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Insecticidal Activity of *Phytolacca dodecandra* L. Herit (Phytolaccaceae) Plant Extracts Against Cabbage Flea Beetle *Phyllotreta cruciferae* Goeze (Coleoptera: Chrysomilidae)

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Abstract: The objective of this study was to evaluate insecticidal effect of *Phytolacca dodecandra* plant extracts against cabbage flea beetle (*Phyllotreta cruciferae*). Five concentrations of cold and hot water extracts were prepared from leaves, immature and mature fruits by mixing 0.625, 1.25, 2.5, 5 and 10 g of powder with 100 ml of water on weight by volume (W/V) basis. These plant extracts were tested by thin film residue method by applying 1 ml of the extracts on glass test tube and rinsed to make uniform layer. In each concentration, 10 healthy insects were introduced and the percentage of mortality was recorded continuously for 96 h with 24 h interval. The hot water extracts of immature fruit and mature fruit powder mixed at 10 g/100 ml showed 100% mortality after 24 h. The minimum LC_{50} concentration of 0.101 g/100 ml and 0.132 g/100 ml was calculated for immature fruit hot water extract after 72 h and 96 h exposure period, respectively. The results obtained from mature fruit cold and hot water extract after 24 h; cold water extract of leaves and mature fruits after 48 h; cold water extract of leaves after 72 h were statistically significant ($p < 0.05$). In conclusion, cold and hot water extracts of *P. dodecandra* plant extracts showed insecticidal activity against cabbage flea beetle *P. cruiciferae*. These plant extracts can be useful for small scale farming community to control cabbage flea beetle *P. cruciferae.*

Key words: Mortality · LC_{50} Concentration · Water Extract

INTRODUCTION

African soap berry (*Phytolacca dodecandra)* is a perennial climbing plant belongs to the family Phytolaccaceae which is commonly called Endod in Ethiopia. These plant species are growing rapidly in Ethiopian highlands from 1600 to 3000 meter above sea level and produce fruits biannually in the month of December to February and June to July [1]. Bio-potential of this plant extract is confirmed with different level of LC_{50} and LC_{90} values against immature stages of *Aedes africanus, Ae. aegypti* and *Culex quinquefasciatus* [2, 3]. Petroleum ether, acetone and benzene extract is proved to have larvicidal and pupicidal activity against immature stage of *Cx. quinquefasciatus* [4]. In addition, Abebe *et al*. [5] observed 100% snail mortality by spraying different formulation of Endod strain (E44) in stream. The prevalence rate of schistosomiasis was reduced from 59% to 53% in Kemise town by spraying the ground endod suspension. In Bati town, reduction in the prevalence and intensity of schistomiasis infection was 51% to 43% by endod soap approach method [6]. The aquatic macroinvertebrates such as Batidae and Hydropsychidide are highly susceptible to crude berries extract [1]. The ovicidal effect of ethanolic and dichloromethane leaf extract of *P. icosandra* was confirmed against *Haemonchus contortus* egg by observing greater than 90% hatch inhibition at 0.90 mg/ml or higher concentration [7].

In addition, *P. dodecandra* is used for different medicinal purposes [8]. The leaf juice is used for the treatment of Malaria in Wonago district, Ethiopia [9]. The other medicinal uses of this plant includes purgatives, antihelmintics, laxatives, emetics, diuretics, diarrhea, abdominal pains, edema and intestinal problems [8, 10]; wound treatment, skin diseases like ringworms,

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scabies, abortion, dandruff, itching, headache, rheumatism, skin irritation, stomach pain and intestinal roundworms [10, 11]; treatment of emesis, otitis and pneumonia [12]. In Ethiopia, this multi-potential bioactive plant, *P. dodecandra* is growing naturally and also cultivated for snail control program. Therefore, the present study was initiated to document insecticidal properties of leaves, immature and mature berries against cabbage flea beetle (*Phyllotreta cruciferae*) which cause damage to cabbage seedlings and also showing "shot-hole" appearance on mature cabbage by feeding.

MATERIALS AND METHODS

Insecticidal activity of different parts of *Phytolacca dodecondra* was tested against cabbage flea beetle (*Phyllotreta crucifera*). The experiment was carried out at Genetics laboratory, Tewdros campus, Department of Biology, College of Natural and Computational Sciences, University of Gondar, Ethiopia from February 2013 to May 2013.

Processing of Plant Materials: Leaves, immature and mature fruits of *P. dodecandra* were collected in the vicinity of University of Gondar and also in and around Gondar town. The plant parts were collected randomly from 10 individual plants and mixed together to avoid individual effect of the plant. The collected plant materials were thoroughly cleaned with tap water to avoid debris attached from the natural environment and shade dried to prevent denaturation of active chemicals. The dried plant parts were powdered by using electric blender and fine powder was collected by sieving through kitchen strainer. The powdered plant materials were kept individually in air tight container and stored at 4°C in a refrigerator.

Preparation of Concentrations: Five concentrations were prepared by using cold and hot water on weight by volume basis (w/v) by mixing 0.625, 1.25, 2.5, 5 and 10 g of powder individually with 100 ml of water. For cold water preparation, tap water was used and 100°C boiled water for 10 minute was used for hot water preparation. The above mentioned quantity of plant powder was taken in a conical flask; added 100 ml of cold and hot water individually and allowed for 12 h continuous shaking in a shaker to get complete homogeneous solution. After shaking, liquid part was collected by filtering through muslin cloth and added 2 ml of vessels cleaning vim liquid soap for emulsification purpose. For the control, 2 ml of soap solution mixed with 100 ml of water was used.

Maintenance of flea beetles: Cabbage flea beetle, *Phyllotreta cruciferae* were collected from the cabbage field at Hope of Bridge Children Village farm, near the University of Gondar. The beetles were collected by using insect collection net; transferred to plastic container and brought to the laboratory along with fresh leaves. The beetles were provided fresh cabbage leaves as a food source. The cabbage leaf petiole was tied with water soaked cotton to prevent early drying. These cultures were maintained throughout experimental period.

Evaluation of Insecticidal Activity: Insecticidal activity of plant extract was evaluated by using thin film residue method. In this method, 1 ml of individual concentration of the plant parts was added to 50 ml test tube and rinsed for the appearance of uniform layer. Excess solution in the test tube was discarded and 10 healthy insects introduced in to each tested tube and the mouth was plugged with cotton. The test tube rinsed with 1ml of water (mixture of 100 ml water + 2 ml soap solution) was used as control. The number of dead insects from control and experimental groups were monitored continuously for 96 h with 24 h interval. The number of dead insects was recorded and percentage mortality was calculated and corrected by using Abbott's formula [13].

Corrected % mortality = [% mortality in test - % mortality in control]/[100-% mortality in control] X 100.

Statistical Analysis: The data collected from each experiment was subjected to statistical analysis to derive mean and standard deviation. The statistical significant difference for cold and hot water extracts within the plant parts were analyzed by Chi-square analysis. Probit analysis was carried out to calculate $LC_{50,}$ LC_{90} and 95% upper and lower confidence limit. All the statistical analysis was carried out using SPSS software version 16.

RESULTS

Mean mortality percentage of flea beetles exposed to cold and hot water extract of *P. dodecandra* leaves, immature and mature fruits after 24 h exposure period was presented in Table 1. Result revealed that maximum mortality percentage of 90% was observed in cold and hot water extract at 10 g/100 ml. The calculated LC_{50} and LC_{90} value was 2.706 g/100 ml and 10.944 g/100 ml respectively. The x^2 analysis results was statistically not significant ($p > 0.05$).

Table 1: Insecticidal activity of *P. dodecandra* plant extracts on *P. cruciferae* after 24 h exposure period.

	Leaves		Immature fruit		Mature fruit	
Concentration g/100mL	Cold water	Hot water	Cold water	Hot water	Cold water	Hot water
0.625	6.6±5.77	13.3±5.77	60.0±10.0	80.0±10.0	46.6±5.77	56.6±5.77
1.25	30.0±10.0	23.3±5.77	66.6±5.77	86.6±5.77	70.0±10.0	76.6±5.77
2.5	46.6±5.77	60.0±10.0	76.6±5.77	96.6±5.77	76.6±5.77	80.0±10.0
5.0	66.6±5.77	80.0±10.0	83.3±5.77	100.0±0.0	96.6±5.77	96.6±5.77
10.0	90.0±10.0	90.0±10.0	96.6±5.77	100.0±0.0	100.0±0.0	100.0±0.0
LC_{50}	2.706	2.218	0.446	0.254	0.730	0.525
(UCL-LCL)	(2.36-3.11)	(1.93-2.54)	(0.23-0.67)	(0.11-0.39)	(0.24-1.16)	(0.06-0.947)
LC_{90}	10.944	8.628	6.778	1.198	3.281	2.915
(UCL-LCL)	(8.66-14.89)	(6.97-11.38)	(4.66-12.52)	(0.95-1.56)	(2.04-10.91)	(1.72-13.35)
x^2	4.232	4.364	5.175	2.804	8.132*	8.278*
Significant	0.238	0.225	0.159	0.423	0.043	0.041

Values are mortality percentage mean±standard deviation of three replications. LCL-Lower Confidence Limit; UCL-Upper Confidence Limit; x^2 -Chi-square; * Significant at 5% level ($p<0.05$)

Table 2: Insecticidal activity of *P. dodecandra* plant extracts on *P. cruciferae* after 48 h exposure period.

	Leaves		Immature fruit		Mature fruit	
Concentration g/100mL	Cold water	Hot water	Cold water	Hot water	Cold water	Hot water
0.625	13.3±5.77	30.0±10.0	70.0±10.0	83.3±11.54	56.6±11.54	66.6±11.54
1.25	60.0±10.0	46.6±5.77	76.6±5.77	90.0±10.0	80.0±10.0	83.3±5.77
2.5	66.6±5.77	70.0±10.0	86.6±5.77	100.0±0.0	80.0±10.0	90.0±10.0
5.0	86.6±5.77	86.6±5.77	93.3±5.77	100.0±0.0	100.0±0.0	100.0±0.0
10.0	96.6±5.77	100.0±0.0	100.0±0.0	100.0±0.0	100.0±0.0	100.0±0.0
LC_{50}	1.426	1.268	0.297	0.265	0.529	0.396
(UCL-LCL)	(0.66-2.34)	(1.07-1.47)	(0.14-0.46)	(0.11-0.41)	(0.00-1.07)	(0.24-0.53)
LC_{90}	5.325	5.194	2.803	0.955	2.525	1.825
(UCL-LCL)	(3.06-26.11)	(4.22-6.82)	(2.14-4.11)	(0.76-1.21)	(1.28-725.1)	(1.49-2.39)
x^2	14.210*	5.292	4.068	4.602	15.848*	4.864
Significant	0.003	0.152	0.254	0.203	0.001	0.182

Values are mortality percentage mean±standard deviation of three replications. LCL-Lower Confidence Limit; UCL-Upper Confidence Limit; x^2 -Chi-square; * Significant at 5% level ($p<0.05$)

In immature fruit cold water extract, maximum mortality percentage was 96.6% at 10 g/100 ml treatment. The calculated LC_{50} and LC_{90} value of cold water extract was 0.446 g/100 ml and 6.778 g/100 ml, respectively. In hot water extract, 100% mortality recorded at 10 g/100 ml was on par with 5 g/100 ml treatment. The calculated LC_{50} and LC_{90} value of hot water extract was 0.254 g/100 ml and 1.198 g/100 ml respectively. Both cold and hot water treatment, x^2 analysis results was statistically not significant at ($p> 0.05$).

In mature fruit cold and hot water extract, 100% mortality was recorded at 10 g/100 ml treatment. The calculated LC_{50} and LC_{90} value of cold water extract was 0.730 g/100 ml and 3.281 g/100 ml, respectively. The calculated LC_{50} and LC_{90} value of hot water extract was 0.525 g/100 ml and 2.915 g/100 ml, respectively. The x^2 analysis results of cold and hot water treatment showed statistically significant difference ($p< 0.05$).

Mean mortality percentage of flea beetles treated with cold and hot water extract of *P. dodecandra* leaves, immature and mature fruits after 48 h exposure period was presented in Table 2. Result revealed that 100% mortality was observed in hot water extract and it was 96.6% in cold water extract at 10 g/100 ml treatment. The calculated LC_{50} and LC_{90} value was 1.426 g/100 ml and 5.325 g/100 ml respectively. The x^2 analysis results showed statistically significant difference at 5% level ($p< 0.05$). The range of 95% lower and upper confidence limit (LCL-UCL) of LC_{50} and LC_{90} value was 0.66-2.34 g/100 ml and 3.06-26.11 g/100 ml respectively. In hot water extract of leaves, x^2 analysis results was statistically not significant at 5% level ($p> 0.05$).

In immature fruit cold and hot water extract, mean percentage mortality of flea beetles was 100% at 10 g/100 ml and also in hot water extract at 2.5 and 5 g/100 ml treatment. The calculated LC_{50} and LC_{90} value of cold

Table 3: Insecticidal activity of *P. dodecandra* plant extracts on *P. cruciferae* after 72 h exposure period.

	Leaves		Immature fruit		Mature fruit	
Concentration g/100mL	Cold water	Hot water	Cold water	Hot water	Cold water	Hot water
0.625	60.0±10.0	43.3±15.27	83.3±15.27	93.3±5.77	63.3±11.54	73.3±11.54
1.25	73.3±15.27	70.0±10.0	86.6±11.54	93.3±11.54	83.3±5.77	90.0±10.0
2.5	76.6±15.27	93.3±5.77	93.3±5.77	100.0±0.0	90.0±10.0	100.0±0.0
5.0	100.0±0.0	93.3±5.77	100.0±0.0	100.0±0.0	100.0±0.0	100.0±0.0
10.0	100.0±0.0	100.0±0.0	100.0±0.0	100.0±0.0	100.0±0.0	100.0±0.0
LC_{50}	0.542	0.721	0.172	0.101	0.448	0.405
(UCL-LCL)	(0.00-1.18)	(0.29-1.09)	(0.00-0.47)	(ND)	(0.29-0.58)	(0.26-0.52)
LC_{90}	2.889	2.778	1.274	0.593	1.865	1.091
(UCL-LCL)	(1.35-1.559E9)	(1.83-7.04)	(0.45-3.70)	(ND)	(1.54-2.42)	(0.93-1.36)
x^2	18.489*	7.328	5.343	5.824	4.528	2.275
Significant	0.000	0.062	0.148	0.121	0.210	0.517

Values are percentage mean±standard deviation of three replications. LCL-Lower Confidence Limit; UCL-Upper Confidence Limit; x^2 -Chi-square; ND-Not detected by SPSS software; * Significant at 5% level ($p<0.05$)

water extract was 0.297 g/100 ml and 2.803 g/100 ml respectively. The range of 95% lower and upper confidence limit (LCL-UCL) of LC_{50} and LC_{90} value was 0.14-0.46 g/100 ml and 2.14-4.11 g/100 ml respectively. The calculated LC_{50} and LC_{90} value of hot water extract was 0.265 g/100 ml and 0.955 g/100 ml respectively. The x^2 analysis results of cold and hot water treatment was statistically not significant at 5% level ($p> 0.05$). The range of 95% lower and upper confidence limit (LCL-UCL) of LC_{50} and LC_{90} value was 0.11-0.41 g/100 ml and 0.76-1.21 g/100 ml respectively.

In mature fruit cold and hot water extract, mean percentage mortality of flea beetles was 100% at 5 and 10 g/100 ml treatment. The calculated LC_{50} and LC_{90} value of cold water extract was 0.529 g/100 ml and 2.525 g/100 ml respectively. The x^2 analysis results was statistically significant at 5% level ($x^2 = 15.848$; $p< 0.05$). The calculated LC_{50} and LC_{90} value of hot water extract was 0.396 g/100 ml and 1.825 g/100 ml respectively. The x^2 analysis results was statistically not significant at 5% level ($p> 0.05$).

Mean percentage mortality of flea beetles treated with cold and hot water extract of *P. dodecandra* leaves, immature and mature fruits after 72 hr exposure period was presented in Table 3. Result revealed that 100% mortality was observed in cold and hot water extract of leaves at 10 g/100 ml and also 5 g/100 ml cold treatment. The calculated LC_{50} and LC_{90} value was 0.542 g/100 ml and 2.889 g/100 ml respectively. The x^2 analysis results was statistically significant at 5% level ($p< 0.05$). In hot water extract of leaves, 93.3% mortality was recorded at 2.5 and 5 g/100 ml treatment. The calculated LC_{50} and LC_{90} value was 0.721 g/100 ml and 2.778 g/100 ml respectively. The x^2 analysis results was statistically not significant at 5% level ($p> 0.05$). The range of 95% lower and upper confidence limit (LCL-UCL) of LC_{50} and LC_{90} value was 0.29-1.09 g/100 ml and 1.83-7.04 g/100 ml respectively.

In immature fruit cold and hot water extract, mean percentage mortality of flea beetles was 100% at 5 and 10 g/100 ml treatment and also cold water extract at 2.5 g/100 ml. The mortality rate of 93.3% recorded in cold water extract at 2.5 g/100 ml was on par with hot water extract at 0.625 and 1.25 g/100 ml. The calculated LC_{50} and LC_{90} value of cold water extract was 0.172 g/100 ml and 1.274 g/100 ml respectively. The range of 95% lower and upper confidence limit (LCL-UCL) of LC_{50} and LC_{90} value was 0.00-0.47 g/100 ml and 0.45-3.70 g/100 ml respectively. The calculated LC_{50} and LC_{90} value of hot water extract was 0.101 g/100 ml and 0.593 g/100 ml respectively. The x^2 analysis results of cold and hot water treatment was statistically not significant at 5% level ($p < 0.05$). The range of 95% lower and upper confidence limit (LCL-UCL) of LC_{50} and LC_{90} value was not desired by SPSS software.

In mature fruit cold and hot water extract, mean percentage mortality of flea beetles was 100% at 5 and 10 g/100 ml and also in hot water extract at 2.5 g/100 ml treatment. The calculated LC_{50} and LC_{90} value of cold water extract was 0.448 g/100 ml and 1.865 g/100 ml respectively. The range of 95% lower and upper confidence limit (LCL-UCL) of LC_{50} and LC_{90} value was 0.29-0.58 g/100 ml and 1.54-2.42 g/100 ml respectively. The calculated LC_{50} and LC_{90} value of hot water extract was 0.405 g/100 ml and 1.091 g/100 ml respectively. The x^2 analysis results of cold and hot water treatment was statistically not significant at 5% level ($p > 0.05$).

Mean percentage mortality of flea beetles exposed to cold and hot water extract of *P. dodecandra* leaves, immature and mature fruits after 96 hr exposure period was

Table 4: Insecticidal activity of *P. dodecandra* plant extracts on *P. cruciferae* after 96 h exposure period.

	Leaves		Immature fruit		Mature fruit	
Concentration g/100mL	Cold water	Hot water	Cold water	Hot water	Cold water	Hot water
0.625	80.0±10.0	70.0±10.0	90.0±10.0	93.3±5.77	73.3±5.77	83.3±5.77
1.25	86.6±5.77	76.6±15.27	96.6±5.77	96.6±5.77	86.6±5.77	93.3±5.77
2.5	96.6±5.77	96.6±5.77	100.0±0.0	100.0±0.0	93.3±11.54	100.0±0.0
5.0	100.0±0.0	100.0±0.0	100.0±0.0	100.0±0.0	100.0±0.0	100.0±0.0
10.0	100.0±0.0	100.0±0.0	100.0±0.0	100.0±0.0	100.0±0.0	100.0±0.0
LC_{50}	0.254	0.425	0.200	0.132	0.312	0.278
(UCL-LCL)	(0.11-0.39)	(0.23-0.74)	(0.02-0.35)	(0.002-0.29)	(0.16-0.45)	(0.11-0.41)
LC_{90}	1.198	1.606	0.642	0.534	1.490	0.883
(UCL-LCL)	(0.95-1.56)	(1.00-6.65)	(0.39-0.82)	(0.17-0.74)	(1.21-1.95)	(0.71-1.11)
x^2	2.804	7.926*	0.623	1.033	3.099	2.054
Significant	0.423	0.048	0.891	0.793	0.377	0.561

Values are mortality percentage mean±standard deviation of three replications. LCL-Lower Confidence Limit; UCL-Upper Confidence Limit;x^2 -Chi-square; * Significant at 5% level ($p<0.05$)

presented in Table 4. Result revealed that 100% mortality was observed in both cold and hot water extract of leaves at 5 and 10 g/100 ml. The calculated LC_{50} and LC_{90} value was 0.254 g/100 ml and 1.198 g/100 ml respectively. Thex^2 analysis results was statistically not significant at 5% level ($p>0.05$). The range of 95% lower and upper confidence limit (LCL-UCL) of LC_{50} and LC_{90} value was 0.11-0.39 g/100 ml and 0.95-1.56 g/100 ml respectively. In hot water extract of leaves, calculated LC_{50} and LC_{90} value was 0.425 g/100 ml and 1.606 g/100 ml respectively. The x^2 analysis results was statistically significant at 5% level ($p<0.05$). The range of 95% lower and upper confidence limit (LCL-UCL) of LC_{50} and LC_{90} value was 0.23-0.74 g/100 ml and 1.00-6.65 g/100 ml respectively.

In immature fruit cold and hot water extract, mean percentage mortality of flea beetles was 100% at 2.5, 5 and 10 g/100 ml treatment. The calculated LC_{50} and LC_{90} value of cold water extract was 0.2g/100 ml and 0.642 g/100 ml respectively. The range of 95% lower and upper confidence limit (LCL-UCL) of LC_{50} and LC_{90} value was 0.02-0.35 g/100 ml and 0.39-0.82 g/100 ml respectively. The calculated LC_{50} and LC_{90} value of hot water extract was 0.132 g/100 ml and 0.534 g/100 ml respectively. The x^2 analysis results of cold and hot water treatment was statistically not significant at 5% level ($p > 0.05$). The range of 95% lower and upper confidence limit (LCL-UCL) of LC_{50} and LC_{90} value was 0.002-0.29 g/100 ml and 0.17-0.74 g/100 ml respectively.

In mature fruit cold and hot water extract, mean percentage mortality of flea beetles was 100% at 5 and 10 g/100 ml and also in hot water extract at 2.5 g/100 ml treatment. The calculated LC_{50} and LC_{90} value of cold water extract was 0.312 g/100 ml and 1.490 g/100 ml respectively. The range of 95% lower and upper confidence limit (LCL-UCL) of LC_{50} and LC_{90} value was 0.16-0.45 g/100 ml and 1.21-1.95 g/100 ml respectively. The calculated LC_{50} and LC_{90} value of hot water extract was 0.278 g/100 ml and 0.883 g/100 ml respectively. The x^2 analysis results of cold and hot water treatment was statistically not significant at 5% level ($p > 0.05$). The range of 95% lower and upper confidence limit (LCL-UCL) of LC_{50} and LC_{90} value was 0.11-0.41 g/100 ml and 0.71-1.11 g/100 ml respectively.

DISCUSSION

Eco-safety alternatives for pest control program are the current need to overcome the application of dreadful synthetic chemical pesticide. Plant derived products are considered as one of the alternative sources used to develop commercial products in developed and developing countries. It is believed that plant derivatives are highly suitable for organic food production and also safety to non-target organism. To find out potential plant species with local origin and simple preparation technologies are most suitable for farming communities to reduce economic input in pest control program. In this scenario, present study was conducted to evaluate cold and hot water extract of *P. dodecandra* leaves, immature and mature fruit extract against cabbage flea beetle *P. cruciferae* which cause enormous damage to cabbage seedlings.

In the present study, irrespective of the concentrations and exposure period mean mortality percentage of *P. cruciferae* showed great variation. The minimum LC_{50} value of 0.254 g/100 ml was observed in hot water extract of immature fruit after 24 h exposure period. At this period of exposure, result of cold and hot

water extract of mature fruit showed significant insecticidal activity against *P. cruciferae*. The insecticidal activity of immature fruit extract was 100% mortality at the concentration 2.5 g/100 ml and above. The LC_{50} concentration of cold and hot water extract of immature fruit was 0.101 g/100 ml and 0.172 g/100 ml respectively after 72 h exposure period. After 96 h exposure period all the tested plant materials showed above 70% mortality even at lower concentration. After 96 h exposure period, 100% insect mortality was recorded in plant materials tested at 5 g/100 ml and 10 g/100 ml concentration.

In this study, dose dependent significant variation was observed in the LC_{50} and LC_{90} values against *P. cruciferae*. Several researchers also reported dose-depended increases in insects mortality in different species of plant extracts against insects [14-17]. The parts of *P. dodecandra* reported to contain saponin which may block the respiratory activity of the insects and it may be the reason for mortality. The larvicidal activity of saponin isolated from the fruits of *Balanites aegytiaca* was confirmed [18]. Molgaard *et al.* [19] reported that saponin concentration in aqueous extract was stable for 2 days and degrade. This stability may be another reason for the enhancement of insect mortality in the present study when the exposure period is increased. Karunamoorthi *et al.* [1] also observed strong toxic effect against Baetidae. The snail population was declined in the stream treated with *P. dodecandra* plant extract due to the toxic effect of saponin [5].

In conclusion, the present study proved insecticidal effect of cold and hot water extracts of *P. dodecandra* plant extracts against cabbage flea beetle *P. cruiciferae*. This plant is growing naturally in Ethiopian highlands and also cultivated for controlling snails to prevent prevalence of shistosomiasis. The extract preparation is also adoptable by the farming community. These plant extracts can be useful to control cabbage flea beetle *P. cruciferae.*

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