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Laboratory evaluation of *Moringa oleifera* and *Jatropha curcas* extracts on adult housefly (*Musca domestica* L.)

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Abstract
Synthetic insecticides are frequently used to manage disease vectors like houseflies, however, these chemicals are hazardous to human and animal health and not affordable to most people in rural areas. As a result, the demand for a substitute is pressing. The effectiveness of crude extracts of *Moringa oleifera* and *Jatropha curcas* as insecticides to control adult houseflies was examined in this study. This research was carried out at Ladoke Akintola University of Technology, Department of Crop and Environmental Protection Insectary, Nigeria. *M. oleifera* and *J. curcas* leaves were used to formulate the crude extracts while cypermethrin and water were used as positive and negative controls respectively. These plants had significant insecticidal control of adult houseflies. When applied through feeding, the studied crude insecticides did not exhibit the same level of efficacy as cypermethrin following a 24-hour exposure. Feeding toxicity experiments showed that the application of 10 g/ml of *M. oleifera* leaf had greater insecticidal activity than other application rates. The insect sprays, 1 g/ml and 5 g/ml of extract from *M. oleifera* leaves and 5 g/ml and 10 g/ml of *J. curcas* leaves, efficiently competed with cypermethrin after 24 hours of application. Throughout the experimental trials, the efficacy of each observed concentrations - 1 g/ml, 5 g/ml, and 10 g/ml- remained constant. Additionally, it was shown that applying the tested plant extracts by contact killed more quickly than other ways of application. In conclusion, controlling houseflies can be achieved through the use of crude plant extracts.

Introduction

One of the most prevalent insects, *Musca domestica* L., is closely related to food, utensils, and human habitations. Diseases including cholera, anthrax, the ORF virus, and many more are spread by them (1). Synthetic insecticides like organochlorines and organophosphates are used to prevent the spread of infections; more recently, pyrethroids and spinosad have been used to manage the housefly population (2). However, because of their persistence, these compounds have been shown to pose major environmental contamination problems and to be hazardous to both human and animal health (3). Therefore, a new, inexpensive, safe, and efficient

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bio-insecticide is needed to reduce housefly infestations, resulting in a healthier population and a stronger economy.

According to the literature, utilizing plant-based insecticides can effectively control houseflies instead of utilizing synthetic pesticides (4, 5). Plants are potential options for the management of insect pests due to their eco-toxicological properties, which include lesser toxicity to people, affordable, easy cultivation, and degradation, as well as reduced environmental effects (6).

Moringa oleifera is the predominant species of the monogeneric family *Moringaceae,* which is extensively grown and is indigenous to India, Arabia, and potentially Africa and the West Indies. The tree has been widely acclaimed for its exceptional nutritional and therapeutic properties. In their study, Ferreira et al. (7) documented the fatal effects of *Moringa* seed water extract on *Aedes aegypti* larvae. According to Prabhu et al. (8), *Moringa* has the ability to kill mosquito larvae and repel the malaria-carrying mosquito species, *Anopheles stephensi*.

Jatropha curcas, sometimes referred to as the physic nut, is indigenous to the tropical regions of the Americas. This plant is a tree that belongs to the *Euphorbiaceae* family. Tropical and sub-tropical regions worldwide are home to this plant, which can reach a height of 6 meters. Studies have shown that organic solvents derived from seeds, oil, and vegetative portions have insecticidal, larvicidal, repellant, anti-oviposition, and ovicidal actions on insects (9, 10).

Studies have shown that crude plant extracts can be used to control houseflies (4, 11). Therefore, the objective of this research was to evaluate the insecticidal potential of *M. oleifera* and *J. curcas* leaf extracts against houseflies and determine the most effective concentrations of these plants against *M. domestica* adults.

Materials and Methods

Experimental Site

The research was carried out at the Department of Crop and Environmental Protection Insectary, Ladoke Akintola University of Technology (LAUTECH), Ogbomoso, Oyo State, Nigeria. The temperature of the insectarium used ranges from 26 ºC – 28 ºC. Ogbomoso is located on the 8°101 North of the equator and 4°101 East of the Greenwich meridian.

Experimental design

Three modes of application (i.e. contact, feeding, and fumigant) were used. The treatments were arranged in a Completely Randomized Design (CRD) and were replicated three (3) times. Adult houseflies collected in insect-holding boxes were taken out and introduced into the designated plastic containers (5 insects per container), after which the treatments were introduced.

The following treatments were tested: The crude treatments were extracted and formulated in the institution's biology laboratory. The treatments include; *J. curcas* leaf, *M. oleifera* leaf, cypermethrin (as positive control), and Water (as negative control). The mortality rate for each treatment was taken after 30 minutes, 2, 4, 6, 8, and 24 hours.

Insects' collection

Adult house flies were attracted to the insect wooden cage with meats in a popular abattoir in Ogbomoso between October and November 2022. They were fed with meats and sugary substances mixed with water. The houseflies were allowed to acclimatize to their new environment for a week before the commencement of the experiment. Healthy adult houseflies were picked from the insect box irrespective of gender and used for the study.

Plants' collection and identification

We gathered the leaves of *M. oleifera* and *J. curcas* from the premises of LAUTECH in Nigeria during the rainy season, which runs from April to October. We then transported the plants to the botany section of the Department of Pure and Applied Biology for identification.

Preparation of plant extracts

The leaves of *J. curcas* and *M. oleifera* were air-dried for seven days and each of the plant material was crushed separately with mortar and pestle. One, five, and ten grams of the crushed plant materials were weighed separately with a sensitive scale and were dissolved in 1000 ml of water, and 0.2 g of salt and black soap were added into the solution as adjuvants. The soaked materials were allowed to stay overnight. The filtration was done with muslin cloth and the filtrates collected were stored in a 5-litre plastic keg as stock solution (12), and 10 ml of each concentrate were applied.

Entomological bioassays

Contact toxicity

The experiment was performed at 7 am. Each container was labelled with the corresponding treatment names *Jatropha* leaf, *Moringa* leaf, Cypermethrin, and control. Each solution was applied in three concentrations; 1, 5, and 10 g/ml, directly on the houseflies to the designated plastic containers.

Fumigant toxicity

Cotton wool weighing 1g each was impregnated with three different concentrations: 1, 5, and 10 g/ml. The impregnated wool was then gently placed in designated plastic container.

Feeding toxicity

Separately, cattle meat each of 0.5 g was soaked in each treatment for 5 minutes. The treated meat was introduced into the respective plastic containers.

Statistical analysis

Data were subjected to analysis of variance (ANOVA) and means were separated using Least Significant Difference (LSD) at 5% probability using statistical analysis system (SAS) 2002 v2.0.

Results

Feeding toxicity

There was a significant difference among the treatments. After 30 minutes of exposure, 90% mortality of adult houseflies was recorded in the houseflies treated with cypermethrin. However, low-to-no mortality was observed from the plants' extracts at the same time of exposure. The tested insecticides did not show the same efficacy level as cypermethrin after 24 hours of exposure (Table 1). Additionally, there was no significant difference among the tested rates of application.

Fumigant toxicity

After 30 minutes of exposure, there was no significant difference among the tested treatments in the control groups. However, after 24 hours of exposure, *Moringa* leaf at 10 g/ml had higher insecticidal efficacy than other rates of application. Meanwhile, all the measured rates (i.e. 1, 5, and 10 g/ml) had the same efficacy throughout the experimental trials (Table 2).

Contact toxicity

There was a significant difference among the treatments after 30 minutes of exposure. After 24 hours of exposure, *Moringa* leaf extract at 1 g/ml and 5 g/ml and *Jatropha* leaf at 5 g/ml and 10 g/ml competed effectively with cypermethrin. All the measured rates had the same efficacy throughout the experimental trials (Table 3).

Discussion

Using synthetic pesticides, such as carbamates, organophosphate, organochlorine, synthetic pyrethroids, and insect growth regulators, is a typical strategy for controlling houseflies (13). Meanwhile, it has been documented that all of these synthetic pesticides lead to environmental risks, insect pest resistance, and housefly resurgences (14). Moreover, high exchange rates have made these synthetic pesticides unavailable in a critical niche (15). Therefore, a less expensive and safer method of housefly management is required. This is what prompted this investigation.

Table 1. Effects of feeding toxicity of insecticides on houseflies

Insecticides	Rates (g/ml)	Hours of exposure					
		30 minutes	2 Hours	4 hours	6 hours	8 hours	24 hours
Cypermethrin		90.0^{a}	90.0^{a}	90.0^{a}	90.0^{a}	100^{a}	100^{a}
Control		0.00^{c}	0.00^{d}	0.00^{d}	0.00^{d}	0.00^{c}	0.00^{c}
Moringa leaf	1	0.00^{c}	10.0^{cd}	10.0^{cd}	25.0^{bc}	30.0^{b}	85.0^{ab}
	5	0.00^{c}	0.00^{d}	0.00^{d}	20.0^{c}	25.0^{b}	80.0^{b}
	10	5.00^{bc}	10.0cd	10.0^{cd}	20.0^{c}	35.0^{b}	90.0^{ab}
Jatropha leaf	1	10.0^{bc}	15.0^{bcd}	15^{cd}	35.0^{bc}	35.0^{b}	90.0^{ab}
	5	15.0^{b}	20.0^{bc}	20.0^{c}	40.0^{b}	40.0^{b}	90.0^{ab}
	10	15.0^{ab}	30.0^{b}	40.0^{b}	40.0^{b}	40.0^{b}	95.0^{ab}
Rates	1	25.0^{a}	28.8^{a}	28.8^{a}	37.5^{a}	41.3^{a}	68.8^{a}
	5	26.3^{a}	27.5^{a}	27.5^{a}	37.5^{a}	41.3^{a}	67.5^{a}
	10	27.5^{a}	32.5^{a}	35.0^{a}	37.5^{a}	43.8^{a}	71.3^{a}

Means with the same superscripts are not significantly different at 5% probability

Table 2. Effects of fumigant toxicity of insecticides on houseflies

Insecticides	Rates (g/ml)	Hours of exposure					
		30 minutes	2 hours	4 hours	6 hours	8 hours	24 hours
Cypermethrin		30.0^{a}	40.0^{a}	45.0^{a}	95.0^{a}	100^{a}	100^{a}
Control		0.00^{a}	0.00^{a}	0.00^{b}	0.00^{c}	0.00^{c}	45.0^{d}
Moringa leaf	1	0.00^{a}	0.00^{a}	0.00^{c}	0.00^{c}	0.00^{d}	70.0^{bcd}
	5	0.00^{a}	0.00^{a}	0.00^{b}	5.00^{bc}	5.00^{d}	80.0^{abc}
	10	0.00^{a}	0.00^{a}	0.00^{b}	0.00^{c}	20.0^{bc}	95.0^{ab}
Jatropha leaf	1	5.0^{a}	5.0^{a}	5.0^{a}	10.0^{bc}	10.0^{cd}	80.0^{abc}
	5	0.00^{a}	0.00^{a}	0.00^{b}	0.00^{c}	5.0^{d}	65.0^{bcd}
	10	0.00^{a}	0.00^{b}	0.00^{b}	15.0^{b}	25.0^{b}	85.0^{abc}
Rates	1	8.8^{a}	11.3^{a}	12.5^{a}	26.3^{a}	27.5^{a}	73.8^{a}
	5	7.5^{a}	10.0^{a}	11.3^{a}	25^{a}	27.5^{a}	72.5^{a}
	10	7.5^{a}	10.0^{a}	11.3^{a}	27.5^{a}	36.3^{a}	81.3^{a}

Means with the same superscripts are not significantly different at 5% probability

Table 3: Effects of contact toxicity of insecticides on houseflies

Insecticides	Rates (g/ml)	Hours of exposure					
		30 minutes	2 hours	4 hours	6 hours	8 hours	24 hours
Cypermethrin		100^{a}	100^{a}	100^{a}	100^{a}	100^{a}	100^{a}
Control		0.00^{d}	0.00^{d}	0.00^{d}	0.00^{e}	0.00^{e}	0.00^{c}
Moringa leaf	1	25.0^{bc}	40.0^{bc}	40.0^{bc}	50.0^{cd}	60.0^{cd}	100.0^{a}
	5	35.0^{b}	50.0^{b}	55.0^{b}	60.0^{bc}	65.0^{bc}	100.0^{a}
	10	35.0^{a}	40.0^{bc}	50.0^{bc}	55.0^{bcd}	65.0^{bc}	90.0^{b}
Jatropha leaf	1	15.0^{cd}	25.0^{abcd}	25.0^{bc}	30.0^{bc}	30.0^{d}	90.0^{b}
	5	5.0^{d}	20.0^{cd}	35.0^{bc}	55.0^{bcd}	65.0^{dbc}	100.0^{a}
	10	10.0^{a}	35.0^{bc}	60.0^{b}	80.0^{ab}	90.0^{ab}	100.0^{a}
Rates	1	35.0^{a}	41.3^{a}	41.3^{a}	45a	48.8^{a}	72.5^{a}
	5	35.0^{a}	42.5^{a}	47.5^{a}	53.8^{a}	57.5^{a}	75.0^{a}
	10	36.3^{a}	47.8^{a}	52.5^{a}	58.8^{a}	63.8^{a}	72.5^{a}

Means with the same superscripts are not significantly different at 5% probability

When compared to untreated houseflies, this experiment unequivocally demonstrated that the extracts of *M. oleifera* and *J. curcas* exhibited insecticidal control over adult houseflies. This finding is consistent with past studies showing that *M. oleifera* killed *Trogoderma granarium* (16). Furthermore, *J. curcas* extracts have been shown to have insecticidal effects on housefly larvae by Chauhan et al. (17).

The efficiency of the studied plant extract improves with exposure hours (Table 1–3); this finding is in contrast to what was shown when houseflies treated with cypermethrin were exposed for 30 minutes, killing about 70% of them. This implies that the plant extracts had a delayed effect on the tested insects. This is consistent with the previous finding by Alao et al. (18), who noted that plant extracts have a gradual insecticidal effect.

The findings indicated that the plant extracts' efficacy was independent of application rate. This finding is in contrast to earlier research by Seljasen and Meadow (19), who found that the dosage at which a plant extract is effective against insect pests was a determining factor. Moreover, *M. oleifera* and *Tephrosia vogelii* extracts were found to be efficient in controlling field insect pests of watermelon in a dose-dependent manner (12). According to our observations, adult houseflies can be treated with the tested plant extract at concentrations of 1, 5, or 10 g/ml.

The study revealed that the plant extract, when applied by direct contact, demonstrated higher efficacy in killing the targeted insect compared to other application techniques. Notably, the insecticides used as fumigants showed the least harmful effect. The plant extract might be able to block the acetylcholinesterase enzyme in the bodies of flies, which could potentially lead to the structural deformations in the houseflies' DNA (20). However, our study's limitation is that we did not conduct a molecular test on the tested insects.

Conclusions

These findings showed that the two tested plant extracts had the same level of insecticidal control over the examined insect. Except for *Moringa* leaf extract at 1 and 5 g/ml and *Jatropha* leaf when applied at 5 and 10 g/ml through contact, the efficiency of *M. oleifera* and *J. curcas* leaf extracts against adult houseflies is generally not affected by the rate of administration. Additionally, it was shown that applying the tested plant extract by contact killed it more quickly than applying it in another way. Consequently, adult houseflies can be controlled by *M. oleifera* and *J. curcas*, especially when treated through contact. This observation will encourage our poor rural resource people on the use of plant extracts to control this insect-born disease vector and prevent them from constant exposure to hazardous chemical sprays.

Acknowledgments

Not applicable.

Conflict of interests

There are no conflicts of interest.

Ethical approval

Not applicable.

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