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Study of Repellent Activity of Different Plant Powders against Cockroach (*Periplanata americana)*

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ABSTRACT

Insects are a problem in stored grain throughout the world because they reduce the quantity and quality of grain. The present investigation was aimed to assess the impact of indigenous plants for their insecticidal and repellent activity against Periplanata americana. So, an attempt is undertaken to evaluate the efficiency of various plant powders of the plants viz. Neem, Tulsi, Adathoda, Turmeric, lantana etc., owing to its insecticidal properties.Studies were carried out on the repellency of the plant powders of six botanicals on Periplanata americana. The tested plants include Azadirachta indica, Curcuma longa, Lantana camara, Vitex negundo, Adhatoda vasica, Ocimum tenuiflorum. Each of the plant material (PM) was pulverized and then applied on the insect in four different doses.The dosage rate were 25%PM+75% biscuit, 50% PM+ 50% biscuit, 75% PM+ 25%biscuit and 100% PM + 0% biscuit. Repellency of insect was monitored and recorded on 1,6 and 24 hours duration and by statistically calculating mean, excess proportion index (EPI) and percentage of repellency. All the experimented six plants showed maximum repellency and high EPI value in highest dose.

Keywords*: Repellency, attractancy, EPI, Pests, Biopesticides.*

INTRODUCTION

Cockroaches may become pests in homes, schools, restaurants, hospitals, warehouses, offices and virtually in any structures that has food preparation or storage areas. They contaminate food and eating utensils, destroy fabric and paper products and impart stains and unpleasant odour to surface they contact. Biopesticides are certain types of pesticides derived from animals, plants, bacteria, and certain minerals. Much of the research related to cockroach management has been on essential oils and fungal pathogens. The volatile components of essential oils (terpenes, benzene derivatives etc.,) may be useful for repelling cockroaches and preventing cockroach infestations. During the course of evolution plants have developed, as part of their defensive mechanism, various chemical molecules which provide protection against insect pests, since, the overall pressure of insects on plants is much more than any other herbivore[14]. Biopesticides are pesticides prepared from plants. Neem, Tulsi, Adathoda, Turmeric etc., are some of plants which are reported to have the ability to kill or keep away the pests. They are eco-friendly too. The insecticides of plants origin have additional advantage over synthetic insecticides which are biodegradable and safer to non target organisms, and do not leave the residues. Two methods have been chiefly adopted for the control of cockroaches, the top priority going to biological control and other by chemical control. The insecticides are mainly neurotoxic to insects and are very effective in large scale vector control. But it has been established that the organochlorines (eg: DDT, BHC etc) has residual effect in the biosphere[5,11] and traces of DDT and BHC has been detected in food products ,animal body and even in human breast milk due to biomagnifications.

Unlike synthetic pesticides which have only one active compound and exhibit only one type of biological effect, single plant derived compounds may have more than one biological effect. Detailed investigations have revealed that several plants species have more than compounds and have diverse biological effects. The chances of quick development of resistance to different chemicals in one extract responsible for either one biological effect or different biological effect one highly unlikely[2]. An attempt to find out the effect of repellency of some natural plants extracts against cockroaches based on their EPI (Excessive Proportion Index).

Many experiments have been carried out in other plants also in addition to the selected plant species and have shown commendable effects on insects especially cockroaches. Seven commercial essential oils extracted from the plant species *Boesenbergia rotunda (L.) Citrus hystrix., Curcuma longa L., Litsea cubeba (Lour.), Piper nigrum L., Psidium guajava L.* and *Zingiber officinale* were used and naphthalene as a control, were evaluated for repellent activity against the three cockroach species *Periplaneta americana (L.), Blattella germanica (L.)* and *Neostylopyga rhombifolia* under laboratory conditions[3].

The toxic and repellent properties of nine major constituents of essential oils, comprising benzene derivatives and terpenes, against *Periplaneta americana* (L.) were evaluated, verified and analyzed in many earlier experiments. Contact and fumigant toxicities to adult females and repellency to nymphs were determined. The decreasing order of knockdown activity via contact was methyl eugenol>isosafrole=eugenol>safrole. The benzene derivatives were generally more toxic and repellent to *P. americana* than the terpenes[13].

Piper aduncum essential oil can be used as an alternative natural product for controlling the cockroach Peripatetic americana. Piper aduncum essential oil can be used as an alternative natural product for controlling the cockroach Periplanata americana[7]. Strong repellency (Class V) was obtained for *Cyperus rotundus* and *Eucalyptus robusta* essential oils. At 1 ppm concentration, essential oil of *Cyperus rotundus* showed strong repellency and Class IV repellency was obtained for essential oil of *E. robusta* and the two compounds after one hour exposure. Koehler *et al;*[6] proved that male cockroaches have the highest susceptibility. This could be due to the differences in metabolic rate found in the adult male and female and the nymphs. The higher metabolism would lead to faster excretion of the toxic substance from the body[6]. It can be said that the effectiveness of the *P. aduncum* essential oil is equal with that of Resigen only at very high concentrations.

Plant extracts have been used worldwide as an alternative method to control pests. Studies were conducted to test the repellency of four powdered spices, black pepper (*Piper nigrum.*), chili pepper (*Capsicum annuum*), cinnamon (*Cinnamomum aromaticum*) and turmeric (*Curcuma longa*), against three stored-product insects, the lesser grain borer, *Rhyzopertha dominica*, the granary weevil, *Sitophilus granarius* and the red flour beetle, *Tribolium castaneum*. The cup bioassay technique was used, to determine the response of insects to potential repellents by measuring their movement from treated grain. Twenty adults of three species are released into The experiments were conducted at room conditions. The number of trapped insects was determined at 3 different intervals after the introduction of the insects. Results showed that all tested plant powders had repellent activity against the three stored-product insects. Adults of *S. granaries* repelled faster, followed by *T. castaneum* and *R. dominica*. At the highest concentrations and intervals, wheat grains treated with cinnamon powder were the most repellent to adults of *S. granarius* (up to 92.5% after 1 h), followed by chili pepper treatment for *T. castaneum* (up to 72.5% after 6 h) and black pepper treatment for *R. dominica* (up to 58.75% after 24 h).

Based on earlier findings mentioned above, present study was undertaken to get an idea about which of the plant species (Neem, Lantana, *Vitex negundo*, Tulsi, Adathoda, and Turmeric) are efficient in preventing the pests. The reason for selecting these plants was their common availability in addition to their repellency nature as illustrated in many earlier findings. Also the results in this study were analyzed to compare their efficiencies (attractancy or repellency) so that it can be recommended to wide commercial applications and also to emphasize that environmental friendly techniques are more suitable and applicable to repel insects than other pesticides which are not eco-friendly.

MATERIALS AND METHODS

(a) Experimental animal

For the study, cockroach, ***Periplanata americana*** was subjected to different concentrations of plant powders for 1, 6 and 24 hours.

(b) Experimental plant

Azadirachta indica

Curcuma longa

Justicia adathoda

Lantana camara

Ocimum tenuiflorum

Vitex negundo

METHOD

Collection of cockroaches

In the present study, common cockroaches ***Periplanata americana*** were used. Required number of adult cockroaches were collected and kept in a plastic container, which was perforated for aeration, these insect were starved for one day for experiment.

Preparation of plant powder

The leaves of *Azadirachta indica, Curcuma longa, Vitex negundo, Lantana camera aculeata, Adathoda vasica, Ocimum sanctum* were collected and dried under shade. The dried plant materials were powdered using electric grinder, sieving of the pulverized plant materials and kept in an air tight container for the purpose of the experiment.

Experimental setup

For the present study, an apparatus was improvised in the laboratory which possess the following compartments: middle plastic chamber (10 cm diameter) from which projects two transparent plastic tube (15cm length and 3cm diameter).The end of each plastic tube is fitted with a plastic bottles(11cm height *5.5cm width)and marked A and B respectively. Ten starved cockroaches were introduced in to the middle plastic chamber. Bottle **A** taken as a treated side and **B** taken as a control side as shown in figure 1

Fig 1: experimental, treatment and control Setup of the Study

(a) Experimental design

(b) Treatment set up

(c) Control

Mode of application

1. 2.0g of biscuit powder only-control
2. 1.5g of biscuit powder+ 0.5g of plant powder (Treatment 1)
3. 1.0g of biscuit powder + 1.0g of plant powder (Treatment 2)
4. 0.5g of biscuit powder + 1.5g of plant powder (Treatment 3)
5. 2.0g of plant powder (Treatment 4)

Each of this mixed with water and made a paste. Each of these paste were then coated into the one plastic bottle(A).For control biscuit without treatment were used(bottle B). The repellency was recorded at 1hour, 6hour, and 24hour. The above set ups were replicated three times. The EPI value was recorded.

Statistical analysis

From the obtained data repellency was calculated using the formula of Sakuman and Fukami[12].

$$\mathbf{EPI} = \frac{NT-NC}{NT+NC}$$

$$\mathbf{PC}=\left[1-\frac{NT}{NT+NC}\right]\times 100\%$$

EPI : excess proportion index
NT : number of insects trapped in the chemical-treated test chamber
NC : number of insects trapped in the control test chamber
PC : Percentage repellency (i.e. percentage of animals trapped in control test chamber)

RESULTS AND DISCUSSION

In the present experiment, six plant powders assayed for their repellant property against cockroach, *Periplanata americana*. Observations were made by exposing insects to the plant powders for one day exposure categorized in different time periods viz., (1hour, 6hour & 24hour). Results analyzed are completely based on the repellant activity shown by the cockroaches. Insects which hesitate to move treated bottle side is considered the repellant effect of plant powder present in the connecting bottle of the experimental setup. Number of cockroaches present in the bottle containing food (bottle B) was observed and data were calculated statistically by mean, Excess Proportion Index and percentage of repellency.

Repellence was determined by the number of insect leaving the treated side compared to the untreated controls. It is apparent from the data that all the plant powders showed considerable repellant property.

Repellent activity increases the potential value of the materials in protecting grains from the attack by stored product insect pest. Excessive Proportion Index (EPI) values give an idea about the repellency or attractancy of chemical substance against an animal tested. The plant extracts showed both attractant and repellent activity. The repellency index was classified as: if values <1 it indicates repellency; if 1 it is neutral; and if >1 the material used is attractant in nature. At lower concentration the plant extracts showed attractant and which in turn showed moderate higher repellent activity when the concentration was increased. The reason for this kind of both repellent and attractant at two different concentrations is unknown. Some study shows that sometimes, the reason for these type of insect behaviour might be due to the presence of an olfactory stimulus. The presence of volatile compounds having strong odour could block the tracheal respiration of the insect leading to their death.

Table 1: shows the percentage repellency and EPI value of *Periplaneta americana* treated with different concentrations of the power of *Azadirachta indica* for 1,6 & 24 hours

PLANT NAME	TREATMENT	TIME DURATIONS					
		1HOUR		6HOUR		24HOUR	
		EPI	PC	EPI	PC	EPI	PC
NEEM	O.5gm (25%)	-0.38	70%	-0.52	77%	-0.46	74%
	1.0gm (50%)	-0.57	79%	-0.60	81%	-0.71	86%
	1.5gm (75%)	-0.71	86%	-0.73	87%	-0.80	90%
	2.0gm (100%)	-0.77	89%	-0.80	90%	-0.85	93%
	Control	0	0%	0	0%	0	0%

*PC= percentage of repellency *EPI= excess proportion index

Azadirachtin is currently considered as neem's agent for controlling insect[10]. These hormones control the process of metamorphosis as the insects pass from larva to adult; Azadirachtin block those parts of the insect brain that produce these vital hormones. As a result, insects are unable to moult. When neem is ingested, it disrupts the cockroach's normal functions. Some forget to eat, fly or lay eggs, or they may lay eggs that are sterile. Without food or larvae, the insects will die, leaving insect populations diminished. It is through these hormonal effects that this important compound of neem breaks the life cycle of insects[16].

Table 1 shows the repellency of *Periplanata americana* treated with different concentrations of powder *Azadirachta indica* for 1hr, 6hr & 24hrs durations. The highest repellency was recorded with the highest repellency dose of (2.0g) neem powder. Thavara *et al.*[15] reported the repellent activity of essential oils where neem exhibited highest repellency against cockroaches supporting the present findings of the study. The negative value of EPI indicates that number of insects trapped in the chemical-treated test chamber is lesser in number than number of insects trapped in the control test chamber. This implies that EPI and Percentage repellency have inverse relationship as clearly indicated in the values of table 1. Greater the values of EPI lower will be the percentage repellency of different plant powders used. In the experiment as the concentration of neem powder increases EPI value gradually reduces from -0.38 to -0.77 which thereby gives a gradual hike in the values of percentage repellency from 70% to 89% as the *Periplanata americana* is treated at different concentration of 0.5, 1.0, 1.5, 2.0 gm respectively.

As the time duration differs (1h, 6h, 24h) the percentage repellency also varies. It was analyzed from the experiment that the repellency increases from 70% (1h) to 77% (6h) when 0.5 gm of neem powder is applied but repellency is shown to have a decrease (from 77% to 74%) which might be due to lesser concentration of neem powder and studies show at lesser concentration plant extracts depict attractant nature and thus, percentage repellency decreases. However this is not the trend followed in the cases of other applied concentrations viz., 1.0, 1.5, 2.0gm because the percentage repellency does not show a decreasing trend as time duration increases from 1h to 6h and then to 24h respectively. This study shows that at end of 24h the repellency is maximum as this gives maximum time frame for the entire plant powder to act upon the experimental material at maximum concentration of 2.0gm. Repellency of insects remained at zero level in the control experiment for 1, 6 & 24hrs duration. There was significant difference between each of the treated pest.

Six essential oils (where oil of Azadirachta indica was a component) were tested against the German cockroach, *Blattella germanica* (L.) for repellent and toxic activity and it showed that at least one aspect of the test results indicated that these oils had interesting activity[4]. It was also found out that there was a direct relation between the concentration and degree of lethal effectiveness of the oil. The neem, especially the seed oil, has great potential as natural biocide against termites and weevils[1]. Studies were carried out on the toxicity of the powders of various botanicals on *Periplaneta americana*. Each of the plant materials (PM) was pulverized and then applied to the insects in different doses. For experiments involving *A. indica*, only the highest dose of 100% PM gave a significantly high mortality rate when compared with the control[8].

Table 2: the percentage repellency and EPI value of *Periplaneta americana* treated with different concentrations of the power of *Curcuma longa* for 1,6 &24 hours

PLANT NAME	TREATMENTS	TIME DURATIONS					
		1HOUR		6HOUR		24HOUR	
		EPI	PC	EPI	PC	EPI	PC
TURMERIC	O.5 gm (25%)	-0.33	67%	-0.34	67%	-0.46	71%
	1.0 gm (50%)	-0.28	64%	-0.57	79%	-0.71	86%
	1.5 gm (75%)	-0.49	72%	-0.73	87%	-0.58	81%
	2.0 gm (100%)	-0.71	86%	-0.69	85%	-0.71	86%
	Control	0	0%	0	0%	0	0%

*PC=percentage of repellency *EPI= excess proportion index

Table (2) shows the percentage of repellency of *Periplaneta americana* treated with different concentrations of plant powder *Curcuma longa* for 1,6 & 24 hours. The highest repellency was recorded with the highest dose (2.0gm) of plantpowders. The percentage of repellency in the case of *Curcuma longa* was about 86%, 85% & 86% in 1,6 & 24 hours respectively. The values exhibited in the table clearly indicates like in the table 2 that EPI is lowest at 0.5gm at all time intervals thereby emphasizing the result that at lower concentration percentage repellency is the lowest no matter how long the experimental material is exposed to the plant powder. However at 2.0gm the percentage repellency is seen to be highest (86%) even at 1h exposure which continues to show its repellency even at 24h.

Table 3: the percentage repellency and EPI value of *Periplaneta americana* treated with different concentrations of the power of *Adathoda vasica* for 1,6 &24 housr

PLANT NAME	TREATMENTS	TIME DURATIONS					
		1HOUR		6HOUR		24HOUR	
		EPI	PC	EPI	PC	EPI	PC
ADHATODA VASICA	O.5gm (25%)	+0.33	36%	+0.20	40%	+0.20	40%
	1.0gm (50%)	+0.20	40%	-0.03	52%	-0.03	52%
	1.5gm (75%)	-0.09	55%	-0.07	54%	-0.14	58%
	2.0gm (100%)	-0.14	58%	-0.30	63%	-0.25	62%
	Control	0	0%	0	0%	0	0%

*PC=percentage of repellency *EPI= excess proportion index

Unlike in table 1&2, the EPI shows positive values at 0.5g and 1.0g (25% & 50% treatment exposure) which indicates that number of insects trapped in the chemical-treated test chamber are greater in number than number of insects trapped in the control test chamber. This implies *Adathoda vasica* shows greater attractancy power than repellency and hence, Percentage repellency (PC) is lowest (40% at 24h) when compared with other concentrations where PC is 52% (1g), 58% (1.5g) and 62% (2.0g). Similar trend was shown by the repellent activity of different solvent extract of *A. vulgaris, S. indicus, T. purpurea and P. juliflora* were tested at 2.5 and 5% concentrations against *T. castaneum*.

The result indicates variation among the plant extracts against the selected insect pest. In general, majority of the extracts showed attractant activity at lower concentration at 1 hr duration. But the trend had changed when the duration and concentrations increased. Highest activity was observed at higher concentration of the all the plant extract. In controversy ethyl acetate extract of *S. indicus* showed higher activity at lower concentration then higher concentration.EPI value ranged from -0.43 to -0.60 at 1 hr and 6 hr in 5% concentration and -0.65 EPI value at 6 hr in 2.5% concentration. In hexane extract of *P. julijlora* showed higher repellent activity EPI value ranged from -0.11 and -0.33 in 2.5% concentration at 1 hr and 6 hr duration respectively. On the other hand chloroform extract of *T. purpurea* showed highest repellent activity against T. castaneum. EPI value of chloroform extract of *T. purpurea* was ranging from -0.55 to -0.63 at 5% concentration, this was followed by A. vulgaris EPI value at 5 % concentration of A. vulgaris showed -0.31 to -0.21 at 1h and 6h duration respectively. Chloroform extract of other plants showed very lesser activity, when compared to all other extracts. Ethyl acetate extract of *S.indicus* notably showed highest activity at lower concentration against the *T.castaneum*. EPI value was -0.45 and -0.65 at 1h and 6 h duration respectively. And at higher concentration the value was -0.43 and -0.60. Next to S. indicus, showed moderate activity. Ethyl acetate extract of other plants showed very low/nil activity[9].

So, at lower concentration *Adathoda* plant powder cannot be recommended to repel any pests as it shows greater tendency to attract. However at higher concentrations at different time intervals EPI values show negative value which indicates more cockroaches stay in control chamber than on treated side. This clearly indicates *Curcuma longa* to be more efficient and repellant than *Adathoda vasica*.

Table 4: the percentage repellency and EPI value of *Periplaneta americana* treated with different concentrations of the power of *Ocimum tenuiflorum* for 1,6 &24 hours

PLANT NAME	TREATMENTS	TIME DURATIONS					
		1HOUR		6HOUR		24HOUR	
		EPI	PC	EPI	PC	EPI	PC
Ocimum tenuiflorum	O.5gm (25%)	+0.20	40%	+0.21	42%	+0.20	40%
	1.0gm (50%)	-0.03	52%	-0.07	54%	-0.11	56%
	1.5gm (75%)	-0.09	55%	-0.14	58%	-0.26	64%
	2.0gm (100%)	-0.16	59%	-0.26	64%	-0.25	62%
	Control	0	0%	0	0%	0	0%

*PC=percentage of repellency *EPI= excess proportion index

The leaves of *Ocimum* sps. contain an essential oil which contains eugenol, eugenal carvacrol, flavones apigenin, luteolin, flavone-7-O-glycoside, etc., have been reported. So a review was made to understand the impact of these components on Cockroaches. The essential oil extracts of six Malaysian plants, i.e. *Curcuma longa, Zingiber officinale, Pandanus odorus, Cinnamomum zeylanicum, Syzygium aromaticum* and *Cymbopogon citratus*, were evaluated for repellent activity against *Periplaneta americana* using a modification of the 'two-cylinders' method. Dose-dependent repellency ranging from 57.1 to 100% was exhibited by all six extracts at the lowest concentration tested (12 ppm)[3].

Table (4) shows the percentage of repellency of Periplaneta americana treated with different concentrations of plant powder Ocimum tenuiflorum for 1, 6 & 24 hours. The highest repellency was recorded with the highest dose (2.0gm) of plant powder. The percentage of repellency at 2.0gm in the case of *Ocimum tenuiflorum* was about 59%, 64% & 62% in 1, 6 & 24 hours respectively which was found to be higher than at 0.5, 1.0, 1.5gm. The values exhibited in the table clearly indicate that EPI is lowest at 1.0 and 1.5 gm at all time intervals thereby emphasizing the result that at lower concentration percentage repellency is the lowest. *Ocimum tenuiflorum* shows small level of attractancy at 0.5 gm by showing a positive value of +0.20. This implies at lower concentration this plant extract showed attractant nature but it also showed a moderate increase in its repellent activity when the concentration was increased during the experiment. The reason for this kind of both repellent and attractant at two different concentrations is unknown. Similar results were observed in work by Li J. *et al.* where repellency against the *B. germanica* nymphs increased with increasing concentrations of 2AP (PC = 65-93 %), whereas

repellency increased with decreasing concentrations of pandan essence (PC = 67-85 %) and hexane-pandan extract (PC = 68-83 %). 2AP is a highly effective repellent as its repellency is projected to increase until it tapers off at an optimum efficiency level with higher concentrations, making it possible for its efficiency level to be controlled.

Ocimum tenuiflorum shows attractancy at lower concentration of plant powders.ie attractancy in 0.5gm of plant powders is seen even after prolonged exposure of 24 hours[9] study also supported the fact that EPI values ranged from + 1 to -1 in their specific study. These terms simply express polarity of the directional choice. Positive and negative values indicated positive and negative approaches respectively. In their present study, Tulsi oil had more repelling property than other oil tested. In general, repellency increased as the concentration increased in all treatments of the oils tested in their work.

Table 5: the percentage repellency and EPI value of *Periplaneta americana* treated with different concentrations of the power of *Lantana camara* for 1,6 &24 hours

PLANT NAME	TREATMENTS	TIME DURATIONS					
		1HOUR		6HOUR		24HOUR	
		EPI	PC	EPI	PC	EPI	PC
Lantana camara	O.5gm (25%)	-0.16	59%	-0.41	63%	-0.13	57%
	1.0gm (50%)	-0.27	64%	-0.47	74%	-0.46	74%
	1.5gm (75%)	-0.43	72%	-0.60	80%	-0.63	82%
	2.0gm (100%)	-0.50	76%	-0.68	85%	-0.60	80%
	Control	0	0%	0	0%	0	0%

*PC=percentage of repellency *EPI= excess proportion index

Table 6 shows the repellency of *Periplanata americana* treated with different concentrations of powder *Lantana camara* for 1hr, 6hr & 24hrs durations. Unlike other experimented plants in this study, the highest repellency was recorded with the repellency dose (1.5gm) of *Lantana camara* powder. Moreover in all the other concentrations (0.5, 1.0 and 2.0gm) the PC is found to increase during the exposure time of 1h to 6h but after this a gradual decrease is seen when *Periplanata americana* is kept exposed for 24h. Only at 1.5 gm the PC shows a consistent increase in its activity indicating that Lantana is highly effective at moderate concentrations unlike in Neem, turmeric, curcuma and Adathoda. The negative value of EPI indicates that number of insects trapped in the chemical-treated test chamber is lesser in number than number of insects trapped in the control test chamber. *Lantana camara* shows above 50% repellency in all concentrations of plant powders. It indicates that it's a potential repellant against cockroaches in 0.2 concentration of plant powder *Lantana camara* shows highest repellency(76%, 85% & 80%) than other concentrations and the EPI value is -0.50, -0.68 & -0.60. *Lantana camara* shows lowest repellency in 0.5gm of concentration.

Table 6: the percentage repellency and EPI value of *Periplaneta americana* treated with different concentrations of the power of *Vitex negundo* for 1,6 &24 hours .

PLANT NAME	TRATMENTS	TIME DURATIONS					
		1HOUR		6HOUR		24HOUR	
		EPI	PC	EPI	PC	EPI	PC
Vitex negundo	O.5gm (25%)	+0.20	40%	+0.29	34%	+0.20	40%
	1.0gm (50%)	-0.06	54%	-0.03	52%	-0.14	58%
	1.5gm (75%)	-0.14	58%	-0.23	63%	-0.62	62%
	2.0gm (100%)	-0.20	61%	-0.26	64%	-0.26	64%
	Control	0	0%	0	0%	0	0%

*PC=percentage of repellency *EPI= excess proportion index

Table (6) shows the repellency of *Periplanata americana* treated with different concentrations of powder *Vitex negundo* for 1hr, 6hr & 24hrs durations. In 0.5gm of plant powder shows the attractancy in 1, 6, 24 hours respectively.EPI values show positive values at 0.5 and as EPI has an inverse relationship with PC, PC is least at this concentration.

The highest repellency is seen at the highest concentration (2.0 gm), EPI value is -0.20%, -0.26 & -0.26 and percentage of repellency is 61%, 64% & 64%. It shows an average level of repellency.

Among the six plants tested the highest repellency was seen in the case of *Azadirachta indica* and the least repellency was shown by *Adathoda vasica* and the order of repellency can be shown as Neem> Turmeric> Lantana>Vitex> Ocimum> *Adathoda vasica.* Neem- (74%, 86%, 90%, 93%)> turmeric (71, 86, 81, 86%)> Lantana-57%, 76%, 85% & 80%> *Vitex negundo* shows, 40%, 59%, 64% & 62% > *Ocimum sanctum* 40,61%, 64% & 64%> Adathoda-40, 52, 58, 62%. *Adathoda vasica* is least effective at 2.0gm concentration of plant powder tested. In 2.0gmconcentration neem shows the highest repellency than other plantpowders against cockroaches. Thus, Neem can be strongly recommended in the plant powder form to be utilized as a strong repellent for pests and cockroaches and should be therefore commercialized.

Repellency of insect remained at zero level in the control experiment for 1, 6 & 24hours duration. There was significant difference between each of the treated pest. However its activities are comparably higher than the control sample. Among these *Vitex negundo* and *Ocimum sanctum* exhibited more than 50% repellency. Then a gradual decline in the repellency was observed in decreasing the concentration of plant powders.

SUMMARY AND CONCLUSION

The major thrust of this work is to find the repellent effects of various components found in the plants include, *Azadirachta indica, Curcuma longa, Lantana camara, Vitex negundo, Adhatoda vasica, Ocimum tenuiflorum* against cockroach *Periplanata Americana* at different exposure time.

Among the six plants tested the highest repellency was seen in the case of *Azadirachta indica* and the least repellency was shown by *Adathoda vasica* and the order of repellency can be shown as Neem> Turmeric> Lantana>Vitex> Ocimum> *Adathoda vasica.* Neem- (74%, 86%, 90%, 93%)> turmeric (71, 86, 81, 86%)> Lantana-57%, 76%, 85% & 80%> *Vitex negundo* shows, 40%, 59%, 64% & 62% > *Ocimum sanctum* 40, 61%, 64% & 64%> Adathoda-40, 52, 58, 62%. *Adathoda vasica* is least effective at 2.0gm concentration of plant powder tested.

Plants are the richest source of organic chemicals on earth. Some of their components are highly volatile components have been found to act as insect deterrents. The repellent effects of different plant powders at different time durations are significantly different. So, an attempt is undertaken to evaluate the efficiency of various plant powders of the plants viz. Neem, Tulsi, Adathoda, Turmeric, Citrus, etc., owing to its insecticidal properties. Even though pesticides can curb many diseases and pest growth; its side effects are also highly noticeable. In this context the relevance of the study becomes essential as the usage of natural plants can eliminate the possibility of using other harmful pesticides or chemicals.

The natural materials like Neem, Turmeric, Lantana, *Vitex negundo, Adathoda vasica* and Tulasi etc, have the features essential for a safe insecticide, such as proved to be effective against cockroaches, *Periplanata americana*. Relatively short lifespan(biodegradable), less toxicity to non target organisms, easy availability, easily accessible, renewable, economically cheap and several bioactive varieties are available.

So plant can be considered as good alternative to be synthetic and biological method of insect control. The study indicates plant extracts of selected plant species to be useful for this purpose and can be introduced as repellants against various insect pests and can be used in wide application in many industrial and commercial purposes, so future prospect of the study lies in the fact that more plant species should be identified and utilized for such pest repellent activities so that an eco-friendly approach can be followed for sustainable development of the nature and its dependents.

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