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Research Article

Molluscicidal Activity of Essential oils of *Piper Nigrum* Against the Vector Snail of *Fasciola* Species

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Abstract:

In the eastern region of Uttar Pradesh, fascioliasis, a common zoonotic disease, shows a significant incidence. Essential oils derived from various plants play a crucial role in human health. It is also found that the essential oils extracted from different plants show a significant role in controlling different pests. The present study indicates that the essential oils obtained from fruits of *Piper nigrum* serve as effective herbal molluscicides against the vector of the flat worms *Fasciola hepatica and Fasciola gigantica*, the snail *Lymnaea acuminata*. The essential oils from fruits of *Piper nigrum* extracted using both traditional and innovative methods, including solvent extraction (SE) and hydrodistillation (HD). The results clearly demonstrate that the essential oils from fruits of *Piper nigrum* exhibit a strong molluscicidal effect (24-hour LC50 2.5), especially against the vector snail *Lymnaea acuminata*. The present study clearly demonstrate that the essential oils extracted from the king of spices *Piper nigrum* fruit is highly toxic to the vector snails *Lymnaea acuminata*. It is said to be a potent molluscicides of plant origin because of highly toxic, species specific, biodegradable, cost effective and eco-friendly.

Key words: fascioliasis; piper nigrum; lymnaea acuminata; fasciola

Introduction

Fascioliasis is one of the common zoonotic disease found in the cattle population of eastern Uttar Pradesh. Due to this dreadful disease the quality and quantity of meat and milk production decreases causing great economic loss to animal husbandry [1-7]. The causative agents of this dreadful disease are two common digenean trematodes *Fasciola hepatica* and *Fasciola gigantica* [8-9]. These trematodes are digenetic and complete their life cycle in cattle and aquatic snail *Lymnaea accuminata* which act as an intermediate host (vector). One way to reduce the incidence of endemic disease fascioliasis is to delink the life cycle of these flat worms by controlling the snails *Lymnaea acuminate* by using natural products [10-13]. Previously the use of chemical pesticides caused a great hazard to the ecosystem and indirectly affect the other biota sharing the same habitat. It is necessary to replace such types of control measures with cost effective, ecofriendly and biodegradable control methods [14-15]. One such method is the use of essential oils extracted from different plants as a potent molluscicides. Black pepper (Piper nigrum) is a flowering vine belonging to the Piperaceae family, primarily grown for its fruit, known as the peppercorn. This fruit is typically dried and utilized as a spice and seasoning. It is classified as a drupe, measuring approximately 5 mm (0.20 in) in diameter when fresh and fully mature, exhibiting a dark red color, and containing a stone that houses a single pepper seed. The terms "peppercorns" and "ground pepper" can be collectively referred to as pepper, but they can also be specified as black pepper (dried unripe fruit), green pepper (dried unripe fruit), or white pepper (seeds from ripe fruit).

Materials And Methods

Purchasing of Plant Derived Molluscicicdes

The black fruits of *Piper nigrum* was purchased from the local spice market of Sahabganj Gorakhpur, UP, India and further used for toxicity experiments. The materials were dried in sunlight and grinded in the grinder to make them powder.

2.2. Collection of Snails

Grown-up *Lymnaea acuminata* (2.25±0.20 cm long) were gathered locally from lakes and low lying lowered fields in Gorakhpur. The snails were adjusted for 72 hours in dechlorinated faucet water at 25±10 C. The pH of the water was 7.1-7.3 and broken up 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, separately.

2.3. Extraction of Essential Oils

The essential oils of *Piper nigrum* was extracted by hydrodistillation technique portrayed in English Pharmacopeia [21]. The Essential oil was extracted from 500 g test through hydro-refining in Clevenger's mechanical assembly (Merck Specialities Pvt., Ltd., Mumbai, India). The essential oil (EO) was isolated and hints of water eliminated by going through anhydrous Na_2SO_4.

2.4. Statistical Analysis

The statistical analysis has been done by using a computer programme, POLO in which calculations of lethal concentration values (LC_{50}), lower and upper confidence limits (LCL and UCL), slope values, t- ratio, 'g' value and heterogeneity factor were included [16]. The product moment correlation coefficient was applied between different data obtained in Tables 1 [17]

The slope values observed in the Table 1 are all very steep. A separate estimate of the LC_{50} based on each of the six replicates was found to be within the 95% confidence limits. The t-ratio is greater than 1.96 and the heterogeneity is less than 1.0. The "g" value is less than 0.5 at all probability levels (90, 95, 99).

Exposure period	Molluscicides	LC_{50}	LCL	UCL	Slope Value	t-ratio	g-value	Heterogeneity
24h	*Piper nigrum*	2.58	1.00	4.51	1.79±0.43	3.75	0.23	0.26
48h	*Piper nigrum*	2.24	0.94	3.34	1.27±0.37	3.02	0.19	0.22
72h	*Piper* nigrum	2.01	0.82	3.11	1.12±0.35	2.87	0.18	0.21
96h	*Piper* nigrum	1.95	0.76	3.01	1.10±0.33	2.82	0.20	0.23

Notes: There is a negative correlation was observed from the above data in between the exposure period and different essential oils of plant origin molluscicides as the Product moment correlation observed ($p<0.05$).

Table 1: Toxicity and molluscicidal activity of *Piper nigrum* essential oil against the snail *Lymnaea acuminata*.

3. Result

The present study clearly shows that the essential oils extracted from plants the fruits of *Piper nigrum* was highly toxic to the vector snail *Lymnaea acuminata* (24-hour LC_{50} values of 2.58). On the basis of present research work the extracted essential oils of *Piper nigrum* fruits are potent plant derived molluscicides. The molluscicidal activity was observed at every 24 hours upto 96 hours and clearly shows that it is time and dose dependent. This is the inaugural assessment of these plants derived essential oils regarding fascioliasis hosts. The positive outcomes noted offer an alternative method for managing fascioliasis. Portions of the active raw materials used in biological tests designed to isolate and identify the compound responsible for the molluscidal effects are crucial for comprehending the underlying mechanisms.

4. Discussion

The aquatic ecosystem can be negatively impacted by the overuse of chemical molluscicides, making it crucial to choose a safe and environmentally friendly molluscicide for integrated pest management. The application of essential oils derived from various plants has proven to be highly effective, cost-efficient, and eco-friendly. The essential oil from the fruits of *Piper nigrum* and its active component eugenol are recognized for their effective molluscicidal properties against the snail *Lymnaea acuminata*, the vector of causative agent of dreadful disease fascioliasis. The results indicate that the 24-hour LC_{50} value for essential oil of fruits of Piper nigrum is 2.58. The essential oils extracted from fruits of *Piper nigrum* demonstrated significant toxicity to the vector snail *Lymnaea acuminata*.

The seeds of *Tachyspermum ammi* serve as a spice and are recognized for their effectiveness in controlling *Lymnaea acuminata* and *Indoplanorbis exutus*, the snail vectors. Previous studies have indicated that the essential oils derived from various plants are effective molluscicides, as their toxicity surpasses that of their unrefined counterparts and operates effectively at low concentrations [18-20]. It was previously observed that the essential oils of fruits of *Piper nigrum* is very effective in controlling mosquitoes like *Anopheles* and stable flies [22-35].

The steep slope values demonstrate that a little increase within the concentration in numerous molluscicides cause a noteworthy mortality within snails. The t- ratio value esteem more prominent than 1.96 indicates that the regression is significant. Values of heterogeneity less than 1.0 illustrates that within the reproduces the concentration reaction line would drop inside 95% certainty constrain limit and thus the model fit the data adequately. The index of significance of potency estimate is clearly observed from the data as the value of 'g' is less than 0.5. The incidence of endemic disease fascioliasis can be reduced by using the essential oils for controlling the vector snail *Lymnaea acuminata*. The essential oils extracted from different plants and used as molluscicides has been observed earlier and found poisonous to different snails [22-35].

5.Conclusion

It can be inferred from the investigation presented that essential oils exhibit higher toxicity compared to the crude forms of molluscicides derived from plants. The increased mortality rate clearly indicates that the essential oils contain some significant bioactive compounds that need to be extracted and evaluated in the future. The occurrence of fascioliasis can be diminished by managing the vector snail through the use of essential oils as a safer, cost-effective, and biodegradable molluscicide from plant sources.

6.References

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