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Research Article

Studies on Molluscicidal Activity of Essential oils from Plant Origin Against the Vector Snail of *Fasciola* Species

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Abstract

The endemic zoonotic disease fascioliasis is very common in eastern Uttar Pradesh. The essential oils play an important role in controlling snail population. Current research shows that essential oils from various Mentha piperata and Mentha spicata plant materials are effective as phytomolluscicides against the snail vector *Lymnaea acuminata.* Essential oils from various plant materials of Mentha piperata and Mentha spicata are extracted by traditional and non-traditional methods such as solvent extraction (SE) and hydrodistillation (HD). From the results section, it is clear that Mentha piperata and Mentha spicata essential oil have strong molluscicidal activity (24-h LC50 values are 4.01 and 4.50 respectively, especially against the snail vector Lymnaea acuminata). The results of this study clearly showed that essential oils cause great harm when applied to snail carriers. The aim of this study is to establish the molluscicidal effect of essential oils of different plant materials of Lantana indica against the snail vector *Lymnaea acuminata.*

Key Words: molluscicide; essential oil; lymnaea acuminata; mentha piperata; mentha spicata

Introduction

The Phylum Mollusca is better known for the second largest Phylum after Arthropoda in the Animal Kingdom [1-8]. There are about 80,000-135,000 species of molluscs found worldwide [9-10]. The Class Gastropoda of the Phylum Mollusca includes snails which are specialized invertebrates found in terrestrial as well as aquatic environment. Many of the terrestrial gastropods are havoc for the agro-horticulture and ornamental plants [11-12]. Similarly, many of the aquatic snails serve to spread zoonotic diseases acting as a vector for many trematodes *Fasciola* and *Schistosoma* species and are responsible for the spreading of endemic diseases Fascioliasis and Schistosomiasis. These aquatic snails are important from the medical and veterinary point of view. The zoonotic disease fascioliasis is very common in the cattle population of eastern Uttar Pradesh [13-18]. The quality and quantity of milk production as well as meat is directly affected by this endemic disease. It causes great economic loss to the farmers in rural areas as well as milk and meat producers in urban areas of this region. The main causative agents of this dreadful disease are two digenean trematode flukes *Fasciola hepatica* and *Fasciola gigantica* [19-20]. The aquatic snail *Lymnaea acuminata* is the vector of these flukes. The incidence of fascioliasis can be reduced by delink the life cycle of fluke by snail control programme. There are so many synthetic molluscicides like methiocarb, EDTA, metaldehyde, iron phosphate, salt, nicolsamide etc. The excessive use of synthetic molluscicides play a crucial role in creating hazard to environment. They directly affect the particular pest as well as other non-target organisms sharing the same habitat. To reduce these harmful effects on other biota there must be a molluscicides which is biodegradable, cost effective and eco-friendly in nature. To cope this situation, the plants have a variety of products which might be used as molluscicides. They also possess many bio active compounds which are potent molluscicides. Many of the aromatic plants synthesize secondary metabolites as a part of their normal growth and development to compensate abiotic and biotic stresses. *Mentha* is the genus of plants known as mint, a family of aromatic, flowering herbs from the family Lamiaceae. The genus includes numerous species and hybrids, like peppermint (*Mentha piperita*) and spearmint (*Mentha spicata*), which are used for flavoring, in traditional medicines, and for producing essential oils [21-25]. These plants are known for their square stems, aromatic leaves, and wide-spreading rhizomes.

Materials and Methods

Collection of Snails

Adult snails *Lymnaea acuminata* (2.25±0.20 cm in length) were collected locally from lakes and low lying submerged fields in Gorakhpur. The snails were acclimatized for 72 hours in dechlorinated tap water at 25±10° C. The pH of the water was 7.1-7.3 and dissolved oxygen, free carbon dioxide and bicarbonate alkalinity were set to 6.5-7.2 mg/l, 5.2-6.3 mg/l and 102.0-105.0 mg/ l, respectively.

Collection of Plant Origin Molluscicide

The plant materials of *Mentha piperata* and *Mentha spicata* species are

collected locally from the local Botanical Garden Gorakhpur. The collected leaves along with stems are sun dried properly for few days and grinded to make a fine powder.

Extraction of Essential Oils

The essential oils of and *Mentha piperata* and *Mentha spicata* were obtained by hydrodistillation method described in British Pharmacopoeia [26]. The Essential oil was isolated from 500 g sample through hydro-distillation in Clevenger's apparatus (Merck Specialities Pvt., Ltd., Mumbai, India). The volatile fraction (EO) was separated and traces of water removed by passing through anhydrous Na_2SO_4.

Statistical Analysis

Lethal concentration values (LC_{50}), lower and upper confidence limits (LCL and UCL), slope values, t- ratio, 'g' value and heterogeneity factor were calculated using POLO computer programme [27]. The product moment correlation coefficient was applied between different data obtained in Tables 1 [28]

Results

The current research demonstrates that the essential oils derived from the plant materials of *Mentha piperata* and *Mentha spicata* exhibit significant toxicity to the vector snail *Lymnaea acuminata*, with a 24-hour LC_{50} values are of 4.01 and 4.50. Based on the findings of this study, the essential oils extracted from different plant parts of *Mentha piperata* and *Mentha spicata* are effective plant origin molluscicides. The observed molluscicidal activity was recorded at intervals of 24 hours up to 96 hours, indicating a clear dependence on both time and dosage. This represents the first evaluation of these plant origin essential oils in relation to fascioliasis hosts. The favorable results obtained provide an alternative strategy for the management of fascioliasis. Components of the active raw materials utilized in biological assays aimed at isolating and identifying the compound responsible for the molluscicidal properties are essential for understanding the underlying mechanisms.

Exposure period	Molluscicides	LC_{50}	LCL	UCL	Slope Value	t-ratio	g-value	Heterogeneity
24h	*Mentha piperita*	4.01	1.11	4.46	1.74±0.41	3.72	0.22	0.23
	Mentha spicata	4.50	0.99	4.13	1.32±0.30	4.32	0.21	0.22
48h	*Mentha piperita*	3.87	0.98	3.45	1.22±0.35	3.01	0.18	0.21
	Mentha spicata	4.01	0.88	3.23	1.11±0.30	2.92	0.17	0.20
72h	*Mentha piperita*	3.44	0.86	3.14	1.10±0.31	2.86	0.16	0.20
	Mentha spicata	3.74	0.82	3.12	1.08±0.29	2.82	0.15	0.21
96h	*Mentha piperita*	3.01	0.76	3.07	1.02±0.28	2.81	0.14	0.21
	Mentha spicata	3.11	0.74	3.00	1.01±0.30	2.80	0.13	0.22

Table 1: Molluscicidal activity and lethality of *Mentha piperata* and *Mentha spicata* essential oil extracts against the vector snail *Lymnaea acuminata*.

Notes: Product moment correlation showed significant ($p<0.05$); negative correlation in between the exposure period and different essential oils of plant origin molluscicides

Discussion

The aquatic ecosystem is highly influenced by overuse of chemical synthetic pesticide. The safer approach of snail control programme is highly appreciated by the scientific community worldwide. One way to reduce the incidence of fascioliasis is to delink the lifecycle of fluke by controlling snail population [29-30]. The essential oils from plant origin play an important role in controlling the snail population. The essential oils of different plants are much effective molluscicides because it is cost effective, environmental friendly, biodegradable and no adverse effect on other biota sharing the same habitat. Earlier it has been reported that the essential oils of *Piper nigrum*, *Tachyspermum ammi*, *Allium sativum*, *Polianthes tuberosa* and *Syzygium aromaticum* act as potent molluscicides against the vector snail *Lymnaea acuminate* [31-33]. It is clear from the present investigation that the essential oils of *Mentha piperata* and *Mentha spicata* significantly causing vector snail *Lymnaea acuminata* mortality. The steep slope indicates that small increases in the concentration of many molluscicides result in significant mollusc mortality. A t-ratio value greater than 1.96 indicates that the regression is significant. A heterogeneity value less than 1.0 indicates that the model fits the data well because the concentration response line falls within the 95% confidence limits within the replicates. The significance index of performance evaluation is clearly visible from the data as the "g" value is less than 0.5. The incidence of endemic disease fascioliasis can be reduced by using essential oils to control the snail vector, *Lymnaea acuminata*. Essential oils extracted from various plants and used as molluscicides have already been discovered and found to be toxic to various snails [34-38].

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