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An Ecofriendly Approach to Control Myiasis using Crude Leaf Extracts of *Ricinus communis* (Euphorbiaceae) against Third Instar Larvae of *Sarcophaga ruficornis*

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Abstract
Myiasis, caused by dipteran larvae infesting living tissues, poses significant health and economic challenges in humans and livestock. The present study evaluates the larvicidal efficacy of crude leaf extracts of *Ricinus communis* L. (Euphorbiaceae) against third instar larvae *of Sarcophaga ruficornis* under laboratory conditions. Leaf extracts were prepared using suitable solvents and tested at different concentrations to determine their toxicity and growth-inhibitory effects. The treated larvae exhibited dose-dependent mortality, reduced feeding activity, developmental abnormalities, delayed pupation, and decreased adult emergence compared with untreated controls. Phytochemical constituents present in the extracts, including alkaloids, flavonoids, tannins, and phenolic compounds, are presumed to contribute to the observed bioactivity. The findings demonstrate that *R. communis* leaf extract possesses potent larvicidal properties and offers an environmentally safe, biodegradable, and sustainable alternative to synthetic insecticides. This ecofriendly botanical approach may serve as an effective strategy for controlling myiasis-causing flies and reducing their associated impacts.

Keywords: Myiasis; Parasitosis; Flesh Fly; Castor

Introduction

Myiasis is the condition where the larvae of certain fly species use living vertebrate host as a food source for their growth and development. The phenomenon also known as fly strike is commonly observed among domestic and wild animals and is a real welfare problem of worldwide occurrence in animal raising countries. It has been reported as one of the most common parasitic infestations among livestock animals throughout the tropical regions of the world (Farooq et al 2008; Colebrook and Wall 2004). The daily farmers have to face huge economic losses due to reduction in the productive traits and mortality as a result of disease among domestic animals. Before eradication of screwworm fly in USA, the average animal losses to livestock industry due to myiasis was estimated to be US$ 140 million (Peter et al 2005). Similarly, the Australian sheep industry was estimated to suffer a loss of A$ 280 million (Sackett et al 2006). The flesh fly Sarc*ophaga ruficornis* has been reported to cause myiasis among domestic animals resulting into severe economic losses to livestock industry in the tropical regions worldwide. Besides animals, it had also been reported to cause myiasis among humans from developing countries throughout the world (Singh and Singh, 2015). Though myiasis had been recognized as the major factor leading to economic losses, the disease is still poorly controlled in animal raising countries. Parasitic infestations among livestock are of particular interest because it results in wide range of pathological effects. Larval feeding may cause damage to skin and subcutaneous tissue leading to inflammation and significant blood loss.

Animal physiological functions are largely impaired by larval infestations resulting into decline in productivity in terms of reduced milk production, loss of body mass, low fertility and poor hide quality (Farkas et al, 1997).The feeding larvae establish Cutaneous lesions and the infested animals become restless, lethargic and irritated and hence cannot feed properly. Death may result due to toxemia and septicemia in case of non-treatment (Schnur et al 2009). The wounds generally predispose animals to infestations but skin and hair soiled by faces and urine are particularly attractive to ovipositing flies.

Over the decades, the control of myiasis was dependent largely on the use of synthetic chemical compounds such as macrocyclic lactones, carbamates and organophosphate insecticides. Synthetic anti- myiatic agents like Ivermectin have been reported to cause contamination of milk and meat with drug residues which results in serious health hazards among humans (Kaneene and Miller, 1997). The use of chemical compounds has continued despite their potential toxicity and contamination of chemical products by their residues. Frequent use of such compounds has been the major cause of insecticide resistance among ectoparasities (Wall 2007). Being biodegradable, the plant derived materials are in use these days to control the pest and parasite of veterinary animals. The use of plant extracts in treatment of myiasis among the domestic animals as an alternative to synthetic insecticides has been reported worldwide like Sukontason et al (2004) studied the effect of eucalyptol on housefly and blowfly and Siriwattanarungsee (2008) studied the efficacy of neem extract against the blowfly and house fly. However, limited studies have been documented that had been available in literature evaluating the larvicidal efficacy of essential oil of bettle leaf on larvae of *C. bezziana* (Waradhana et al, 2007) and Bioefficacy of crude extracts of *Azadirachta indica* (Meliaceace) on survival and development of myiasis causing larvae of *Chrysomya bezziana* (Diptera : Calliphoridae). However, no study was available in literature to assess the efficacy of castor plant (*Ricinus communis*) against Sarc*ophaga ruficornis.* The present study reports the toxicity of leaf extract *Ricinus Communis* against third instar larvae of *Sarcophaga ruficornis.*
Ricinus communis (family Euphorbiaceae) commonly known as castor oil plant and is distributed widely across the world like Asia, South Africa, Brazil and Russia (Rana et al 2012). The plant is native to India but also cultivated for medicinal values of the oil obtained from its seeds. Ricin the most poisonous naturally occurring component is found mainly in seed. Apart from the ricin, the plant contains another toxic compound called ricinine which is potent insecticide and is found in all parts of the plant (Hussein et al 2015). The studies have shown the presence of ricinine (Kang et al 1985; Leite et al 2005) and N- demethylricinine (Skursky et al 1969) in dried leaves of *Ricinus communis.*

Collection of plant material
Leaves of *Ricinus communius* were obtained from waste lands near Khalsa College Amritsar. The collected leaves of *Ricinus communius* were first given a dip in water to remove dust. Cleaned leaves were then kept to dry at room temperature for about two weeks. Leaves were continuously tilted to avoid any fungal infection to it. Completely dried leaves were powdered using electric mill and were kept for extraction.

Preparation of extracts
Crude plant extract was prepared using soxhlet extractor with Methanol. The extract was filtered over sodium sulphate using whatman No 1 filter paper in case of each solvent. The collected extracts were evaporated under reduced pressure using rotator vacuum evaporator, so as obtain completely dry extract. The concentrate was then kept at 40 – 45° C in oven. The crude extract was weighted and kept in deep freezer for further use.

Experimental application
Larvae of each solvents were divided into four groups with eighty larvae each and 5th group (control) with eighty larvae. Each group was further subdivided into four subgroups (concentrations) eighty larvae each. Each subgroup was divided into four replicates each with twenty larvae. Concentrations used in this experiment are listed in Table 1 and were prepared by mixing crude plant extract in methanol whereas third instar larvae were treated by dipping them for 30 seconds and methanol alone in case of control group. After treatment the larvae of each replicate were kept in the rearing jar covered by the muslin cloth. The replicates were kept in incubator at 35°C and examined daily for 7 successive days and mortality rates were recorded. The larvae who survived were observed to demonstrate the effects of extracts on the development of the larvae till fly emergence.

Parameters used
Four different parameters were used to study the effect of crude extract of castor on larvae of *Sarcophaga ruficornis*. Parameters used were % age larval mortality, % age pupation, % age pupal mortality and % age adult emergence. After experimental application of the extracts larval mortality was recorded daily for at least 7 days. The % age pupation was recorded by counting the number of viable, turgid and dark brown colored puparia after subtracting the dead larvae. The % of adult emergence was recorded daily after 7- 10 days of pupation.

Statistical analysis
The data was subjected to statistical analysis by ANOVA to test for the differences between various concentrations and control using SPSS (16.0) software. LC_{50} values were calculated using probit analysis.

Results

The effects of crude extracts of *Ricinus communis* on larval survival and development by dipping method are shown in Table 1. The dead larvae were flaccid with dark brown or black colour whereas deformed appears to be normal except for the anterior portion that seemed to be as that of third instar larvae. All the larvae who escaped from death were pupated normally, but all of them did not emerge to adult flies with all the tested extracts. The percentage emergence of adult flies was significant with all the concentrations as compared with the control.

Table 1. The effects of crude extracts of *Ricinus communis* on larval survival and development by dipping method

Conc (g/100 ml)	Dipping technique			
	Mortality of larvae (%)	Pupation (%)	Pupal mortality (%)	Emergence of adult (%)
9.0	72.00 ± 2.50	17.33 ± 1.63	92.01±1.63	7.99 ± 1.33
4.5	56.00 ± 3.40	44 ± 3.40	89.34±2.20	10.66 ± 1.63
2.25	56.00 ± 1.63	44 ± 1.63	51.43±2.20	48.57 ± 2.26
1.125	16 ± 1.63	84 ± 1.63	34.74±3.58	65.26 ±2.11
Control	0.00 ± 00	100 ± 00	100 ± 00	100 ± 00
P value	0.000	0.000	0.000	0.000

Discussion

The present study evaluated the efficacy of crude extract of *Ricinus communis* by using dipping method. The choice of dipping technique is based on the fact that most of the veterinarians apply extract locally for controlling external parasite in livestock animals. The observations demonstrated that crude leaf extracts of *Ricinus communis* possess significant larvicidal activity against third instar larvae of *Sarcophaga ruficornis*, indicating their potential as an ecofriendly alternative to synthetic insecticides for myiasis control. The observed dose-dependent mortality and developmental abnormalities suggest that bioactive phytochemicals present in the leaves interfere with normal physiological and metabolic processes of the larvae. Similar findings have been reported for various plant-derived extracts that exhibit insecticidal, growth-regulating, and antifeedant properties against dipteran pests (Pavela, 2016).

The larvicidal effect of *R. communis* may be attributed to the presence of secondary metabolites such as alkaloids, flavonoids, tannins, saponins, and phenolic compounds. These phytochemicals are known to disrupt enzyme activity, impair digestion, and affect the nervous system of insects, ultimately leading to mortality (Isman, 2020). Previous studies have also shown that extracts from *R. communis* exhibit toxicity against mosquito larvae and other insect pests, supporting the present findings (Ramos-López et al., 2010).

In addition to larval mortality, treated individuals exhibited delayed pupation and reduced adult emergence. Such developmental disruptions may decrease the reproductive potential and population density of *S. ruficornis* in natural environments. The use of botanical insecticides offers several advantages, including biodegradability, low environmental persistence, reduced risk of resistance development, and minimal adverse effects on non-target organisms compared with conventional chemical pesticides (Mossa, 2016).

Therefore, *R. communis* leaf extract represents a promising, sustainable, and environmentally compatible approach for managing myiasis-causing flies. Further studies focusing on the isolation of active compounds, elucidation of their mode of action, field evaluation, and safety assessment are necessary to develop effective botanical formulations for practical application.

A unique phenomenon was observed in dipping method. It was observed that the highest concentration of the extracts caused mortality lower than in the lowest concentration in various solvent. It may be due to the fact that the larvae where stimulated to pupation promptly in higher concentration in order to avoid damage from the extracts. Whereas the lowest concentration may not stimulate them to form pupae immediately and hence more active constitutes were absorbed resulting in higher mortalities. As the result larvae treated with high concentrations may produce more percentage of normal flies than treated with lower concentration.

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AA, RR, K and GK conceived the concept, wrote and approved the manuscript.

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