

Evaluation of Bio-efficacy of *Calotropis procera* against Juvenile Stage of Common Household Pest *Periplaneta americana* (American Cockroach)

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ABSTRACT

Aim/Background: The present study aimed to evaluate the effects of *Calotropis procera* (Aiton) W.T. Aiton against the juvenile stage of common household pest *Periplaneta americana* (American Cockroach). **Materials and Methods:** The leaf extracts were prepared in selected solvents (methanol, acetone and water) and evaluated against the juvenile cockroaches at different concentrations (10, 20, 30, 40 and 50 ppm). The results of mortality rate were recorded at different time intervals (6, 12, 24 hr) of exposure. **Results:** The results obtained shows that the methanol extract of plant sample having significant mortality rate at 20 ppm (20.00±8.16%) at 12 hr of exposure. The highest mortality rate of methanol extract was observed at 50 ppm (96.66±3.51%) at 24 hr of exposure. The lowest mortality rate was recorded from acetone extract of 10 ppm (11.66±2.88%) at 24 hr. However, the plant extract shows moderate mortality rate between (12.00±4.35-95.33±4.50%). **Conclusion:** The present finding reveals that, the mortality rate is in proportion to the concentration level of plant extract and exposure period. Moreover, the results obtained reveals that the plants based biopesticides could be the best alternatives for present synthetic pesticides for controlling the population of cockroaches.

Keywords: *Periplaneta americana*, *Calotropis procera*, Bioefficacy, Juvenile, Mortality.

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INTRODUCTION

Periplaneta americana generally known as American Cockroach is a menage pest set up over the world with about 3500 species. They are among the notorious pests that are usually found in homes, supermarkets, public places, and refuse dumps. In about 20 of homes without visible substantiation especially in the civic terrain, cockroaches had mechanically carried and transmit numerous pathogenic responses in humans due to bacteria, contagions, fungi, protozoa and helminths.^[1] They are considered dangerous organisms to humans causing serious health problems similar as disinclinations, asthma, and others.^[2] Nowadays, various germicides are used to control these pests. Still, the use of synthetic chemicals to control nonentity pests has led to several adverse impacts, including water and soil impurity, nonentity resistance, toxin to man and creatures, environmental pollution and toxin to non-target species.^[3-5] Presently, botanical preparations are promising source of insecticidal effects, because of their application and biodegradable properties.^[6-9]

Calotropis procera (Aiton) W.T. Aiton is a member of the family, Asclepiadaceae, a shrub extensively distributed in West Africa, Asia and other corridor of the tropics. The plant is erect, altitudinous, large and imperishable with milky latex throughout. A large volume of latex can be fluently collected from its green leaf.^[10] Local people use it successfully to combat some cutaneous fungal infections. The profusion of latex (containing alkaloids) in the green part of the plant reinforces the idea that it produces and accumulate latex as a defence strategy against organisms similar as contagion, fungi and insects.^[11] Moreover, the presence of plant defence related proteins similar as hevein and α -amylase inhibitors has been described in the latex of numerous plants.^[12]

Considering the above facts the attempt has been made to estimate the effect of *C. procera* on mortality rate of juvenile cockroaches. Nonetheless, the standardization of herbal medicines is an essential issue for converting botanicals into remedial modalities.

MATERIALS AND METHODS

Collection of Plant

The fresh leaves of *Calotropis procera*, (Milkweed) were collected from Omerga, District Osmanabad (MS), India (Figure 1). The collected leaves were taken to the laboratory for processing and



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performing various bioassays. The taxonomic identification of plant was made by Dr. Rafik Shaikh, Poona College of Arts, Science and Commerce Camp, Pune (MS) India, by using flora of Maharashtra.^[13] The testimonial instance (PC124- CP1) is kept in the Department of Botany, Poona College for further reference.

Preparation of plant sample

Using the method employed by^[14] the fresh leaves of collected plant were washed under running tap water to exclude dust and debris, also dried for 7-10 days in the shade at the environmental temperatures (27-37°C day time). The dried leaves (500 g) were crushed mechanically using electrical blender. The 30 g of the powdered material were bagged and labelled for further use. By using the procedure^[15] the powdered form of *C. procera* were extracted with different organic solvents (water, methanol and acetone) by using Soxhlet apparatus. The excerpts were faded and concentrated using the boiling water bath and the crude remainders attained were stored at 4°C for further experimental use.

Collection of juvenile cockroaches

The same aged *P. americana* nymphs were collected from their natural territories as kitchens and restroom closets, cabinetwork, piles of used papers, bottom rainspouts and menage appliances from different locales of Pune megacity. The collected cockroaches were used to test insecticidal exertion of splint excerpts of *C. procera*.

Bioefficacy assay against juvenile cockroach

During primary webbing with the laboratory trial, the collected juvenile cockroaches were treated with the plant samples. The lethal effect was assessed by the procedure of^[16] with some revision and as per the reported method.^[17] For the bioassay test, nymphs were taken into five batches with different attention of plant samples i.e. of 10 ppm, 20 ppm, 30 ppm, 40 ppm and 50 ppm sprinkled on it. After 6, 12 and 24 hr exposure, the number of dead cockroaches were counted and recorded. The chance of mortality was reported from the normal of three replicates.

Statistical analysis

All results were tested and analysed by excel for windows program Microsoft office 2010. Data attained were expressed by computation of the mean and standard error (Mean±SE) statistically.

RESULTS

Extraction of plant samples

The observed yields of the extracts isolated from *C. procera* are shown in (Figure 2). The highest yield was observed in water (47 mg) than methanol (45 mg) and acetone (8 mg) per 10 g of powdered plant sample.

Effect of different plant extract on juvenile cockroach

The effect of methanol extract of *C. procera* on mortality rate of juvenile cockroach are shown in (Table 1). It was observed that, at low concentration (10 ppm) there were no effect of plant extract at different time intervals (6, 12 and 24 hr) of exposure. However, at 20 ppm mortality were recorded at 12 and 24 hr exposure as 20±8.16% and 31.66±6.23% respectively. The mortality rate was moderate at 30 ppm concentration. At 40 ppm the mortality was recorded as 16.66±6.23%, 38.33±6.23% and 41.63±7.63% at 6, 12 and 24 hr respectively. The significant results were obtained at 50 ppm concentration. The highest mortality of methanol extract was recorded at 50 ppm concentration at 24 hr (96.66±3.51%) exposure period. It was observed that the effect of methanol extract is progressively higher with respect to the concentration and length of exposure.

The results obtained of acetone extract are summarized in (Table 2). At 10ppm concentration no mortality was recorded at 6 and 12 hr while, at 24 hr exposure period mortality was recorded as 11.66±2.88%. At the 20 ppm concentration mortality were recorded at 12 and 24 hr exposure as 15.66±5.13% and 28.33±7.63% respectively. At 30 ppm the mortality was recorded as 26.33±10.11%, 28.66±7.76% at different length of period as 12, and 24 hr. respectively. At 40 ppm the mortality was recorded as 14.66±4.50%, 35.00±5.00%, 45.00±8.66% at 6, 12 and 24 hr. respectively. At 50 ppm concentration level the mortality was observed as 13.66±4.72%, 31.66±5.68%, 66.00±4.58% at 6,12,24 hr. respectively. The highest mortality of acetone extract was recorded at 50 ppm concentration at 24 hr. length of exposure period.

The effect of water extract of *C. procera* on mortality rate of juvenile cockroach at different exposure time interval are presented in (Table 3). At 10 ppm and 20 ppm concentration no mortality was recorded at 6, 12 and 24 hr. At 30 ppm the mortality was recorded as 12.00±4.35%, 12.66±3.05% at different length of period as 12, and 24 hr. respectively. At 40 ppm the mortality was recorded as 13.66±4.04%, 37.00±6.24%, 39.00±8.54% at 6, 12 and 24 hr respectively. At 50 ppm concentration level the mortality was observed as 15.00±5.56%, 35.66±5.13%, 56.33±6.02% at 6,12,24 hr. respectively. The highest mortality of water extract was recorded at 50 ppm concentration at 24 hr. length of exposure period.

It was established that, plant extracts have been used worldwide as an indispensable system to control pests unlike synthetic fungicide which have one active amalgamation, and show only one type of natural effect. Still, single plant consequent suspension may have further natural effect.^[18] Plants are rich source of bioactive composites that can be used as a suitable cover to develop eco-friendly pest operation strategies.

DISCUSSION

The bioefficacy of *Calotropis procera*, an extensively distributed medicinal plant, demonstrates significant eventuality in controlling the juvenile stages of the common menage pest, *Periplaneta americana*. The present findings are in agreement with the literature available. The methanol excerpt of *C. procera* retain most significant exertion against the nymphs of cockroach having mortality rate at 50 ppm (96.66 ± 3.51), while the rest of the excerpt having moderate to significant eventuality in the range of (12.00 ± 4.35 - 95.33 ± 4.50). Former studies have proved the presence of bioactive composites similar as alkaloids, flavonoids, and cardenolides in *C. procera*, which are known for their pesticidal capacity.^[19] These phytochemicals probably contribute to the mortality and reduced mobility observed in treated nymphs. The implicit medium underpinning the bioactivity of *C. procera* involves hindrance with the pest's physiological and neurological processes. Composites like proteolytic enzymes and cardenolides can disrupt the hormonal balance essential for growth and molting in insects.^[20] Further exploration employing histological and biochemical analyses could interpret these pathways.

It was reported that the excerpt of *N. oleander* was largely effective on the nymph of American cockroaches at different concentrations.^[21] Different plants as, *Phytolacca dodecandra*, *Buddleja polystachya* and *Vernonia amygdalina* also set up important effective against the cockroaches as well as other pest insects.^[22] Using *C. procera* for pest control offers several advantages. It is an eco-friendly substitute to chemical fungicides, which frequently affect in resistance development and non-target properties. The plants rigidity to dry surroundings and its vacuity as a waste resource add to its feasibility in low- cost pest operation systems.^[23] While synthetic fungicides like pyrethroids have advanced immediate efficacy, the long- term sustainability and reduced environmental footmark of plant-grounded druthers like *C. procera* make them feasible for Integrated Pest Operation (IPM). Analogous studies on other plants, similar as neem (*Azadirachta indica*), support this approach.^[24] The discussion explores the present findings in light of being exploration, emphasizing the counter accusations for pest operation and sustainable druthers to synthetic fungicides.

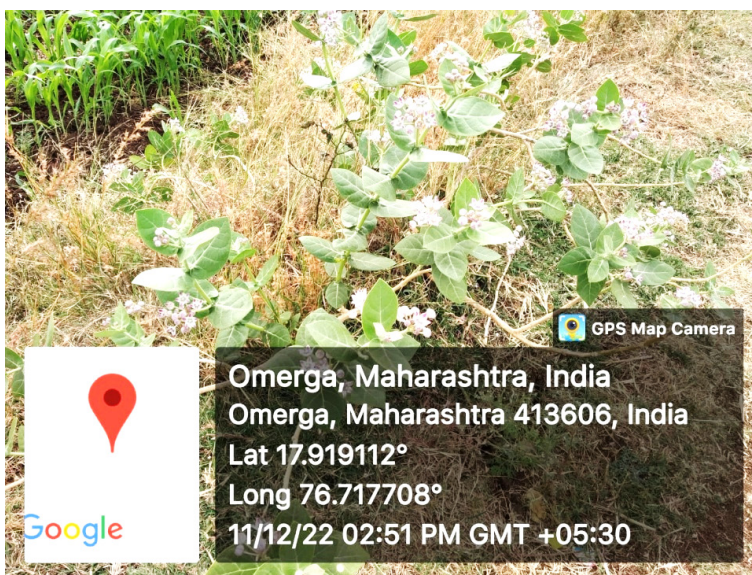


Figure 1: Collection of *Calotropis procera*.

Table 1: Effect of methanol extracts of *C. procera* on mortality of juvenile stage of cockroach at different time intervals.

Concentrations (ppm)	Mortality rate at different time intervals (Hr)		
	6	12	24
10	00	00	00
20	00	20±8.16	31.66±6.23
30	16.66±6.23	34±7.87	38.33±2.35
40	16.66±6.23	38.33±6.23	41.63±7.63
50	36.66±6.23	95.33±4.50	96.66±3.51
Control	00	00	00

The experiment performed in triplicates, $n=3 \pm SD$.

Table 2: Summary of effect of acetone extracts of *C. procera* on mortality of juvenile stage of cockroach at different time intervals.

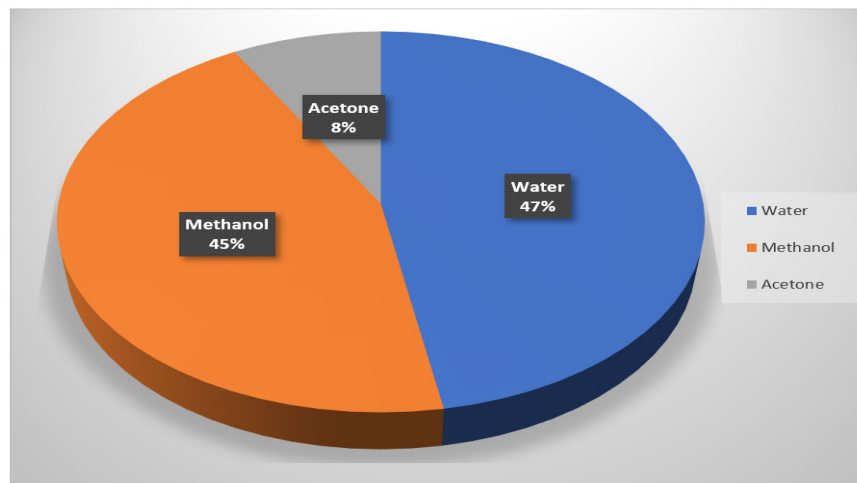
Concentrations (ppm)	Mortality rate at different time intervals (Hr)		
	6	12	24
10	00	00	11.66±2.88
20	00	15.66±5.13	28.33±7.63
30	00	26.33±10.11	28.66±7.76
40	14.66±4.50	35.00±5.00	45.00±8.66
50	13.66±4.72	31.66±5.68	66.00±4.58
Control	00	00	00

The experiment performed in triplicates, $n=3\pm SD$.

Table 3: Results of effect of water extracts of *C. procera* on mortality of juvenile stage of cockroach at different time intervals.

Concentrations (ppm)	Mortality rate at different time intervals (Hr)		
	6	12	24
10	00	00	00
20	00	00	00
30	00	12.00±4.35	12.66±3.05
40	13.66±4.04	37.00±6.24	39.00±8.54
50	15.00±5.56	35.66±5.13	56.33±6.02
Control	00	00	00

The experiment performed in triplicates, $n=3\pm SD$.

**Figure 2: Percent yield of crude extract obtained from leaves of *Calotropis procera* in different solvents.**

CONCLUSION

The present study emphasizes the bioefficacy of *Calotropis procera* as a promising botanical agent against the juvenile stage of *Periplaneta americana*. The findings provide a strong foundation for developing eco-friendly, plant-based pest management strategies that can mitigate the reliance on synthetic chemical pesticides. Given the rising concerns over environmental pollution, pest resistance, and human health risks associated with conventional insecticides, *C. procera* offers a sustainable

and environmentally safer alternative. Moreover, future research needs to focus on the formulation of standardized products, dose optimization, and long-term studies to evaluate the persistence and environmental impact of *C. procera* extracts. Integrating this natural bio-pesticide into integrated pest management systems could be a significant step toward sustainable pest control practices. This study maximises the utilization of *C. procera* in traditional pest control system since it is locally available, eco-friendly and cost effective.

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CONFLICT OF INTEREST

The author declares that there is no conflict of interest.

AUTHORS CONTRIBUTION

Dr. Rafik Shaikh and Dr. Kalim Shaikh are involved in the complete writing of the article. Mr. Tanvir Pathan and Mr. Wasim Shaikh done experimental work and also involved in the overall formatting and editing, critical revision of tables and graphs, and improvement of the article.

SUMMARY

Calotropis procera exhibits insecticidal properties, particularly through its various extracts. Although direct studies on its effect against the juvenile stages of *Periplaneta americana* are scarce, the existing evidence supports the potential of *C. procera* as a natural alternative to synthetic insecticides. While specific studies on the efficacy of *C. procera* against the juvenile stages of *P. americana* are limited, the general insecticidal properties of the plant suggest its potential effectiveness. The compounds responsible for the insecticidal activity in *C. procera* could disrupt the development of cockroach nymphs, leading to increased mortality rates. Further research is needed to specifically evaluate its efficacy against cockroach nymphs and to explore its practical applications in pest management.

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