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Studies on the insecticidal properties of *Chromolaena odorata* (Asteraceae) against adult stage of *Periplaneta americana*

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Abstract

Cockroach (*Periplaneta americana*) is a household pest, which transmit disease in the environment. The development of resistance due to resistance has prompted efforts to seek alternative biological control methods. Community based-plant species, *C. odorata* was studied for its insecticidal activity of cockroach, *P. americana* at room temperature. Mortality of *P. americana* was sparingly recorded in treatment with the lowest concentration of the leaf extract after a short period of exposure (6 hrs). However, the maximum Mortality rate was recorded after exposure of the test species to the highest concentration of leaf extract. The survivals and mortality rate were very highly significant at 0.001% level of confidence. Phytochemical analysis showed alkaloids, flavonoids, saponin and tannin present in the plant species used. Based on this study, leaf extract of *C. odorata* have exhibited some measures of efficacy in the control of *P. americana*. Further investigation could be carried out to know the bioactive chemical with this insecticidal property, responsible for the control of this nuisance pest.

Keywords: *Chromolaena odorata*, leaf extract, *Periplaneta americana*, insecticidal activities, pest management.

1. Introduction

The increased use of pesticides in the control of vector and filthy insects has prompted some concern over the adverse effects of these chemical substances on living organisms and their environment ^[1] thus researchers are now focusing attention to alternative method of controlling insect vectors ^[2].

Indigenous plants exist in nature, particularly in tropical areas, which are associated with some domestic uses ^[3]. These plants contain bioactive chemicals, which serve as suitable alternative biocontrol substance ^[4]. Many researchers repute the use of extracts of medicinal plants to control insects ^[5]. However, it is now the focus of many researchers, as insects are developing resistance to synthetic chemical pesticides. The unfriendly nature of these synthetic chemical pesticides has caused them to inhibit actions of enzymes, and blocking many essential processes ^[6]. This has in turn led to resurgence of targeted pest population ^[7], resistance and undesirable effect on non-target organisms ^[8]. Botanical derivatives have been used in different capacities such as; fumigants ^[9], contact poison ^[10], and repellants ^[11] etc. Many of these pesticides are cheap, locally available, nontoxic and easily bio-degradable ^[12, 13].

Chromolaena odorata is a member of Asteraceae and one of the plants that has been associated with pesticidal and medicinal value in many areas ^[14]. It is not habitat specific; however it grows commonly in wastelands ^[15]. *C. odorata* is recognized as one of the world worst tropical weeds that proliferate at a fast rate ^[16]. The notorious role of cockroach (*Periplaneta americana*) as an important insect in public health have been reported; it is considered the most common insect pest spreading pathogenic diseases such as enteric fever, dysentery and leprosy ^[17] allergic reactions such as dermatitis, itching, swelling of the eyelids and more serious respiratory conditions have also been reported ^[18]. In Nigeria, high parasite load has been reported from the external body surface of cockroach living in and around residential homes ^[19]. Predictable adverse effects arise from wide spread utilization of conventional chemical insecticides on biota. The aim of the current study was to investigate the potential pesticidal effect of *C. odorata* on an insect vector, *P. americana*.

2. Materials and Methods

2.1 Description of Study Area

The study area is a peri-urban area, which falls under the geographical coordinates of Latitude 5.25 – 5.29°N and Longitude 7.04 – 7.06°W lying on an area of flat agricultural land that is

gradually being transformed to urban area. The climate falls under type AW in the Kopper-Geiger classification of wet-dry climate and Zone B of the Nigerian's eco-climatological zones [20] given the close relationship between climate and vegetation, the location of the study area coincides with the rain-forest belt. It is also characterized by varying sizes of plants arranged in canopies. The soils are derived from coastal plain sand (Benin formation) [21]. This type of soil has been described by [22] as a well-aerated soil, which has good drainage, causing it to dry out quickly. The moderate to high population density could be as a result of population migration from city centers to suburban areas.

2.2 Plant Material

C. odorata plants were collected from an agricultural land in Naze in Owerri, Southeastern Nigeria and identified by Dr Duru C. M. in the Department of Biology, Federal University of Technology Owerri.

2.3 Extraction Procedure

Samples of *C. odorata* were thoroughly washed with clean tap water. The washed fresh leaves of *C. odorata* were later pulverized using mortar and pestle into a fine texture without addition of water. The ground material was mixed with distilled water at 1:4(v/v) for a single dose of 25% strength of leaf extract, as reported by Ayodele and Oke [3].

2.4 Collection of test animal

The test animals were (*P. americana*) collected from their hidden places and 50 adults *P. americana* were used in this study.

2.5 Exposure technique of test organism to leaf extract.

0.3, 0.5, 0.7 and 1.0 ml of the 25% extract were taken and applied to the center of moistened filter paper placed at the

bottom of small conical flask. Ten insects were introduced into the flask and covered with lid. The flask was then turned over during exposure, so that the insect will be in contact with the extract. Each treatment had three replicates and the flask was kept under observation for 48 hours and in the dark environment. The normal, dead and moribund animals were counted from the flask. The percentage mortality was corrected for natural mortality using Abbott formula [23]. The percentage mortality included moribund and dead animals. The moribund animals were those whose color had not turned totally black like the dead, but made only weak limb movement when agitated with a mounted needle [3].

2.6 Phytochemical Analysis

Preliminary phytochemical screening of *C. odorata* was carried out to ascertain the presence of some chemical constituents like alkaloids, flavonoids, saponins and tannin using the standard procedure of Harborne [24].

2.7 Statistical Analysis

Data collected were analyzed using one-way analysis of variance (ANOVA). Statistical significant differences of the treatment were determined using Turkey post-hoc test. All statistical analysis was carried out using SPSS version 16.0 statistical package.

3. Result and Discussion

The test organism, *P. americana* avoided contact with the places where the leaf extract was dropped. Ayodele and Oke [3] reported that the avoidance of the insect poisoned portion of the plate could be indicative of some measure of efficacy. Mortality values of adult *P. americana* exposed to different concentrations of the leaf extract are shown in Fig 1.

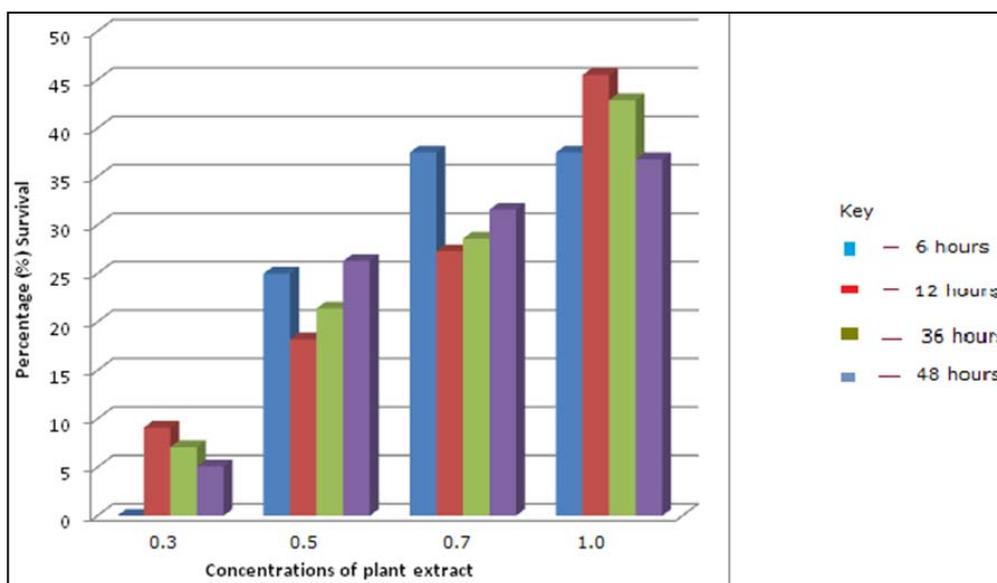


Fig 1: The percentage survival of *P. americana* subjected to various treatments after 6 - 48 hours of exposure

Results obtained showed increase in mortality rate in all the samples in dose and time dependent manner. Phytochemical analysis revealed the presence of tannin, saponin, flavonoid and alkaloids. The presence of these phytochemical alters some biochemical functions of organisms. Man [25] reported that increase mortality rate which was reported in this study

could be attributed to phytochemical content of the leaf extract. Studies have shown that high dose of flavonoid alters the normal body functioning of insects [26]. Also *C. odorata* oil was found to be effective against both the larvae and adults stages of mosquitoes [27]. Kelm and Nair [28] also reported the presence of flavonoid, tannin, saponin in leaf extract of

Chromolaena odorata. Saponin are a class of steroidal or triterpenoid secondary plant metabolite with diversified biological properties, such as antifeeding [29] Barbosa *et al* 1990 and growth inhibitory activities, [30] Geyer *et al* 2011; [31] Nozzolillo *et al.* 1997. Also studies have shown that saponin can generate adverse physiological response in animal [30] Geyer *et al.* 2011; [32] Harmatha *et al.* 1987. Increased mortalities were also recorded when crude saponin of *Cestrum parqui* was used to treat larval stage of mosquito *Culex pipiens* [33] Chaieb (2010). This cytotoxic effect and growth inhibitions and many are taking advantage of this effect and using it

against pest and disease problem of human. Vandockk *et al* [34] reported the effect of flavonoid on bio chemical reactions such as its effect on the mitochondrial enzyme components and we suggest that the effect on the mitochondrial enzyme components could be used in the control of insect population. Many of plants extracts have proved effective in the control of pest population in an agricultural farm [35]. It was observed that the insect body has changed from brown to black after its death. This observation is similar to the finding of [3] that attributed it to the possible toxic effect of the leaf extract on animal.

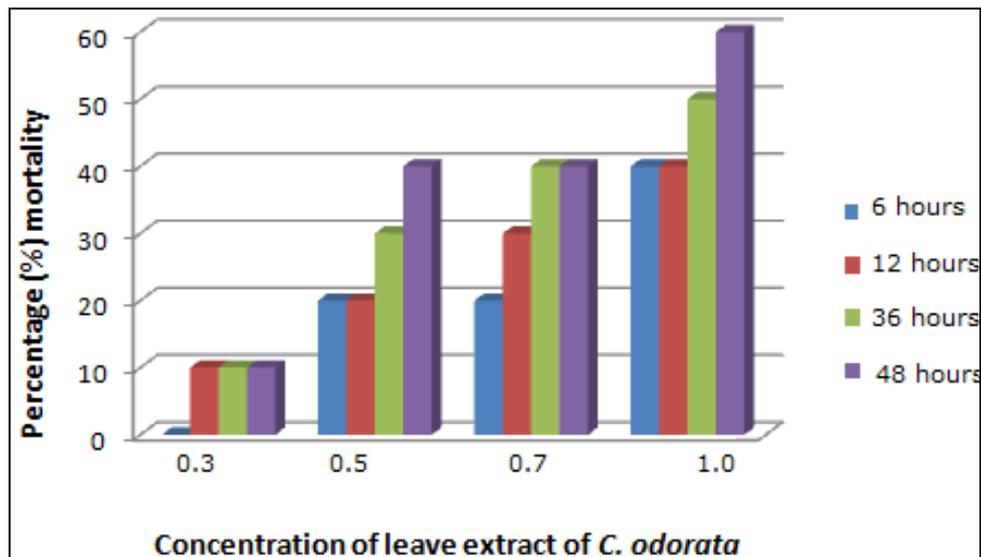


Fig 2: Mean mortality of *P. americana* adults after 6 - 48 hours of exposure

Table 1: Status of phytochemical components of leaf extract of *C. odorata*

Phytochemicals	Status
Tannin	++
Saponin	+++
Flavonoid	+
Alkaloids	+

Key: +++ highly present, ++ moderately present and + slightly present

Table 2: Percentage mortality and survival of *P. americana* subjected to different concentration of leaf extract of *C. odorata*

Concentration of leaf extract	Percentage mortality of <i>P. americana</i>	Percentage survival of <i>P. americana</i>
0.3	12.41	30.44
0.5	23.15	27.20
0.7	27.98	23.85
1.0	36.63	18.68
LSD	0.923***	0.504***

Key *** highly significant <0.001 P - values

4. Conclusion

The present study on the preliminary screening of the potential anti-insecticidal property of *C. odorata* against *P. americana* showed that the leaf extract was toxic to the insect vector. This toxicity is an indicative of some measures of anti-insecticidal activity on the test organism. This goes to suggest that the plant extracts could serve as an alternative method chemical control. There is therefore need to study and establish the

bioactive substance in the plant extract which contains the insecticidal property.

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