Research Article
CODEN (USA): IJPLCP

ISSN: 0976-7126
Kassie, 11(8):6921-6926, 2020

International Journal of Pharmacy & Life Sciences
Open Access to Researcher

Evaluating the effect of three plant leaf extract against German cockroach (*Blattella germanica*) survival under uncontrolled condition

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Article info

Received: 08/07/2020

Revised: 23/07/2020

Accepted: 28/08/2020

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Abstract

The present study was conducted to evaluate the efficacy of *Phytolacca dodecandra, Buddleia polystachya* and *Vernonia amygdalina leaf* extract against theadult German cockroach,*Blattella germanica*under uncontrolled condition by comparingcontrol measures.The research consists of three botanical leaf extracts were prepared by three concentration levels (5g/100ml, 10g/100ml and 15g/100ml of water), a positive control *(*deltamethrin)andnegative control(Water), were laid out in a randomized complete design with three replications. Total of 330 adult cockroaches were tested.Mortality of cockroaches were recorded after 24, 48 and 72 hours of explosure. Data were analyzed by using SPSS software package version 20.0.The results indicated that all the botanical extract concentrations were significant for cockroaches mortality.The mean mortality count of adult *B. germanica* was thehighest (100) in 15g/100ml concentration of *P. dodecandra*and Possetive controland the lowest (no mortality) in the negative control was recorded in 24 hours exposure time.

Hundred percent (100%) of mortality were recored by *P. dodecandra* at 5g/100ml after 72 hours, 10g/100ml after 48 hours 15g/100ml after 24 hours and by *B. polystachya* and *V. amygdalina* at 15g/100ml after 48 hours. These results were no significant differences with positive control. But, there was significant differencein mortality in both increase in concentration levels and exposure time for all botanicals. Therefore, users use these easily prepared and available botanicals to control/ eliminate cockroaches by by formulating 15g/100ml of water and more concentration levels rather than using of synthesic pesticides to keep environmental polution.

Keywords: *Blattella germanica*, botanical pesticides, efficacy, extract, mortality

Introduction

The increased use of pesticides in the control of pests has prompted some concern over the adverse effects of these chemical substances on living organisms and their environment (Pavela, 2008), thus researchers are now focusing attention to alternative method of controlling insect vectors (Patil *et al.,* 2010). Indigenous plants exist in nature, particularly in tropical areas, which are associated with some domestic uses (Ayodele and Oke, 2003). These plants contain bioactive chemicals, which serve as suitable alternative biocontrol substances(Chowdhury, *et al.,* 2008). Thus repel, inhibit growth or kill pests (Hikal *et al.,* 2017).Botanical pesticides prepared from their barks, leaves, roots, flowers, fruits, seeds, cloves, rhizomes and stems (Ahmad *et al.,* 2017).The plant parts are dried and ground into fine powder and extracted with organic solvents that will maximize extraction of the targeted compounds.

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Then, extracts are concentrated, formulated and evaluated for efficacy under laboratory, controlled or field conditions (Joseph and Sujatha, 2012).Botanical pesticides are considered safe in pest control because they have low or none pesticide residue making them safe to the people, environment and ecosystem (Talukder *et al.,* 2004); they affect insect pests in different ways depending on physiological characteristics of the insect species as well as the type of the insecticidal plants. The components of various botanical insecticidal can be classified into six groups namely; repellents, feeding deterrents/ antifeedants, toxicants, growth retardants, chemosterilants and attractants (Rajashekar *et al.,* 2012).

Diffrenrent botanicals are used to protect agricultural and household products as natural, cost effective and easily accessible from nearby source. In addition, due to their biodegradability unlike synthetic chemical pesticides they are environmental friendly and hence favorable to the environmental sustainability and community wellbeing (Pavela, 2007).They inhibit or disrupt insect feeding (Rajashekar *et al.,* 2012; Talukder, 2006); toxic cause death to insects (Padin, *et al*., 2013); showed deleterious effects on the growth and development of insects, reducing the weight of larva, pupa and adult stages and lengthening the development stages (Talukder, 2006); also reduce the survival rates of larvae and pupae as well as adult emergence (Koul, *et al*., 2008); causing temporary or permanent sterility of one or both of the sexes or preventing maturation of sexually functional adult stage (Navarro-Llopis *et al.,* 2011; Wilke *et al*., 2009).

Cockroaches are important insect pests of public health (Yeom *et al,* 2012); and the most common pests in many homes. Various studies around the world revealed that cockroaches living close to human dwellings were important carriers of etiologic agents belonging to all groups of potential pathogens and they cause of allergies and asthma. The insect is used as a key indicator of insanitary conditions (Slater *et al*, 2007; Mindykowski *et al,* 2010).The insect is as various agents vector, like a poliomyielitis virus, enteropathogenic bacteria, amebas cyst, eggs of worm, and the fungus Aspergillus. More or less 22 species of bacteria, virus, fungi and protozoans and 5 species of worms have been isolated from the body of the cockroach in the field (Soedarto, 1995). The presence of cockroaches in homes can also causepsychological distress, elicit allergic reactions, and trigger asthma attacks as a result of the presence of allergens(Brenner, 1995).

The German cockroach as a mechanical vector can easily transmit pathogens such as bacteria, viruses, fungi, protozoa, and parasiteson their legs and bodies. It has a small body size, special nutritional habits, and specific behavior. Besides, it can readily adapt itself to the human environment and the causative agents of allergic diseases (Nasirian, 2008).German cockroach found in most parts of the world. It is light yellowish brown and 10–15mm in length, making it one of the smallest domestic cockroaches. The female usually carries the egg case until shortly before the young come out. It is considered as an important medical and economic pest because it has a shorter generation time and higher fecundity than the other cockroaches, which makes it difficult to control. The indiscriminatemovement between filth and food make them potentially efficientvectors of human pathogens (Alcamo and Frishman 1980; Brenner *et al.,*1987).

Conventional synthetic insecticides, such as pyrethroids, carbamates and organophosphates are very popularly used compounds for controlling cockroaches (Lee *et al,* 1996; Syed *et al*, 2014). However, these insecticides have several adverse effects including acute or chronic toxicity to humans and animals. They can also have an adverse impact on the food chain of the ecosystem (Govindarajan *et al*, 2011;Amerasan *et al*, 2012; Muthukumaran *et al*, 2015). Furthermore, cockroaches can develop resistance to these insecticides.Due to these problems, an alternative approach is to search for effective botanical extracts, which are safe to humans and the environment (Pai *et al.*, 2005).The aim of this study is to evaluate the efficacy *P. dodecandra, B. polystachya* and *V. amygdalina* leaf aqua extracts to control adult *B. germanica*and to give information for users that use botanical extracts by easy preparation method without cost and risk at a places these cockroach present.

Material and Methods

Locality

This experimental research study was done during the period of time February-April of the temprate season 2020, in the Yeka Sub city, Addis Abeba, Ethiopia, which belongs to the average of temperature was 23. 5°C.

Table 1: Name ofbotanicals used in the experiment for against *Blattella germanica*

Scientific name	Family name	English name	Amharic name	Part used
Phytolacca dodecandra	Phytolaccaceae	Soap berry	Endod	Leaves
Buddleia polystachya	Scrophulariaceae	Butterfly bush	Anfar	Leaves
Vernonia amygdalina	Astaraceae	Bitter leaf	Grawa	Leaves

Collection and extraction of Botanical leaves

Fresh green *P. dodecandra, B. polystachya* and *V. amygdalina* leaves were collectedfrom available areas and washed by water to remove dust and micro organisms that attached on their surfaces. Then put under shade for 15 days until they were diered completely. The diered leaves were and cut into pieces and groundby using an electrical graiding machine until optain very fine powder. The fine powder of each botanicals were weighed (5g, 10g, and 15g) by sensitive weight balance. Then each balanced fine powder were mixed in 100 ml of water separately by 5 minutes shaking to made well solution. After staying 72 hours, each prepared solutions were filtered through mush cloth repeatedly until optained 30ml filtered extract for each treatments.

Collection of Cockroches and Study Design

The experiment was laid out in a randomized complete design (RCD) with three replications.Total more than 450 adult cockroaches were collected from 11 home rooms (their hidden places) by females by once night carefully without injure cockroaches. At morning, ten (10) Cockroaches were counted and introduced into separately arranged 33 experimental units (containers).Total number of cockroaches for this efficancy test were 330. Botanicals extract concentrations and controls were sprayed in each experimental units these containing cockroaches. The number of diedCockroaches were observed, counted, recorded and removed after 24, 48 and 72 hours of spyayng and death rate in (%) were calculated.

Statistical Analysis

Data collected were analyzed using one-way analysis ofvariance (ANOVA). Statistical significant differences of thetreatment were determined using Turkey Tukey Student Test. Allstatistical analysis was carried out using SPSS version 20.0statistical package.

Results and Discussion

Cockroaches are omnivorous and feed on human and non-human foods, such as household items, glue in books and furniture. They contaminate food: by depositing saliva and faeces on it, and through the mechanical transfer of diseases, which can cause food poisoning and diarrhoea. They also have, and transmit, an unpleasant odour due to chemicals produced by abdominal glands and agitate allergies (Kathy, 2016). Plant extracts have been used worldwide as an alternative method to controlpests unlike synthetic pesticide which have one active compound, and exhibitonly one type of biological effect. Single plant derived compound may have morethan one biological effect (Anis*et al*., 2010). Plants are rich source of bioactive compounds that can be used as a suitable substitute to develop eco-friendly pest management strategies. In the present study, screening of the plant extracts along with the commercial botanicals showed that both possess bioactivity against *B. germanica.*The result of the present study showed that the mortality of *B. germanica* exposed totested botanicals extract increased with increase in grams and exposure time. The mean mortality of adult *B. germanica* exposed to *P. dodecandra, B. polystachya* and *V. amygdalina* leaf extract is presented in Table 2.

Table 2: Mean mortality ± SE of *B. germanica* by botanical extracts and controlsafter 24, 48 and 72 hours exposure

Treatments	Concentration (w/v)	Mean mortality ± SE over time (hours) after exposure		
		24 hours	48 hours	72 hours
Phytolacca dodecandra	5	66.00 ± 00^{c}	92.00 ± 0.00^{b}	100.00 ± 0.00^{a}
	10	91.00 ± 00^{b}	100.00 ± 0.00^{a}	100.00 ± 0.00^{a}
	15	100.00 ± 0.00^{a}	100.00 ± 0.00^{a}	100.00 ± 0.00^{a}

Buddleia polystachya	5	35.00 ± 0.00^{e}	66.00 ± 0.00^{c}	78.00± 0.00^{c}
	10	68.00 ± 0.00^{c}	90.00 ± 0.00^{b}	93.00 ± 0.00^{b}
	15	90.00 ± 0.00^{b}	100.00 ± 0.00^{a}	100.00 ± 0.00^{a}
Vernonia amygdalina	5	33.00± 00.00^{e}	42.00 ± 0.00^{d}	55.00 ± 0.00^{d}
	10	55.00 ± 00.00^{d}	64.00 ± 0.00^{c}	76.00 ± 0.00^{c}
	15	88.00± 0.00^{b}	100.00±0.00^{a}	100.00 ± 0.00^{a}
Possitive control	30ml	100.00 ± 0.00^{a}	100.00 ± 0.00^{a}	100.00 ± 0.00^{a}
Negative control	30ml	0.00 ± 0.00^{f}	0.00± 0.00^{e}	0.00± 0.00^{e}
CV (%)		4.30	3.67	3.24
P-value		<0.0001	<0.0001	<0.0001

Means within a column followed by the same letter are not significantly different (Tukey Student Test (HSD) at p=0.05). SE=Systematic Error, CV = Coefficient of variation, w/v= weight of powder/volume of water.

The present study was conducted to evaluate the efficacy of *P. dodecandra*, *B. polystachya* and *V. amygdalina* leaf extract against*B. germanica* under uncontrolled condition. According to the result of the study there no mortality were recoreded from negative control after all time of explosure. Hundred percent (100%) of mortality were recored by *P. dodecandra* at 5g/100ml after 72 hours, 10g/100ml after 48 hours15g/100ml after 24 hours and by *B. polystachya*and *V. amygdalina* at 15g/100ml after 48 hours. These results were no significant differences with positive control.

Conclusion

Biopesticides are certain types of pesticides derived from animals, plants, bacteria, and certain minerals.They are natural products that are effective against bacteria, fungi, nematodes, viruses and insect pests. They are highly biodegradable, have varied modes of action, are no or less toxic to humans, are nonpollutant and they are readily available in the environment. They have various chemical properties and modes of action and affect on insects in different ways namely; repellents, feeding deterrents/antifeedants, toxicants, growth retardants, chemosterilants, and attractants. So it is preferable to use the botanical insecticides instead of synthetic insecticides. So, we recommended using botanical insecticidal and being promoted and research is being conducted to find new sources of botanical insecticides.

Reccomendations

Continuous use of synthetic pesticides has resulted in negative effects such as pollution, health hazards and loss of biodiversity. For the reason that, botanical pesticides are successful in managing different pests with minimal costs and ecological side effects, easily available and biodegraded, have varied modes of action and low toxicity as well as availability of source materials.We, therefore, recommend using botanical insecticides as an integrated insect management program which can greatly reduce the use of synthetic insecticides.

Acknowledgments

The author would like to gratefully acknowledge household owners for their willingness to collect adult cockroaches from their homes carefully.

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Cite this article as:
Kassie W.B. (2020). Evaluating the effect of three plant leaf extract against German cockroach (*Blattella germanica*) survival under uncontrolled condition , *Int. J. of Pharm. & Life Sci.*, 11(8): 6921-6926.
Source of Support: Nil
Conflict of Interest: Not declared
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