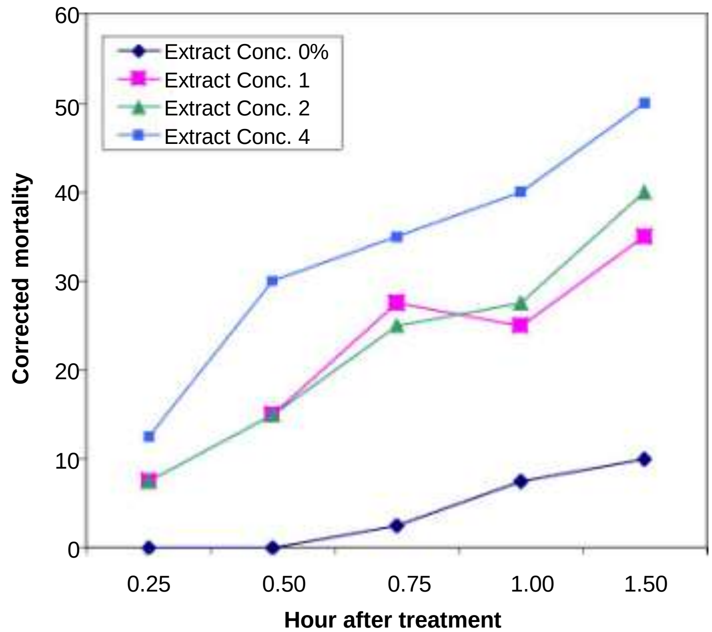

Figure 1. Corrected mortality with ethanol extract of Melgota fruits (*Macaranga postulata*) on *Sitophilus oryzae*

Table 1. Corrected mortality with ethanol extract of Melgota fruits (*Macaranga postulata*) on *Sitophilus oryze*.

Concentration	Corrected Mortality (HAT)					Mean Mortality
	0.25	0.50	0.75	1.00	1.5	
0.00% (Control)	0.00	0.00	2.50	7.50	10.00	4.00
1.00	7.50 a*	15.00 a	27.50 a	25.00 a	35.00 a	22.00
2.00	7.50 a	15.00 a	25.00 a	27.50 a	40.00 a	23.00
4.00	12.50 a	30.00 b	35.00 b	40.00 b	50.00 b	34.00

HAT: Hours after treatment.
*Within column values followed by same letter(s) did not differ significantly at 5% level by DMRT.

different concentration of the extract solution is shown in Figure 1**.** Mortality percentage at 0.25, 0.50, 0.75, 1.00, and 1.50 HAT indicated that 4.00% solution showed the highest mortality (34.00%) in *S. oryzae*. at 1.50 HAT. Mortality percentage showed parallel response to the level of concentration at different time intervals after treatment. Mortality after 1.00 HAT to 1.50 showed that the effect of the extracts does not fall within 1.50 h interval of time. Thus, the extract may show long time effect on the receptor insects. The experimental results tabulated on Table 1. Amin et al (2000), reported the direct toxicity of the three plant extract on the following biskatali > neem > akand in lesser grain borer. Talukder and Howse (1993) also noted similar direct toxicity effect of pithraj on red flower beetle. Recently Roy et al. (2005), reported the direct toxicity of leaf extracts of shyialmutra on rice weevil by following order of toxicity 3>2>1%.

Repellency test

Among the extracts 1% fruit extract of melgota (*M. postulata*) showed the lowest repellency 9.84% in case of rice weevil. On other side 2%, showed 12.76%, and 4% showed 22.43% (Table 2). The highest repellency in rice weevil observed with 4% extract. The repellent action increased with increase in concentrations of the extract applied. The comparison is plotted on Figure 2. Roy et al. (2005) reported repellent effect of shyialmutra in rice weevil with 3% leaf extract.

The biological activity of plant extracts is due to the various compounds present in the extracts. These compounds may independently or jointly contribute to cause toxic and repellent action against *S. oryzae* . Further investigation is needed to identify the active compound(s) of the extract responsible for its activity and to examine the effect of *M. postulata* extract against a wider

Table 2. Repellency of different concentration of dried ethanol extracts Melgota (*Macaranga postulata*) on rice weevil.

Extract Concentration (%)	After treatment				Mean Repellency Rate	Repellency Class
	30 min	60 min	90 min	120 min		
1.00	6.50 a*	12.50 a	10.67 a	6.4516 a	9.84	I
2.00	12.50 b	18.18 b	10.67 a	6.4516 a	12.76	I
3.00	23.53 c	33.33 c	23.53 b	12.5 b	22.43	II

*Within column values followed by same letter(s) did not differ significantly at 5% level by DMRT.

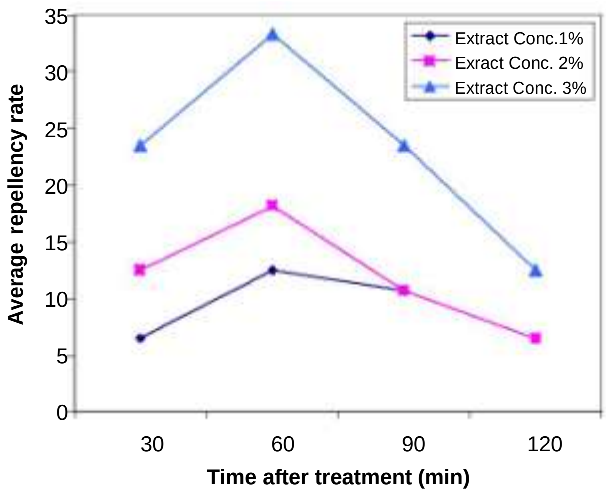

Figure 2. Repellency of different concentration of dried ethanol extracts Melgota (*Macaranga postulata*) on rice weevil

Table 3. Thin layer chromatography of ethanolic extract of melgota (*Macaranga postulata*) (R_f Values).

Mobile Phase	R_f value	Comment
Ethyl Acetate: n Hexane (1:25)	0.14	6 Spots
	0.21	
	0.66	
	0.92	
	0.96	
	0.99	

range of insects. Thin layer chromatography of crude ethanol extract of Melgota (*M. postulata*) fruits showed six distinct compounds at uv-visible light with n-hexane: ethyl acetate (25:1, v/v) (Figure 3). The R_f values were calculated using the following formula by the method of Furniss et al. (1989):

$$R_f = \frac{\text{Distance traveled by the component}}{\text{Distance traveled by the solvent front}}$$

R_f values of each component is shown in Table 3. Now we are in the way to purify the fractions of melgota *(M. postulata*) individually by column chromatography. After purification, we will again set up an experiment for their

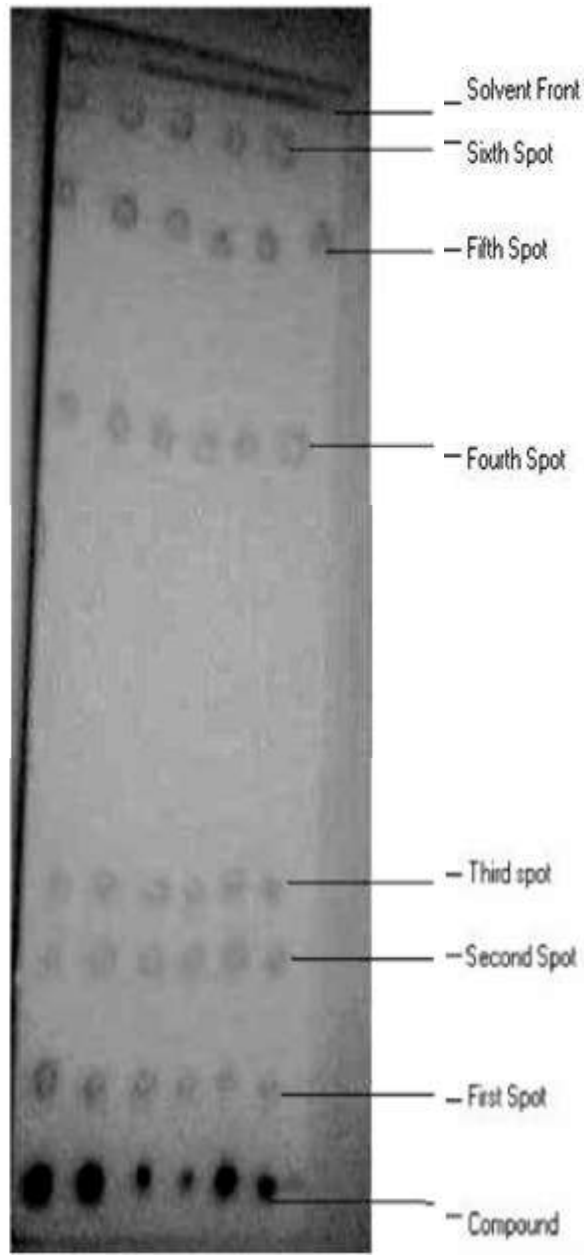

Figure 3. The thin layer chromatography of melgota extract.

insecticidal activity and repellent action. The structure of the component will be determined by ^{1}H-NMR, IR, and mass spectroscopy study, which will be reported on due course. In our view, biopesticides from plant origin may contribute to an effective vector control tools. These new agents should preferentially be applied in integrated control strategies to gain maximum and safer impact on insect growth.

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