Antifeedant Activity of *Peltophorum pterocarpum* and *Ipomoea aquatica* Extracts as Botanical Pesticides against *Pomacea canaliculata*

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Abstract. *Pomacea canaliculata* is dangerous pest to paddy field due to fast action on eating stem and young leaves of paddy. Synthetic pesticides are common method used by farmers to control *P. canaliculata* infestation. However, the usage of synthetic pesticides gave negative impact to natural environment, aquatic and non-target organisms. Thus, botanical pesticides are alternative methods to control *P. canaliculata*. The aims of this research are to quantify chemical compound in *Peltophorum pterocarpum* and *Ipomoea aquatica* extracts and evaluate antifeedant activity of extracts for controlling *P. canaliculata*. Ultraviolet-Visible (UV-Vis) spectrophotometer analysis was done to quantify chemical compound in *P. pterocarpum* and *I. aquatica* extracts. The result showed all treatments gave the highest amount of lupeol compared with catechin, rutin, salicylic acid, quercetin and kaempferol. *Peltophorum pterocarpum* extracts in methanol showed highest antifeedant index (AFI) (46.9%) compared with other treatments. Thus, it showed *P. pterocarpum* extracts in methanol have more abilities to act as an antifeedant. In summary, *P. pterocarpum* is recommended as an alternative botanical pesticide due to its antifeedant properties on *P. canaliculata*.

1. Introduction

*Pomacea canaliculata* Lamarck, golden apple snail (GAS) is classified in kingdom Animalia from the family of Ampullaridae and order of Mesogastropoda found around the world [23]. *P. canaliculata* was distributed widely in Asia for dietary protein supplement and provided income to rural poor [7]. However, *P. canaliculata* has become a major pest to rice fields due to its biological characteristic such as high fertility which makes its populate rapidly in a short time [11]. Various methods were used to control the infestation of *P. canaliculata* in rice fields such as cultural control, biological control and chemical control. However, farmers are frequently used chemical control (molluscicides) because this method was more effective to control *P. canaliculata* infestation due to chemical properties. Usage of molluscicides increased crop production due to effect and fast action on *P. canaliculata*. At the same time, molluscicides have a negative impact on humans, environment and especially to non-target organisms such as pollinator agents and beneficial plants [14].

Botanical pesticides are an alternative way to replace the usage of molluscicides for controlling *P. canaliculata* infestation. According to Silva [20], about 247 families from 2500 plants play the role of secondary metabolites to protect themselves from pests. Some of plants have their own mechanism to protect themselves from enemies such as pests and diseases due to their chemical compound, which are toxic to pests, act as repellents, are antifeedants, and regulate insect growth activities [18].

The presence of biological active compounds in *Peltophorum pterocarpum* (golden flamboyant) and *Ipomoea aquatica* (water spinach) have the ability to be botanical pesticides. *P. pterocarpum* belongs to Fabaceae family and known as Radhachura (Beng.) [12]. Biswas et al. [4] conducted an experiment by using leaves of *P. pterocarpum* against paracetamol that prompted severe liver damage in mice. *I. aquatica* is a member of Convolvulaceae family, widely found in muddy stream banks, freshwater ponds and lakes [9]. Ayoola et al. [3] found that teatraction of *I. aquatica* has piscicidal substances that could be incorporated in use control and management of *Oreochromis niloticus* (Nile Tilapia). The efficacy of the *P. pterocarpum* and *I. aquatica* extracts in methanol and ethanol as
botanical pesticides for controlling *P. canaliculata* was observed and measured by identifying the chemical compound and antifeedant activity of each extracts towards *P. canaliculata*.

2. Materials and methods

2.1. Samples and plants collection

The samples of *P. canaliculata* were collected from Sekinchan, Selangor and sorted by measuring the shell height using a vernier calliper. Before started the antifeedant test, *P. canaliculata* conditions confirmed if there was response by pushing the operculum. The leaves of *P. pterocarpum* were collected from campus of Universiti Teknologi MARA (UiTM) Shah Alam and *I. aquatica* were planted in greenhouse at UiTM Puncak Alam before collected.

2.2. Plants extraction

Extraction method followed the protocol of Handa [10] and Sujatha et al. [22] with some modifications. The leaves of both plants were washed with tap water to get rid of unwanted things and debris. Then, the leaves were dried in the oven at 70°C for 48 hours. Next, the dried leaves were blended in the electric blender until become the powder. Twenty (20) g of powder for each plant was weighed and placed inside a thimble. The samples went through soxhlet extraction using 350ml of methanol and ethanol. From the soxhlet procedure, the solvent extracts were transferred into rotary evaporator at 50°C for 40 minutes; the final product range between 3 to 4g [17].

2.3. Quantification of phytochemical compounds

Ultraviolet-Visible (UV-VIS) spectrophotometer was used and done by following the protocol of Telange et al. [24] with some modification; using different maximum absorbance (λ_max) for all standard compounds. The stock solutions of standard (lupeol, catechin, rutin, salicylic acid, quercetin and kaempferol) were diluted in methanol. Then, the working solution of each standard was prepared using serial dilution technique and vortexed for a minute to mix the solution.

The maximum absorbance (λ_max) was measured at absorption maxima; 285nm (lupeol), 290nm (catechin), 271.4nm (rutin), 320nm (salicylic acid), 370nm (quercetin) and 395nm (kaempferol). The lupeol, catechin, rutin, salicylic acid, quercetin and kaempferol used as standard references of quantification each compound in *Peltophorum pterocarpum* extract in methanol (T1), *Peltophorum pterocarpum* extract in ethanol (T2), *Ipomoea aquatica* extract in methanol (T3) and *Ipomoea aquatica* extract in ethanol (T4). Each extract was measured for three times. The amounts of each standard in each extract calculated using regression equation of each standard.

2.4. Antifeedant test

For the antifeedant test, no choice method was conducted by using the protocol of Suanda and Resiani [21] with some modifications. The *P. pterocarpum* extract in methanol (T1), *Peltophorum pterocarpum* extract in ethanol (T2), *Ipomoea aquatica* extract in methanol (T3) and *Ipomoea aquatica* extract in ethanol (T4) were applied to paddy seedlings before placing into the aquariums; each containing ten *P. canaliculata*. This research composed of five different concentrations (20000, 40000, 60000, 80000 and 100000 mg/L) for treatments with three replication. Distilled water, methanol, ethanol and nielosamide were used as a control. The range of the shell size was 25 to 30mm. Latip et al. [17] stated that the *P. canaliculata* and paddy weight from the antifeedant test needs to be measured within seven days (168 hours) at different treatments and concentrations. The weight loss (WL) was measured by using this equation (1):

\[
% WL = (IW-FW) \times 100/IW
\]

Where the IW is the initial weight and FW is the final weight. Then, the antifeedant index (AFI, %) of each treatment was calculated using this equation (2):

\[
AFI = (1 - WL/IW) \times 100
\]
Where C is consumed by control and T is consumed by treatments. The value of WL and AFI were analysed by using analysis variance (ANOVA) and the means were compared using the Duncan Multiple Range Test (DMRT) at p<0.05.

3. Results

Quantification of phytochemical compounds for each treatment showed the presence of saponin compound (lupeol), flavonoids compounds (catechin, rutin, quercetin and kaempferol) and phenolic acid compound (salicylic acid) (Table 1). It showed that all treatments have the highest saponin compound (lupeol). There are significance different (p<0.05) between each phytochemical compound of each treatment. For T1, the result showed lupeol (9.91%) is the highest; while kaempferol (0.85%) is the lowest yield compound respectively. On the other hand, in T2; the result showed that lupeol (8.98%) is the highest yield compound while quercetin (0.64%) is the lowest. The preliminary phytochemical analysis of T1 showed the presence of flavonoids, alkaloids, carbohydrates, glycosides, amino acids, proteins and tannins [5]. Besides, other compounds such as kaempferol, lupeol, quercetin and quercetin-3-0-β-D-galactopyranoside had previously reported in P. pterocarpum leaves, stems, bark and flowers [13].

The result from Table 1 showed the highest yield compounds of T3 and T4 is lupeol; 8.30% and 7.53% respectively. However, for T3, kaempferol (0.50%) is the lowest, while for T4, salicylic acid (1.04%) is the lowest yield compound. Ipomoea aquatica contains flavonoids, phenolic acids, saponins, alkaloids, lipids, steroids, tannins, minerals, glycosides, reducing sugars and β-carotene [15]. Some of flavonoids (kaempferol, quercetin, luteolin, apigenin and myricetin) were found in the I. aquatica.

The result for the antifeedant test of P. pterocarpum and I. aquatica extracts on P. canaliculata was monitored by recording weight loss of P. canaliculata, weight loss of the paddy and antifeedant index (AFI, %) after being exposed for seven (7) days or 168 hours. Figure 1 shows the result for mean weight loss of P. canaliculata within 7 days (168 hours) after treated with different treatments. T1 with the highest concentration shows the highest mean percentage weight loss of P. canaliculata (45.61%) compared with T2 (42.55%), T3 (37.18%) and T4 (24.50%). The increasing concentration of each treatment shows the increasing of weight loss of P. canaliculata. Figure 2 shows the result for mean weight loss of paddy within 7 days (168 hours) after exposed with P. canaliculata. T4 with the highest concentration give the highest mean percentage weight loss of paddy (36.78%) and T1 give the lowest (22.86%) compared with other treatments. The mortality percentage of P. canaliculata is

\[
\text{AFI, } \% = \frac{(C-T)}{(C+T)} \times 100
\]

Table 1. Quantification of phytochemical compounds in 100,000mg/L of treatments

| Treatments                        | Phytochemical compounds | F-value | P-value |
|-----------------------------------|-------------------------|---------|---------|
|                                  | Lupeol | Catechin | Rutin | Salicylic Acid | Quercetin | Kaempferol |       |        |
| P. pterocarpum methanol extract   | 9.91   | 9.58     | 7.07  | 2.22          | 1.04      | 0.85       | 1324.64 | <.0001 |
| P. pterocarpum ethanol extract    | 8.98   | 7.44     | 2.46  | 1.42          | 0.64      | 1.59       | 4252.96 | <.0001 |
| I. aquatica methanol extract      | 8.3    | 7.23     | 3.96  | 1.31          | 0.78      | 0.50       | 1638.31 | <.0001 |
| I. aquatica ethanol extract       | 7.53   | 6.80     | 1.98  | 1.04          | 1.06      | 1.11       | 1036.17 | <.0001 |

*Note. p- value< 0.05 is indicate significant differences between concentration*
concurrent with the weight loss of paddy. It showed that the mortality of the *P. canaliculata* (Figure 3) affects the weight loss of paddy. The weight loss of paddy is lowest when *P. canaliculata* treated with the highest concentration of each treatment.

The highest antifeedant index (AFI, %) usually measures the decreasing feeding rate of insect pests. Highest concentration gives highest AFI. The highest mean percentage weight loss of paddy showed the lowest AFI for each treatment. Figure 4 indicated that the highest concentration of each treatment has a highest percentage of AFI. T1 shows the highest AFI (46.87%) compared with other treatments. For all treatment, 20,000mg/L of concentration had a lowest percentage of AFI while 100,000mg/L of concentration had a highest percentage of AFI.

![Figure 1. Mean percentage weight loss of *Pomacea canaliculata* treated with different concentrations of different treatments](image)

**Figure 1.** Mean percentage weight loss of *Pomacea canaliculata* treated with different concentrations of different treatments.
4. Discussions

Quantification of phytochemical compounds shows that *Peltophorum pterocarpum* and *Ipomoea aquatica* extract in methanol and ethanol contains flavonoids, phenolic acids and saponin compound. Both plants contain higher saponin compound (lupeol) rather than flavonoids and phenolic acids compound. Flavonoids, phenolic acids and saponin compound are functional in reaction towards *Pomacea canaliculata*. However, those compounds are not effectively functioning for mortality effect. As mentioned by Golawska et al. [8], a few types of flavonoids compound commonly act as a repellent and antifeedant to the insects due to the promotion of oxidative stress within insect tissues. The interaction of insect and secondary metabolites (flavonoids) occurs when the chemical will change the feeding behaviour of insect pests. The flavonoids showed harmful effect on the feeding behaviour of the pea aphid, *Acyrthosiphon pisum*; where it can reduce the aphid ingestion. Phenolic acids function
in several biochemical interactions; especially in plant response to different stress factors such as pathogen infections, UV radiation and wounding or insect feeding. The plants that contain a higher concentration of phenolic acids changed the insect behaviour including reducing the feed by various grasshoppers and planthoppers. The saponin compounds of extracts showed a deterrent activity against *Myzus persicae* and *Epilachna paenulata*\(^{[24]}\). The saponin compound has the potential to influence the activities of *P. canaliculata*. The secondary metabolites compound (alkaloids, flavonoids, steroids, cardiac glycosides, terpenoids, tannins, polyphenols and saponins) found in *Parkia biglobosa* seed extracts are functioning in antifeedant activity on *Callosobruchus maculatus* at higher concentration\(^{[19]}\).

Antifeedant chemicals are vital for the unsuitability of non-host plants as food for insects\(^{[2]}\). The antifeedant can easily found amongst alkaloids, phenolics and terpenoids act as the secondary metabolites and are more harmful to insects. The measurement of the antifeedant index (AFI) was to evaluate the antifeedant activity of chemical compounds for *P. pterocarpum* and *I. aquatica* extract in methanol and ethanol. The lowest rate of feeding on *P. canaliculata* seen in the highest AFI\(^{[2]}\). A highest concentration gave highest percentage of AFI.

5. Conclusions

Based on the finding, *Peltophorum pterocarpum* extract with methanol is more effective on antifeedant effect compared with other treatments. The use of *P. pterocarpum* as botanical pesticides is highly recommended because it is toxicologically safe, environmentally friendly, easy to use and have a wide range of pesticidal activity. However, further quantitative studies should be conducted under field conditions to evaluate the antifeedant effect on *P. canaliculata* in paddy field.

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