

Efficacy of Herbal Pesticides on Control of Cockroaches (*Blatta Orientalis*)

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ABSTRACT

Cockroaches are nuisance and public health menace. They have a tendency of becoming resistant to commercial insecticides which have proved costly to eradicate. This study aimed at finding an alternative solution to the insects using natural plant extracts.

The plant extracts were separately obtained from ripe hot pepper fruits, citrus fruits peelings, Mexican marigold plant and garlic bulbs. The potency of the extracts was tested using a cross sectional study in seven villages randomly selected from Kimaeti Location of Bumula Constituency in Bungoma County. The villages were assigned arbitrary identity as V₁, V₂, V₃, V₄, V₅, V₆ and V₇. Twenty households infested with the insects were selected randomly from each sample village. Each village received different treatments; V₁, V₂, V₃, V₄ and V₅ were treated with extracts from pepper, citrus peelings, Mexican marigold, garlic and a concoction of the four extracts respectively. Village V₆ was treated with commercial potent insecticide as appositve control and village V₇ was treated with distilled water as a negative control. A follow up round of treatment was done after 10 days to ensure the insects that hatched afterwards are destroyed. A controlled laboratory treatment was also done to check the effect and time of action of each extract. The outcome of the treatment in the villages was done through interviews.

The results from villages V₁, V₂, V₃, V₄ showed a marked eradication of bedbugs with V₁ (55%), V₂ (70%), V₃ (40%) and V₄ (45%). The outcome of village V₅ in which a concoction of extract was applied was very high (90%) which was slightly higher than the commercial insecticide. The laboratory findings showed that the insects had negative chemotaxis to Mexican marigold and garlic. Pepper and citrus fruits showed direct killing. The time of action varied with each extract but was shortest with the mixture of extracts. The findings showed that the concoction of the named plants can indeed eradicate cockroaches. There is however need to carry out more research to ascertain other active compounds in the extracts and their mode of action.

Key words: Potent, Cockroaches, Eradication, Concoction, Chemotaxis

INTRODUCTION

Cockroaches are worldwide indoor pests of social nuisance in the household. About thirty species are associated with man. They are commonly found in the crevices where they feed on decaying food materials and are also hard to eradicate. They not only spoil food but also transfer pathogens and cause allergic reactions accompanied by psychological distress (Brenner *et al.*, 1995). This research targeted the cockroaches as test insect because of their vulnerability.

The insects have developed resistance to many known insecticides especially pyrethroid insecticides proving very hard and costly to eradicate (Dang *et al.*, 2017). According to research by a PhD student David Lilly of the university of Sydney, the resistance of the bugs is due to development of a thicker cuticle which the insecticide could not penetrate (Lilly *et al.*, 2016). This resistance to commercial insecticides formed the basis of the current research to provide an alternative and cheap way of dealing with the menace.

The current research used extracts from among plants which have history of being used as insecticides or pesticides in the gardens. For instance, garlic repels root maggots, cabbage looper, peach tree borer as well cockroach (Hummel, 1999). On the other hand Mexican marigold (*Tagetes minuta*) repels insects, chillies and hot pepper have direct effect on carterpillars aphids, flies, ants and other insects (www.barpbb.com). Orange (citrus fruits) peelings are used on mosquitoes (www.ehow.com). However scanty information is available on use of plant extracts on cockroaches. This motivated the current study.

MATERIALS AND METHODOLOGY

The study was both cross-sectional survey and laboratory experiment.

Study participants

Study participants were residents of seven villages in Kimaeti Location, Bumula Constituency, in Bungoma County, Kenya. The recruitment was by use of phone call through a specific line. Selected participants were those who were accessible via phone calls and were willing individuals who admitted that indeed their households were infested with cockroaches. They signed written consent that they were heads of their households and gave express authority for the study.

Permission to carry out the study was granted by public health department of Bungoma County and National Commission for Science, Technology and Innovation (NACOSTI) Kenya.

Laboratory equipment

The only laboratory equipment used were small glass cages and means of timing

Procedures

Extracts from plants

The extraction was done separately for the four plants, Pepper, Mexican marigold, garlic and orange peelings

Black pepper: One kilogram of ripe pepper was chopped and boiled in three litres of water for 30 minutes. Thirty grams of soap was added to improve adherence to surfaces. It was left to cool and strained. The content was kept in air tight container.

Mexican marigold: About 5kg of freshly gathered leaves flowers stems and roots were crashed and boiled in 5 litres of water for 1 hour and 50g of soap added for the same purpose. It was then strained and contents kept as in the case of pepper.

Garlic: Four garlic cloves were crushed and soaked in 1litre of cold water for 3 days, blended and strained. The content was then sealed in a container.

Orange peelings: Much of the white inner portions of the orange were removed from the rinds. About 1kg was boiled for 10 minutes. The contents were covered and left for 24 minutes to allow the rinds to soak creating an orange oil solution. The oil obtained was also kept in sealed containers.

Laboratory experiments

Two chambered glass cages with the chambers separated by a perforated mesh were used to test the effect of the plant extracts on the insects. Seven cages were used in this experiment. Cockroaches previously collected were used in the experiment. They were put in one chamber of each cage and were sprayed directly but separately with extracts from pepper, orange peelings, garlic, Mexican marigold and a concoction of the four extracts. They were also sprayed with distilled water and commercial insecticide as negative and positive controls respectively. The effect and time taken for the effect was noted.

Field survey

The potency of the extracts was tested using a cross sectional study in seven villages randomly selected from Kimaeti Location of Bumula Constituency, in Bungoma County, Kenya. The villages were assigned alphabetical letters V₁, V₂, V₃, V₄, V₅, V₆ and V₇ as arbitrary identity to conceal the village and household identity. Twenty households infested with the insects were selected randomly from each sample village. Each village received different treatments; V₁, V₂, V₃, V₄ and V₅ were treated with extracts from pepper, citrus peelings, Mexican marigold, garlic and a concoction of the four extracts respectively. Village V₆ was treated with commercial potent insecticide as a positive control and village V₇ was treated with distilled water as a negative control. A follow up round of treatment was done after 10 days to ensure the insects that hatched afterwards are destroyed. Afterwards, the individuals from the various households were interviewed separately on the effectiveness of the treatment their house was given and their response noted.

Data was managed using Microsoft excel (Microsoft company) and data analysis done by Graphpad prism 7 (graphpad inclusions). Correction tests were used in the analysis.

RESULTS

From laboratory experiments

Results from laboratory experiments showed that the effect of the plant extract was either negative chemotaxis or direct killing of the insect with slight variation in time of action (Table 1).

Table 1: Correlation Analysis – Plant extract and Cockroaches Control

Herbal extract	Correlation Coefficient (r)	Significance	R ²	F-value
Black pepper	- 0.587	p < 0.01	0.372	126.8
Mexican marigold	- 0.621	p < 0.01	0.420	126.8
Garlic	- 0.489	p < 0.01	0.247	95.4
Orange peeling	- 0.437	p < 0.01	0.243	71.7

Results from field survey

The results obtained in the field study were based on individual responses based on the effectiveness of the plant extract treatment given to their household. (Table 2)

Table 2: Correlation Analysis – Plant extract and Cockroaches Control

Black Pepper	r = - 0.594
Mexican marigold	r = - 0.558
Garlic	r = - 0.423
Orange peeling	r = - 0.476

DISCUSSION AND CONCLUSION

Results from laboratory experiments revealed that extracts from pepper and orange rinds has direct killing effect. This could be strongly attributed to active compounds they possess. The active compounds could be of wide spectrum insecticidal since they are capable of killing bedbugs. Oils extracted from citrus fruit peelings contain

limonene as the main component which is a strong insect repellent and also paralyzes insects like fleas (Moore *et al.*, 2007). The oil also contains linalool which is a pest killer. However, their effect on cockroaches is not well documented. Pepper on the other hand contains capsaicin (8-Methyl-N-vanithyl-6-nonenamide) and other several compounds called capsaicinoids as active compounds which are irritants with a choking effect to most animals including insects (Govindarajan and Sathyanarayana, 1991). This irritation could be the cause of direct killing effect to insects observed in the laboratory experiment.

From the results, garlic and Mexican marigold are seen to be negatively chemotactic to bedbugs indicating that they have substances that are repulsive to insects. When crushed, chopped or blended, garlic bulbs contain an amino acid that undergoes biotransformation to a substance called allicin which has a characteristic odor that repels insects (Mobki *et al.*, 2013). This could probably be the cause of movement of the insect away from the point of application of the extract. Mexican marigold contains chemical compounds called thiopenes in their seeds, leaves, roots and other parts of the plant which are offensive to insects as well as nematodes (Arnason *et al.*, 1989). This effect could probably be responsible for negative chemotaxis to insects in the experiment.

When all the four extracts were mixed to form a concoction, it had a direct killing effect which took a shorter time. This could be as a result of the combined effect of extracts from pepper and orange rinds. The efficiency of an insecticide is determined by time of action; hence the effect observed with the concoction suggests that it can make a good insect killer. The effects with distilled water and commercial insecticides are negative and positive controls respectively.

The results from field study showed a marked positive response in the effectiveness of the plant extracts on eradication of cockroaches. Higher response on the use of extracts from orange rinds and pepper could be due to the killing effect of their active compounds. Higher response in the use of extracts from orange rinds is an indication that its active compounds, limonene and linalool, are more potent compared to others. Slightly lower response observed in the use of extracts from garlic and Mexican marigold may probably be attributed to the fact that when the insects were repelled in the first round, the eggs hatched and the insects reappeared.

The higher response when a concoction of the four extracts was used could probably be a combined effect of the four extracts. Combined effects of extracts from pepper and orange rinds killed the insects in both rounds of treatment and destroyed the life cycle. On the other hand, extracts from garlic and Mexican marigold probably expelled the insects and repelled any further insect infestation.

Therefore, this study documents that the combined effect of the concoction of plant extracts is effective in eradication of cockroaches. The study recommends further investigation to ascertain the mode of action of the known active compounds and also find out if there are other active compounds involved.

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