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Potent insecticidal activity of fruits and leaves of *Capsicum frutescens* (L.) var. *longa* (Solanaceae)

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Abstract

Capsicum frutescens (L.) var. longum (Solanaceae) is a well used tropical and subtropical medicinal plant. The present study was undertaken to investigate insecticidal activity of different concentrations of methanol extract of fruits and leaves of C. frutescens against 2nd and 3rd instar larvae of Aedes aegypti. The mortality of the larvae was found to be concentration dependent. Among larvae, 2nd instar larvae were shown to be more sensitive than 3rd instar larvae. The fruit extract has shown more killing effect than leaf extract. Preliminary phytochemical analysis showed the presence of tannins, alkaloids, steroids and glycosides in both extracts. The larvicidal activity of methanol extract may be attributed to the presence of phytoconstituents. This is the first report on the insecticidal potential of C. frutescens. Further studies on isolation of active compounds, mechanism of action, toxicity and field trials are under investigation.

Key words: *Capsicum frutescens*, Phytochemical analysis, *Aedes aegypti*, Larval mortality

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INTRODUCTION

Capsicum frutescens (L.) var. *longum* (Solanaceae) is a well used tropical and subtropical medicinal plant. It is known as Bird chilli in English, Kutaviraa in Ayurveda and Surkh mirch in Unani. It is cultivated as a condiment crop. It is more woody and taller with small pod like berries and innumerable small flat seeds. The crimson or orange red fruits are elongate conical some what flattened and very pungent. The pungent principles are present in the flesh rind and seeds as well. It acts as stimulant, accelerates oxygenation of cells, encourages adrenal glands to produce corticosteroids, and increases gastrointestinal secretion. It is also carminative, antispasmodic and antiseptic. It is applied externally, in painful muscle spasms in areas of shoulder, arm and spine; for treating arthritis, rheumatism, neuralgia, lumbago and chilbains. The British Pharmacopoeia reported rubefacient and vasostimulant action. The plant contains

hydroxybenzoic acid, hydroxycinnamic acid and ascorbic acid. Fruits contain up to 1% of capsaicin **[1,2]**.

Mosquitoes are the most important single group of insects in terms of public health importance, which transmit a number of diseases, such as malaria, filariasis, dengue, Japanese encephalitis, etc. causing millions of deaths every year. Natural products of plant origin with insecticidal properties have been tried in the recent past for control of variety of insect pests and vectors **[3]**. Phytochemicals derived from plant sources can act as larvicide, insect growth regulators, repellent and ovipositor attractant and have different activities observed by many researchers **[4-6]**. However, insecticides of plant origin have been extensively used on agricultural pests and to a very limited extent, against insect vectors of public health importance. *Aedes aegypti* is the primary vector of dengue fever, dengue haemorragic fever, dengue shock syndrome and chikungunya. It has adapted its biological behavior to the human environment, making use of the water that collects in discarded plastic containers and used tires as breeding sites where the mosquito oviposits. From the egg to the adult there are four larval instars and one pupal stage **[7]**. The literature survey revealed no information on insecticidal potential of *C. frutescens*. The objective of this paper is to screen methanol extract of *C. frutescens* fruit and leaf for potential insecticidal activity in terms of larvicidal effect against 2nd and 3rd instar larvae of *A. aegypti*.

MATERIALS AND METHODS

Collection and Identification

The plant material was collected during April 2010 from Hosanagara Taluk of Shivamogga district, Karnataka, India. The plant sample was identified by Dr. K.G Bhat, MGM College, Udupi, Karnataka. A voucher specimen (Voucher No: KU/AB/KA-2036) was deposited in the University herbaria, PG department of Studies and Research in Applied Botany, Shankaraghatta-577451 for future reference.

Chemicals

Methanol (HiMedia, Mumbai), Dimethyl sufloxide (S.D Fine Chemicals, Mumbai).

Extraction and Phytochemical Analysis

The leaves and fruits were separated, washed 2-3 times with tap water and once with sterile water, shade dried and powdered. For extraction, a known amount of powder (100gm) was subjected to soxhlet extraction and exhaustively extracted with methanol for about 48 hours. The extract was filtered, concentrated in vacuum under reduced pressure using rotary flash evaporator and dried. The extract was subjected to phytochemical screening to detect the presence of secondary metabolites **[8,9]**.

Preparation of extract

For screening insecticidal activity, the concentrated methanol extract of fruit and leaf were dissolved in 10% Dimethyl sulfoxide (DMSO) to get concentrations 10, 25, 50 and 100 mg/ml.

Screening for Insecticidal activity

The insecticidal efficacy of methanol extract of *C. frutescens* fruit and leaf was determined against second and third instar larvae of *Aedes aegypti*. The larvae were collected from stagnant water and identified in University of Agricultural Sciences, Shivamogga by an Entomologist. Twenty larvae were placed separately into beakers containing different concentrations of methanol extracts. A beaker containing 10% DMSO (without extract) serves as control. The larvicidal effect of the extracts was determined by counting the number of dead larvae after 24

hours and the observation was continued for two more days. Dead larvae were identified when they failed to move after probing with a needle in siphon or cervical region. The test was repeated thrice and the percentage of larval mortality for each concentration of extract was calculated **[10]**.

RESULTS AND DISCUSSION

Table-1: Phytoconstituents detected in methanol extracts of *C. frutescens*

Phytoconstituent	Fruit extract	Leaf extract
Tannins	+	+
Terpenoids	-	-
Alkaloids	+	+
Steroids	+	+
Saponins	-	+
Flavonoids	-	-
Glycosides	+	+

'+' Detected; '-' Not detected

Preliminary phytochemical analysis showed the presence of tannins, alkaloids, steroids and glycosides in both leaf and fruit extracts. In addition to these, saponins were detected in leaf extract (Table-1).

Table-1: Insecticidal activity of different concentrations of methanol extract of *C. frutescens*

Conc (mg/ml)	Mortality of larvae (%) at different intervals of time							
	II instar larvae				III instar larvae			
	24 h		48 h		24 h		48 h	
	LE	FE	LE	FE	LE	FE	LE	FE
0	-	-	-	-	-	-	-	-
10	-	81±0.5	-	98.6±0.76	-	54.6±0.76	-	61.6±1.04
25	61±0.5	99.6±0.28	75.6±0.28	99.3±0.57	-	61.3±0.76	40±0.0	68.6±0.76
50	72.3±1.04	99.3±0.57	85±0.0	98.6±1.15	25±0.5	75±0.0	55±0.0	89.6±0.76
100	92±0.86	99±0.5	99.3±0.28	99±0.5	41.3±0.57	91.6±1.04	66±0.5	99.6±0.28

LE – Leaf extract; FE - Fruit extract; Results are mean ±SE; '-' No mortality

The insecticidal efficacy of different concentrations of methanol extract of *C. frutescens* leaf and fruit was evaluated against 2nd and 4th instar larvae of *A. aegypti*. The percent mortality of the larvae was found to be concentration dependent. Among larvae, 2nd instar larvae were shown to be more sensitive than 4th instar larvae. The fruit extract has shown more killing effect than leaf extract. Over 50% mortality of 2nd and 4th instar larvae was observed in all the concentrations of fruit extract tested in 24 hours. The mortality of 2nd instar larvae was recorded as 100% at concentration 25mg/ml and higher in 24 hours whereas at 10mg/ml concentration, 100% mortality was observed on 2nd day. In case of 4th instar larvae, 100% mortality was observed on 2nd day at concentration 100mg/ml. In case of leaf extract, complete mortality of 2nd instar larvae was observed at 100mg/ml concentration on 2nd day. At the end of 48 hours, the mortality of 3rd instar larvae by leaf extract was found to be 65%. Leaf extract concentration 10mg/ml did not caused mortality of both the larval stages. It is evident from the results of the study that the

extracts are more effective against early larval stages. There was no mortality of larvae in control beakers i.e., beakers containing no extracts (Table-2).

Chilies are high in vitamin A and C, but low in calories and sodium. Chilies contain potassium, magnesium and folic acid. But capsaicinoids are responsible for the pungency and are considered as active compounds in chilies. Capsaicin accounts for about 50 to 70% of the total capsaicinoids. Other bite-contributing components are dihydrocapsaicin, nordihydrocapsaicin, homocapsaicin and homodihydrocapsaicin. Chilies have been recognized by many cultures around the world for their medicinal qualities. When chilies are eaten, capsaisin stimulates the release of endorphins, which give a pleasurable feeling. Moreover, chilies are believed to increase circulation, relieve rheumatic pain, treat mouth sores and infected wounds, reduce blood clots and aid digestion by stimulating saliva and gastric juice flow. Capsaicin has been tested by many investigators for its effects on experimental carcinogenesis and mutagenesis. There is no solid evidence showing that chili and capsaicin are carcinogenic in humans. In contrast, many studies reveal substantial antioxidant, antigenotoxic and anticarcinogenic effects of chili extracts and capsaicin. Therefore, capsaicin is suggested as an important dietary phytochemical with antioxidant and chemopreventive activities **[11-13]**.

Mosquitoes are the most important single group of insects acting as vector for many diseases. The approach to combat these diseases largely relied on interruption of the disease transmission cycle by either targeting the mosquito larvae through spraying of stagnant water breeding sites or by killing the adult mosquitoes using insecticides **[14]**. The large-scale use of chemical pesticides in agriculture and public health leads to adverse effects such as development of pesticide resistance, frequent pest out breaks, emergence of new pests, pollution and health hazards. Throughout history, plant products have been successfully exploited as insecticides, insect repellents, and insect antifeedants **[15]**. Plants offer an alternative source of insect-control agents because they contain a range of bioactive chemicals, many of which are selective and have little or no harmful effect on non-target organisms and the environment. It is observed that the carbohydrates, saponins, phytosterols, phenols, flavonoids and tannins are having mosquito larvicidal activity **[10].** Prenylated xanthones, tetracyclic phenols and saponins are reported to be effective in controlling mosquito *A. aegypti*, the vector of yellow fever **[16]**. In this study, the presence of tannins, alkaloids, steroids and glycosides was detected in the extracts which may account for the biological activity.

CONCLUSION

Aedes aegypti is the primary vector of dengue fever, dengue haemorragic fever, dengue shock syndrome and chikungunya. Control has mainly been by using chemical insecticides but these lead to many problems such as adverse effects on the environment and the increasing resistance by some mosquitoes. Phytochemicals derived from plant sources can act as larvicide, insect growth regulators, repellent and ovipositor attractant and have different activities observed by many researchers. However, insecticides of plant origin have been extensively used on agricultural pests and to a very limited extent, against insect vectors of public health importance. In this study, the larvicidal activity of fruit and leaf extracts of might be attributed mainly to the presence of various phytoconstituents. In suitable formulations and doses, the extracts could be used to control the arboviral infections. This is the first report on insecticidal efficacy of *C. frutescens* and further studies on isolation of active compounds, toxicity, field trials and mechanism of insecticidal action are under investigation.

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