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***J. Nat. Prod. Plant Resour.*, 2015, 5 (5):26-35**
(http://scholarsresearchlibrary.com/archive.html)

ISSN : 2231 – 3184
CODEN (USA): JNPPB7

Insecticidal effects of leaves, flowers and fruits of *Lantana camara Linn.* (Philippine Kantutay) on *Musca domestica L.* (Philippine Houseflies)

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ABSTRACT

Insects are the most widespread of all animals. Some insects are friends of human but great majority are harmful to man simply because they destroy crops and spread diseases. Houseflies for one are harmful to human health as they are good agents of bacteria, germs and other dirt causing diseases. In dealing with these insects, insecticides are use, Unfortunately, most insecticides for houseflies are synthetics though some are water based, but stillharmful to the environment. Lantana camara Linn. or familiarly called as Kantutay have lantadene which is a chemical toxic to the liver of animals and can cause various symptoms if ingested. It also contained lantanine and other phytochemicals which made it a viable source of pharmaceutical drugs.Its various parts such as the leaves, flowers and fruits were subjected to extraction process and thetoxicity of each part was tested against houseflies (Musca domestica L.)by topical and spray method using Peet-Grady Test. The toxicity effects of the extractsin eradicatingMusca domesticaL.in its varying developmental stages from egg to maggots and finally to pupa was compared statistically byTwo-way Analysis of Variance.

Key words: *Lantana camara Linn., Maggots, Musca domestica L., Peet-Grady Test, Pupa*

INTRODUCTION

Recent reports indicate that there are nearly 200 million insects for every human on the surface of the earth.[5]They inhabit practically every type of environment. There even some insects that live in or on the bodies of man and animals alike. There are insects which are harmful to human as they are capable of spreading disease causing agents. Houseflies (*Musca domestica L.*) are one of them. Some of the diseases commonly transported by houseflies are amoebic dysentery, bacillary dysentery, typhoid fever and cholera.[1]These happens whenever houseflies landed on foods and other frequently handled home commodities.This common fly originated on the steppes of central Asia, but now occurs on all inhabited continents, in all climates from tropical to temperate, and in a variety of environments ranging from rural to urban. It is commonly associated with animal feces, but has adapted well to feeding on garbage, so it is abundant almost anywhere people live.[8]

At home, houseflies are a common sight. They multiply fast and they seemed to be everywhere as they fly from one surface to another bringing with them lots of disease causing agents. Eradicating houseflies would surely consume money, effort and time and that the most convenient way of dealing with them is through the use of synthetic insecticide, water based or otherwise. The greatest drawback on the use of synthetic insecticides is the effects to the environment and the danger it post to other human.[1] Thus, an alternative is needed to be in placed through the use of botanical based pesticides and one of the plants found to contain insecticidal properties is Kantutay which scientifically termed as *Lantana camara Linn*.[21]

Kantutay (*Lantana camara Linn.)*) is an erect or sub-candent, half-climbing, gregarious somewhat hairy and strongly aromatic plant. It is a small branching shrub with angled and prickly branches that grow up to 2-meter long.

[6] Due to extensive selective breeding throughout the 17th and 18th centuries for use as an ornamental plant there are now many different forms of *L. camara* present throughout the world.[3]

The flowers of *L. camara* is tubular shape which each have four petals and are arranged in clusters at the end of stems. Flowers come in many different colors including red, yellow, white, pink and orange which differ depending on location, age and maturity. [9] The leaves are egg-shaped, simple, arranged oppositely on the stem and have a strong odor when crushed.[13] The fruit of *L. camara* is berry-like and turns a deep purple color when mature. Both vegetative and seed reproduction occur. Up to 12,000 fruits can be produced by each plant [23] which are then eaten by birds and other animals which can spread the seeds over large distances, facilitating the spread of *L. camara*.[7]

Lantana camara Linn. is a common plant among Filipinos and is widely spread in the Philippines. It has essential oil as defined by its anti-ashmatic and pectoral properties.[24] *L. camara* is a favorite remedy for snakebite. A strong decoction of the leaves being taken internally and externally to wash eczema while crushed leaves are good for wounds and are applied as poultice in sprains.[11] *L. camara* has *lantanine*- a good substitute for *quinine*, which is an antipyretic (fever-reducing), antimalarial, analgesic (painkilling), and anti-inflammatory property.[22]

L. camara is also known to be toxic to livestock such as cattle, sheep, horses, dogs and goats.[4][21]The active substances causing toxicity in grazing animals is pentacyclic triterpenoids or *lantadene*which results in liver damage and photosensitivity.[2][13]*L. camara* also excretes chemicals (*allelopathy*) which reduce the growth of surrounding plants by inhibiting germination and root elongation.[10] Studies conducted in India have found that *Lantana* leaves and barks can display antimicrobial, fungicidal and insecticidal properties.[21]The toxicity of *L. camara* to humans is undetermined [15] as no one dared to physically taste the plant because of its unpleasant aroma.

These bioactive characteristics and chemical components of the various parts of Kantutay(*Lantana camara Linn.)*and its widespread availability made it possible for the plant to be considered as subject based for botanical insecticides to eradicate houseflies especially at home where the immediate victims of agent causing diseases brought by houseflies are precious to every homemaker and head of family in a developing country like the Philippines.

MATERIALS AND METHODS

Materials:
Fresh samples of Kantutay (*Lantana camara Linn*), Houseflies (*Musca domestica L.*) sterilized petri dishes, mortar and pestle, tap water, sterilized beaker, sterilized cheesecloth, Peet-Grady Instrument, pieces of pork liver, improvised cages,

Procedure for Preparation:
Phase 1. Collection of the Leaves, Flowers and Fruits of Kantutay (*Lantana camara Linn.*)
The sample leaves, flowers, and fruits of Kantutay (*Lantana camara Linn*) were collected from one of countryside barangays of the Municipality of in the province of Nueva Ecija, Philippines.

Phase 2. Collection of the Test Insects
The insect species that were used to test the insecticidal effects of Kantutay (*Lantana camara Linn*) are houseflies. Adult houseflies were collected from the piggery farm of the researcher situated in the same municipality where *L. camara* samples were collected.

Phase 3. Propagation of Houseflies
A. Mating. Female houseflies were identified having compound eyes which are far apart and have flat forehead, while male houseflies have compound eyes that are near with each other.[8] Adult male and female houseflies were placed in a cage made of screen with one petri dish containing the food for houseflies. The houseflies were continuously fed until they mate and lay eggs.

B. Collection of Eggs. Eggs were collected from the food by immersing it wholly in water so that the eggs float on the surface of the water. Collected eggs were placed in a separate petri dish.

C. Growth of Eggs into Maggots. Some of the propagated eggs were allowed to stay into the food where they were allowed to grow into their maggot stage. Newly developed maggots that are whitish in appearance were separated from the food and placed in a separate petri dish. Some were allowed to develop into their pupa stage while others were separated and used in testing the insecticidal effects of the test plant.

D. Pupation. The collected maggots were allowed to develop into pupa. As soon as the maggots have developed into pupa form, they were transferred into petri dish.

E. Hatching of Adult Houseflies. The collected pupa were allowed to develop into adult form at room temperature. The developed houseflies were used for testing.

Phase 4. Preparation of the Crude Extracts from Leaves, Flowers, and Frits of Kantutay (*Lantana camara Linn.***)**

1. The leaves, flowers, and fruits of Kantutay (*Lantana camara Linn.*) were washed separately with tap water to ensure cleanliness and removal of any foreign materials.
2. Separately the plant parts were brayed with the use of mortar and pestle.
3. Extract the brayed plant part using sterilized cheesecloth and then pour the extract into a sterilized beaker.
4. Specific amount of 50-mL was obtained by the researcher for every extract marked as follows:
4.1 Formula I (FI) for leaves, Volume = 50-mL
4.2 Formula II (FII) for flowers, Volume = 50-mL
4.3 Formula III (FIII) for fruits, Volume = 50-mL
5. Testing the effectiveness of the prepared formulae were done using Peet-Grady Test.
6. Sterilization of laboratory materials was observed to keep the extracts free from any organisms and other contaminants.

Procedure for Testing the Insecticidal Effects of the Crude Extracts of the Leaves, Flowers and Fruits of Kantutay (*Lantana camara Linn.***) Against Houseflies (*Musca Domestica L.*):**

In testing for the toxic effects of thecrude extracts of the leaves, flowers and fruits of Kantutay (*Lantana camara Linn.*) on each developmental stage of the Houseflies, topical application was used as the standard entomological bio-assay.

A. Toxicity of Extracts on Eggs to Maggots. Thirty (30) eggs were placed in three petri dishes which were labeled as FI, FII, and FIII and they were replicated three times. The petri dishes contain a filter paper saturated with crude extract of varying concentration. The development of the eggs into maggots was constantly and carefully observed for 36 hours at twelve hours interval. The number of mortality, and maggot development were recorded.

B. Toxicity of Extracts on Maggots to Pupa. Following the above procedure, 30 maggots were used for this test. Mortality and pupa development were observed and recorded for 4 days at 24 hours interval.

C. Toxicity of Extracts on Pupa to Adults. Same procedure were used on the pupa. Mortality and adult development were observed and recorded for 60 hours at 12 hours interval.

D. Toxicity of Extracts on Adult Houseflies. The procedure on this part made used of the spray method using the Peet-Grady test. Thirty houseflies was observed in three cages. Mortality was observed and recorded fore 3 minutes at 30 seconds interval.

E. Test for Lethal Effects. The test for the lethal effects of the varying concentrations of the crude extracts was done by spray method using Peet-Grady test. In the process, three cages were prepared each containing 30 field-collected houseflies of different ages. Crude extracts in varying concentration of each plant were sprayed. Mortality was observed and recorded for 3 minutes at 30 seconds interval.

Statistical Analysis of Data

Two-way Analysis of Variance was the statistical tools utilized determine the mean difference of the effects of insecticides extracted from the leaves, flowers, and fruits of Kantutay (*Lantana camara Linn.*) as applied to different developmental stage of houseflies (*Musca domestica L.*).

RESULTS AND DISCUSSION

1. On the Chemical Constituents of the Leaves, Flowers and Fruits of Kantutay (*Lantana camara Linn***)**

Phytochemical composition of the *Lantana camara Linn.*has been extensively studied in last few decades. Different parts of L. camara are reported to possess essential oils, phenolic compounds, flavonoids, carbohydrates, proteins, alkaloids, glycosides, iridoid glycosides, phenyl ethanoid, oligosaccharides, quinine, saponins, steroids, triterpens, sesquiterpenoides and tannin as major phytochemical groups. [3][16,20] [19]These ethnomedical and scientific properties of *L. camara* represent it as a valuable plant and establishing it as a candidate for the future drug development.[17]

Lantana camara Linn. is one among the most toxic plants known so far, possibly within top ten. [13] Its high toxicity is due to lantadene, a toxin found naturally in it. The chemical is toxic to the liver of animals. Composition of *L. camara* essential oil which provided its insecticidal efficiency included large amounts of bioactivity of sesquiterpene hydrocarbons, mainly β-caryophyllene. [18]

2. Toxicity Effects of the Different Formulation of the Crude Extracts of Kantutay (*Lantana camara L.*) on the Different Developmental Stages of Houseflies (*Musca domestica L.*)

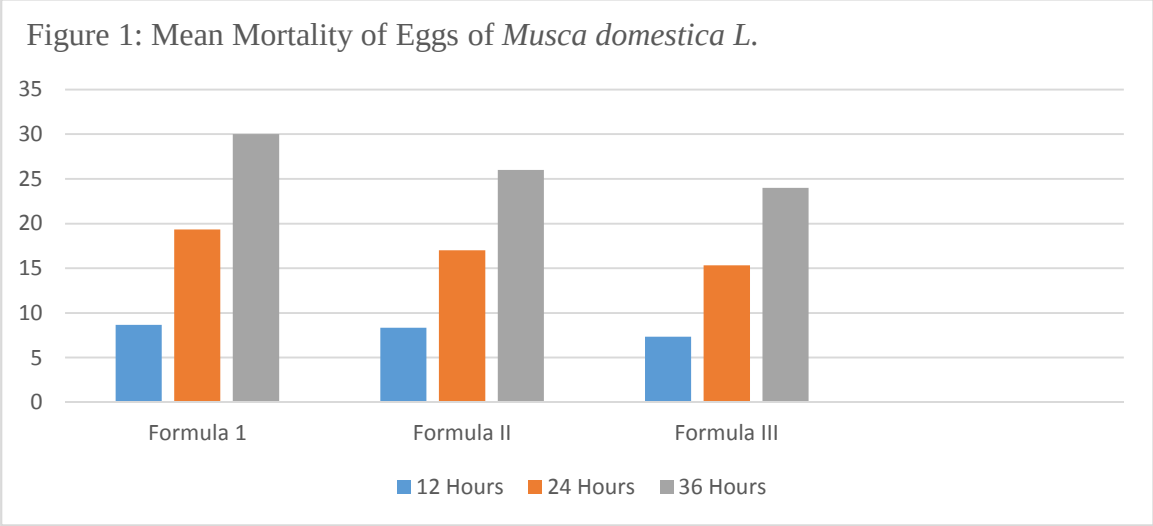
2.1 MortalityNumber of Eggs of Houseflies at Time Intervals of 12 hours After Application of Formulae I, II and III.

Three formulas were prepared to test the effectiveness in eradicating eggs of houseflies. The individual volumes were kept constant and they only differ in formulation. The leaves, flowers, and fruits of Kantutay (*Lantana camara L.*) were used in the preparation of the said formulas. Table 1 shows the mortality of the eggs of houseflies after the application of each of the three formulas on 30 bathes of eggs of houseflies. It should be noted that the eggs of houseflies developed into maggots after 36 hours.[8] This is based on the literature and was verified by observation of the researcher.

Table 1 Mortalityon the Number of Housefly Eggs Affected by the Extracts of Kantutay (*Lantana camara L.*) Leaves, Flowers, and Fruits 12, 24, and 36 Hours After Application (N=30 eggs)

Time Interval in Hours	Trials	Formula I (Leaves)	Formula II (Flowers)	Formula III (Fruits)
12	1	8	8	7
	2	9	8	7
	3	9	9	8
Mean Mortality		**8.67**	**8.33**	**7.33**
24	1	19	17	15
	2	20	17	15
	3	19	17	16
Mean Mortality		**19.33**	**17**	**15.33**
36	1	30	26	24
	2	30	26	24
	3	30	26	24
Mean Mortality		**30**	**26**	**24**

The mean mortality rates of the eggs of houseflies are shown on Table 1. Thirty-six hours after the application of the formulas, the mortality rate of Formula I was 100%. For Formula II, 26 (86.67%) out of 30 eggs died while the records for Formula III gave a mortality number of 24 eggs or 80% out of 30 tested samples.



The graph shown as Figure 1 shows the mean mortality rates of the eggs of houseflies (*Musca domestica L.*) after the application of the three formulas. As revealed in the graph, the eggs of *Musca domestica L.* did not develop into adult houseflies after 36 hours on Formula I, while on Formula II 4 eggs survive and turned into adult houseflies, and on Formula III six eggs became adult houseflies after 36 hours.

A two-way analysis of variance test statistically proved the performance difference of the effectiveness of the three formulas against eggs of *Musca domestica L.* Table 2 shows that the row means are equal, the columns are equal, and the interaction is zero.

Table 2 Summary Table of the Count, Sum, Average (Mean), and Variance of the Mortality on the Number of Eggs of *Musca domestica L.* 12,24, and 36 Hours After Application of the Leaves, Flowers, and Fruits of *Lantana camara Linn*

	Formula I	Formula II	Formula III	Total	
	12 Hours				
Count	3	3	3	9	
Sum	26	25	22	73	
Average	8.666667	8.33333	7.333333	8.111111	
Variance	0.333333	0.33333	0.333333	0.611111	
	24 Hours				
Count	3	3	3	9	
Sum	58	51	46	155	
Average	19.33333	17	15.33333	17.22222	
Variance	0.333333	0	0.333333	3.194444	
	36 Hours				
Count	3	3	3		
Sum	90	78	72		
Average	30	26	24	9	
Variance	0	0	0	240	
	Total			26.66667	
Count	9	9	9	7	
Sum	174	154	140		
Average	19.33333	17.11111	15.55556		
Variance	85.5	58.61111	52.27778		

Table 3 shows the Two-way ANOVA summary table on the effect of the application of the three formulas on the houseflies eggs after 12, 24 and 36 hours.

Table 3 Summary Table of a Two-way ANOVA on the Insecticidal Effect of *Lantana camara L.* Leaves, Flowers, and Fruits on Housefly Eggs of *Musca domestica L.*
12, 24, and 36 Hours After Application

Sources of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F-critical*
Rows	1549.556	2	774.7778	4183.8	9.67E-25	3.554561
Columns	64.88889	2	32.44444	175.2	1.59E-12	3.554561
Interactions	18.22222	4	4.555556	24.6	4.35E-07	2.927749
Wtihin	3.333333	18	0.185185			
Total	1636	26				

There are rows and column effects as well as interaction effect between rows and column. For the row effect, 12 hours was used as interval before observation have been made. After 12 hours, mortality rates continue to increase until the 36th hour where all the houseflies eggs were killed. For the main column effects, the three formulas were effective in eradicating the houseflies eggs in favor of the first formula. A t-test between the second and the third formula shows that the computed t-ratio was only 0.44 which is not within the critical t-value of 2.12. This implies that there is no significant difference between the means of the second and third formula. But Formula II and III significantly differ to Formula I as regards to toxicity on eggs of houseflies.

Table 4 Mortality on the Number of Housefly Maggots Affected by the Extracts of Kantutay (*Lantana camara L.*) Leaves, Flowers, and Fruits 24, 48, 72, and 96 Hours After Application
(N=30 Maggots)

Time Interval in Hours	Trials	Formula I (Leaves)	Formula II (Flowers)	Formula III (Fruits)
24	1	6	6	5
	2	7	6	5
	3	7	6	6
Mean Mortality		**6.67**	**6**	**5.33**
48	1	16	13	11
	2	14	13	12
	3	15	14	12
Mean Mortality		**15**	**13.33**	**11.67**
72	1	22	20	17
	2	22	20	18
	3	23	20	18
Mean Mortality		**22.33**	**20**	**17.67**
96	1	30	26	23
	2	30	27	23
	3	30	27	24
Mean Mortality		**30**	**26.67**	**23.33**

2.2 Mortality on the Number of Housefly Maggots Affected by Formulas I, II and III in 24, 48, 72, and 96 Hours After Application

The mortality number of maggots of houseflies after application of each of the three prepared formula on 30 bathes of maggots is shown on Table 4. It should be noted that the maggots of houseflies developed into adult after 96 hours.[8]

As shown on Table 4, after 96 hours of application of Formula I, all the adult houseflies were eradicated which provided a 100% mortality rate. The second and the third formula produced 16.67 and 23.33 mortality numbers, respectively.

Table 5Summary Table on the Count, Sum, Average (Mean), and Variance of the Mortality on Number ofHousefly Maggots 24, 48, 72 and 96 Hours After Application of the Three Formula Extracts of *Lantana camara L.*

	Formula I *24 Hours*	Formula II	Formula III	Total	
Count	3	3	3	9	
Sum	20	18	15	53	
Average	6.666667	6	5	5.888889	
Variance	0.333333	0	0	0.611111	
	48 Hours				
Count	3	3	3	9	
Sum	45	40	35	120	
Average	15	13.3333	11.6667	13.3333	
Variance	0	2.33333	1.333333	3	
	72 Hours				
Count	3	3	3	9	
Sum	58	60	53	180	
Average	22.33333	20	17.66667	20	
Variance	0.333333	1	0.333333	4.5	
	96 Hours				
Count	3	3	3		
Sum	90	80	70		
Average	30	26.6667	23.3333	9	
Variance	0	0.33333	2.33333	240	
	Total			26.66667	
Count	12	12	12	9	
Sum	222	198	173		
Average	18.5	16.5	14.41667		
Variance	81.7272	65	51.53788		

Table 5 shows that mean of rows can be seen at the fourth column under total while the column mean can be found at the bottom of the summary. For instance, under the 24 hours, the row mean is 5.89 with variance of 0.61; under 48 hours, row mean was 13.33 with variance equal to 3; under 72 hours, row mean was 20 with variance equal to 4.5; and under 96 hours, row mean was 26.67. Column mean under the first formula was 18.5 with variance equal to 81.73; column mean under the second formula was 16.5 with a variance of 65, and column mean under the third formula was 14.42 with a variance of 51.54

Table 6 Summary Table of a Two-way ANOVA on the Insecticidal Effect of the Leaves, Flowers, and Fruits of *Lantana camara Linn.* on Maggots of *Musca domestica L.* 24,48, 72, and 96 Hours After Application

Sources of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F-critical*
Rows	2144.083	3	714.6944	1029.16	1.78E-25	3.008786
Columns	100.0556	2	50.02778	72.04	7.18E-11	3.402832
Interactions	20.16667	6	3.361111	4.84	0.00228	2.508187
Wtihin	16.66667	24	0.694444			
Total	2280.972	35				

Looking at Table 6, there is a significant main effect due to rows as well as significant main effects due to columns. There is also interaction. The results show that time affected the mortality of maggots, i.e., the longer the elapsed time, the more maggots die. The column in the table refers to the formula used. The formula source or composition of the formula affected the mortality of maggots.

Table 7Mortality on the Number of Housefly Pupas Affected by the Extracts of Kantutay (*Lantana camara L.*) Leaves, Flowers, and Fruits 12, 24, 36, 48, and 60 Hours After Application (N=30 eggs)

Time Interval in Hours	Trials	Formula I (Leaves)	Formula II (Flowers)	Formula III (Fruits)
12	1	4	4	3
	2	5	4	4
	3	5	5	4
Mean Mortality		**4.67**	**4.33**	**3.67**
24	1	10	10	8
	2	10	10	9
	3	11	10	9
Mean Mortality		**10.33**	**10**	**8.67**
36	1	16	15	14
	2	17	15	14
	3	16	15	14
Mean Mortality		**16.67**	**15**	**14**
48	1	23	21	19
	2	24	21	20
	3	23	22	20
Mean Mortality		**23.33**	**21.33**	**19.67**
60	1	29	26	25
	2	30	27	26
	3	30	28	25
Mean Mortality		29.67	27	25.33

Table 7 shows the mortality on the number of Housefly pupas as affected by the three formulas of *Lantana camara L.* leaves, flowers, and fruits. Sixty hours after the application of the formula on 30 pupas of *Musca domestica L.*, Formula I has average mortality of 29.67 out of 30 or 98.9%. For Formula II, the average mortality was 27 out of 30 or 90% while for Formula III, 25.33 out of 30 or 84.43% was recorded.

Table 8 Summary Table of the Count, Sum, Average (Mean), and Variance of the Mortality on the Number of Pupas of *Musca domestica L.* 12, 24, 36, 48, and 60 Hours After Application of the Leaves, Flowers, and Fruits of *Lantana camara Linn*

	Formula I *12 Hours*	**Formula II**	**Formula III**	**Total**
Count	3	3	3	9
Sum	14	13	11	38
Average	4.666667	4.33333	3.66667	4.222222
Variance	0.333333	0.33333	0.33333	0.444444
	24 Hours			
Count	3	3	3	9
Sum	31	30	26	87
Average	10.33333	10	8.666667	9.666667
Variance	0.33333	0	0.333333	0.75
	36 Hours			
Count	3	3	3	9
Sum	50	45	42	137
Average	16.66667	15	14	15.2222
Variance	0.333333	0	0	1.4444
	48 Hours			
Count	3	3	3	
Sum	70	64	59	
Average	23.3333	21.3333	19.66667	
Variance	0.33333	0.33333	0.333333	9
	60 Hours			1930
Count	3	3	3	21.4444
Sum	89	81	76	2.77778
Average	29.66667	27	25.33333	
Variance	0.333333	0	0.333333	9
	Total			246
Count	15	15	15	27.3333
Sum	254	233	214	3.75
Average	16.93333	15.5333	14.26667	
Variance	85.35238	68.98095	63.49524	

The rows and column total are shown on Table 8. Under the 12 hours, the mean mortality was 4.22 with a variance of 0.44; under the 24 hours, the mean mortality was 9.67 with a variance of 0.75; under the 36 hours, the mean was 15.22 with a variance of 11.44; under the 48 hours, the mean mortality was 21.44 with a variance of 2.78; and finally under the 60 hours, the mean mortality was 27.73 with a variance of 3.75.

The column means mortality can be found at the bottom of the summary. The mean mortality for the first, second, and third formulae were 16.93, 15.53 and 14.27, respectively with variances of 85.35, 68.98, and 63.5, respectively. The row means and column means are not equal and there is interaction among rows and column. The results imply the rows represented by the time interval affected the number of pupa's mortality. The columns represented by the concentration of the three formulae affected the number of pupas' mortality in favor of the first formula. However, there were no significant differences among the three formulae. Lastly, there was interaction among the rows and columns.

Table 9 Summary Table of a Two-way ANOVA on the Insecticidal Effect of Leaves, Flowers, and Fruits of *Lantana camara Linn.* on Pupas of *Musca domestica L.* 12, 24, 36, 48, and 60 Hours After Application

Sources of Variation	*SS*	*Df*	*MS*	*F*	*P-value*	*F-critical*
Rows	3029.644	4	757.4111	3098.5	8.83E-39	2.689632
Columns	53.37778	2	26.68889	109.1818	1.7E-14	3.315833
Interactions	12.62222	8	1.577778	6.454545	6.94E-05	2.266162
Wtihin	7.333333	30	0.244444			
Total	3102.978	44				

Table 9 shows the Two-way ANOVA summary table on the effect of the application of the three formulas on the pupas of houseflies after 12, 24, 36, 48, and 60 hours of application.

All the three null hypotheses were rejected. There are rows and column effects as well as interaction effect between rows and columns. For the row effect, 12 hours was used as interval before observations have been made. After 12 hours, mortality rates continue to increase until the 60th hour where all the pupas are almost killed. For the main column effects, the three formulae were effective in eradicating the pupas in favor of the first formula.

3. Compared ToxicityEffects of the Leaves, Flowers and Fruits of Kantutay (*Lantana camara L.*) on Adult Houseflies (*Musca domestica L.)*

The toxicity effects of the three formulas representing the leaves, flowers and fruits of Kantutay (*Lantana camara L.*) on adult houseflies (*Musca domestica L.*) 30 seconds, 60 seconds, 90, 120, 150, and 180 seconds after application are shown on Table 10.

Table 10 Mortality on the Number of Adult Houseflies (*Musca domestica L.*) 30, 60, 90, 120, 150, and 180 seconds After Application of the Leaves, Flowers and Fruits Extracts of Kantuaty (*Lantana camara L.*)

Time Interval in Seconds	Trials	Formula I (Leaves)	Formula II (Flowers)	Formula III (Fruits)
30	1	10	4	4
	2	10	5	4
	3	10	4	4
Mean Mortality		**10**	**4.33**	**4**
60	1	20	8	8
	2	20	9	8
	3	20	8	8
Mean Mortality		**20**	**8.67**	**8**
90	1	30	13	12
	2	30	14	13
	3	30	13	13
Mean Mortality		**30**	**13.33**	**12.67**
120	1	0	17	13
	2	0	18	13
	3	0	17	12
Mean Mortality		**0**	**17.33**	**12.67**
150	1	0	22	21
	2	0	22	22
	3	0	22	21
Mean Mortality		**0**	**22**	**21.33**
180	1	0	25	25
	2	0	26	26
	3	0	26	26
Mean Mortality		**0**	**25.67**	**25.33**

It can be seen from Table 10 that 90 seconds after application of Formula I (leaves), all the adult houseflies were eradicated which gave a 100% mortality. The seconds and third formulas produced practically the same effects with 13.33 and 12.67 mortality means, respectively.

Table 11 Summary of the Mean Morality of Adult Houseflies (*Musca domestica L.*) 33, 60, 90, 120, 150, and 180 Seconds After Application of the Extracts of Leaves, Flowers, and Fruits of Kantutay (*Lantana camara L.*)

	Formula I	**Formula II**	**Formula III**	**Total**
	30 Seconds			
Count	3	3	3	9
Sum	30	13	12	55
Average	10	4.33333	4	6.111111
Variance	0	0.33333	0	8.611111
	60 Seconds			
Count	3	3	3	9
Sum	60	26	24	110
Average	20	8.66667	8	12.22222
Variance	0	0.33333	0	34.19444
	90 Seconds			
Count	3	3	3	9
Sum	90	40	38	168
Average	30	13.3333	12.66667	18.66667
Variance	0	0.33333	0.33333	72.5
	120 Seconds			
Count	3	3	3	
Sum	90	52	38	
Average	30	17.3333	12.66667	
Variance	0	0.33333	0.333333	9
	150 Seconds			90
Count	3	3	3	10
Sum	0	66	64	60.5
Average	0	22	21.33333	
Variance	0	0	0.333333	9
	180 Seconds			130
Count	3	3	3	14.4444
Sum	0	66	64	117.5278
Average	0	22	21.33333	
Variance	0	0	0.333333	9
	Total			153
Count	18	18	18	17
Sum	180	274	252	162.75
Average	10	15.2222	14	
Variance	141.1765	57.47712	56.94118	

The rows and column total are shown on Table 8. Under the 130 seconds, the mean mortality was 6.11 with a variance of 8.61; under the 60 seconds, the mean mortality was 12.22 with a variance of 34.19; under the 90 seconds, the mean was 18.67 with a variance of 72.5; under the 120 seconds, the mean mortality was 10.0 with a variance of 60.5; under the 150 seconds, the mean mortality was 14.44 with a variance of 117.52; and finally under the 180 seconds, the mean mortality was 17.03 with a variance of 162.75.

The column means mortality can be found at the bottom of the summary. The mean mortality for the first, second, and third formulae were 10.00, 15.22 and 14.0, respectively with variances of 141.17, 57.478, and 56.94, respectively.

The row means and column means are not equal and there is interaction among rows and column. The results imply the rows represented by the time interval affected the number of adult mortality. The columns represented by the concentration of the three formulae affected the number of adult mortality in favor of the first formula and the toxicity effects of the leaves is higher than the toxicities of flowers and fruits.

Table 12 Summary Table of a Two-way ANOVA on the Toxicity Effects of Leaves, Flowers, and Fruits of *Lantana camara Linn.* on Adult *Musca domestica L.* 30, 60, 90, 120, 150 and 180 Seconds After Application

Sources of Variation	*SS*	*Df*	*MS*	*F*	*P-value*	*F-critical*
Rows	965.037	5	193.0074	1158.044	1.09E-38	2.477165
Columns	268.5926	2	134.2963	805.7778	1.29E-30	3.259444
Interactions	3374.074	10	337.4074	2024.444	2.23E-46	2.106056
Wtihin	6	36	0.166667			
Total	4613.704	53				

All the null hypotheses were rejected. The row means are not comparable, the column means are not comparable, and there is no interaction between rows and columns. The result imply that the mortality means is affected by the time interval. That is, the longer the interval the greater the mortality. The column defined by the concentration of the three formulae also affected the mortality, and there is interaction between rows and columns.

CONCLUSION

1. Toxicity effect test on eggs of *Musca domestica L.* revealed that leaves extract (FI)of *L. camara* was the most effective, while fruits extract (FIII) gave the least toxicity effect.
2. When the extracts were applied to the maggots of *Musca domestica L.*, the crude extracts of leaves represented by FI gave the most lethal result as all maggots did not develop into larvae. Formula III (fruits extract) gave the highest number of developed larvae, so it was least effective.
3. Crude extract from fruits of *L. camara* (FIII) gave the highest number of developed pupa 96 hours after application while FI (leaves extract) obtained zero number on growth.
4. When the crude extracts of *L. camara* leaves, flowers, and fruits were applied to adult *Musca domestica L.* test species in a Peet-Grady Test, leaves extract showed 100% mortality 120 seconds after application while FII gave good result only after 180 seconds. The extract of fruits (FIII) gave the least number of mortality 180 seconds after application.
5. The two-way ANOVA results on the toxicity effects of the crude extracts of leaves, flowers, and fruits of *L. camara* on the eggs, maggots, and pupa of *Musca domestica L.* shows rows and column effects as well as interaction effect between rows and column. Two-way ANOVA statistically defined that the toxicity effects of Formula I (leaves extract) when compared to Formula II (flower extracts) and Formula III (fruit extracts) have significant difference in all the developmental stages of the test species. On the other hand, the lethal effects of Formula I and Formula II on all developmental stages of *Musca domestica L.* have no significant difference.

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