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Research Article

Molluscicidal Efficacy of Essential oils of *Syzygium aromaticum* Clove and *Tachyspermum ammi* Seeds against *Lymnaea acuminata*, a Vector Snail

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Abstract

In eastern Uttar Pradesh, fascioliasis, an endemic zoonotic disease, is quite prevalent. Essential oils that are produced from various plants are extremely important to human health. The current study found that the essential oils from *Tachyspermum ammi* seeds and *Syzygium aromaticum* cloves are effective herbal molluscicides against the vector snail *Lymnaea acuminata*. *Syzygium aromaticum* cloves and *Tachyspermum ammi* seeds are used to extract their essential oils using both conventional and unconventional techniques, such as solvent extraction (SE) and hydrodistillation (HD). The results section makes it evident that both of the essential oils from *Syzygium aromaticum* clove and *Tachyspermum ammi* seeds have a high level of molluscicidal activity (24-hour LC_{50} values are 3.01 and 2.35), particularly against the vector snail *Lymnaea acuminata*. The current investigation unequivocally showed that the exposed vector snails to the essential oils are extremely harmful. The aim of the present investigation is to establish the molluscicidal activity of the essential oils of *Syzygium aromaticum* clove and *Tachyspermum ammi* seeds against the vector snail *Lymnaea acuminata*.

More Information

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Introduction

Several freshwater snails are highly valuable economically because they serve as intermediate hosts for certain digenean trematodes [1-6]. In eastern Uttar Pradesh, there are two such flukes, *Fasciola hepatica* and *Fasciola gigantica*, which are spread by the vector snail *Lymnaea acuminata* [7-12]. About 94% of the cattle are found to be heavily infected by these flukes causing the endemic disease fascioliasis or liver rot disease through which a great loss of economy in milk production and meat production [13]. Controlling the snails is the most effective way to break the fluke's life cycle and thus reduce the prevalence of the disease fascioliasis [14,15]. Essential oils are highly sought after and have been found to be effective against pests such as insects, mites, fungi, and nematodes [16,17]. Thyme, oregano, basil, rosemary, and mint have been found to be the most poisonous oils. However, testing a larger range of oils on different pests will give a more comprehensive picture. A number of essential oils from various plants have been observed to be strong repellents. There are several spices have been employed in food preparations in tropical and sub-tropical countries for a long time.

In Ayurveda and Greek Arabic literature, a number of spices are described as having medicinal properties. *Syzigium aromaticum* (L) is a member of the Myrtaceae family and its flower buds are where the essential oil of clove is obtained. The chemical components found in it are ß-caryophyllene, which represents 14% - 21%, tannins as well as phenols and sesquiterpenes which constitute 10% - 13% [18,19].

Phenylpropene is the main part of the essential oil aside from eugenol, which is answerable for the trademark aroma of the plant and its primary part. The flower buds of the Syzygium aromaticum contain about 49-98% of the essential oil. The conventional utilization of clove is upheld by its numerous properties which have been depicted in various logical reports featuring its cancer prevention agent, hypotensive, dental analgesics, antibacterial, mitigating, and antifungal movement, aside from the synergistic antimicrobial action of the natural ointment with other plants which

permits it to be considered with extraordinary potential for dental applications. Trachyspermum ammi L. having a place with the family Apiaceae regularly known as ajowan, is a notable customarily involved flavor in India and numerous different nations. The rejuvenating balm of T. ammi natural products has been recently explored for its antimicrobial and cell reinforcement movement [20]. The aim and objective of the present study is to evaluate the molluscicidal activity of the essential oils of Syzygium aromaticum clove and Tachyspermum ammi seeds against the snail Lymnaea acuminata, vector of Fasciola species.

Materials and methods

Purchasing of plant derived molluscicides

The flower bud cloves of *Syzygium aromaticum* and seeds of *Tachyspermum ammi* were purchased from the local spice market of Sahabganj Gorakhpur, UP, India and further used for toxicity experiments. The materials were dried in sunlight and ground in the grinder to make them powder.

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.

Extraction of essential oils

The medicinal oils of *Syzygium aromaticum* clove and seeds of *Tachyspermum ammi* were obtained by the hydrodistillation technique portrayed in English Pharmacopeia [21]. The Essential oil was extracted from a 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 were eliminated by going through anhydrous Na_2SO_4.

Statistical analysis

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

Results

The slope values observed in 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 limit. 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).

The aforementioned study clearly shows that the essential oils derived from plants, *Syzygium aromaticum* clove and *Tachyspermum ammi* seed, were highly poisonous to the vector snail *Lymnaea acuminata* (24-hour LC_{50} values of 3.01 and 2.35). Based on the current findings, it seems that *Tachyspermum ammi* seeds and *Syzygium aromaticum* clove essential oils might be sources of plant-based molluscicides. Their harmful effects vary in duration and dosage. This is the first evaluation of these plants against fascioliasis hosts. The observed good results provide an alternative tool for the control of fascioliasis. Aliquots of the active raw materials subjected to biological assays aimed at isolating and identifying the compound responsible for the molluscicidal activity are essential for understanding the mechanisms involved.

Discussion

Aquatic ecosystem may disturbed due to the excessive use of chemical molluscicides, so the selection of a safe and eco-friendly molluscicide is of great importance in integrated pest management. The use of essential oils of different plant origin molluscicides is very effective, low cost, and environment friendly [7,8]. *Syzygium aromaticum* clove and its bioactive compound eugenol are known for their potential molluscicidal activity against the vector of digenean trematodes, the snail *Lymnaea acuminata* [14]. It is clear from the result section that the 24h LC_{50} of *Syzygium aromaticum* clove and *Tachyspermum ammi* seeds are 3.01 and 2.35, respectively. The toxicity of these essential oils was very effective for the vector snail *Lymnaea acuminata*.

The seeds of *Tachyspermum ammi* are also used as spice and are known for their molluscicidal activity against *Lymnaea acuminata* and *Indoplanorbis exutus*, the vector snails [20]. It has been reported earlier that the essential oils of different plant-origin molluscicides are potent molluscicides because the toxicity of these essential oils is higher than their crude forms and acts at low concentrations [22,23]. The steep slope values demonstrate that a small increase in the concentration of numerous molluscicides causes noteworthy mortality within snails. The t- t-*t* - ratio value esteem more prominent than 1.96 indicates that the regression is significant. Values of heterogeneity less than 1.0 illustrate that within the reproduces the concentration reaction line would drop inside the 95% certainty constraint limit and thus the model fits 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 essential oils for controlling the vector snail *Lymnaea acuminata*. The essential oils extracted from different plants and used as molluscicides have been observed earlier and found poisonous to different snails [24-27].

Conclusion

It can be concluded from the above investigation that essential oils have greater toxicity than crude forms of

Table 1: Toxicity and molluscicidal action of *Syzygium aromaticum* clove and *Tachyspermum ammi* seed's essential oil against the snail *Lymnaea acuminata*.

Exposure period	Molluscicides	LC_{50}	LCL	UCL	Slope Value	*t* - ratio	*g* -value	Heterogeneity
24h	*Syzygium aromaticum*	3.01	1.02	4.57	1.79±0.43	3.75	0.23	0.26
	Tachyspermum ammi	2.33	0.84	4.10	1.42±0.33	4.38	0.20	0.24
48h	*Syzygium aromaticum*	2.85	0.92	3.54	1.27±0.37	3.02	0.19	0.22
	Tachyspermum ammi	2.01	0.89	3.32	1.14±0.34	2.98	0.19	0.21
72h	*Syzygium aromaticum*	2.45	0.85	3.34	1.12±0.35	2.87	0.18	0.21
	Tachyspermum ammi	1.92	0.80	3.12	1.11±0.32	2.84	0.19	0.22
96h	*Syzygium aromaticum*	2.02	0.79	3.09	1.10±0.33	2.82	0.20	0.23
	Tachyspermum ammi	1.80	0.78	3.02	1.09±0.31	2.80	0.19	0.20

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

plant-origin molluscicides. The higher mortality rate clearly demonstrates that the essential oils possess some potent bioactive compounds that have to be extracted and evaluated later on. The incidence of fascioliasis can be reduced by controlling the vector snail by applying essential oils with safer, cost-effective, and biodegradable plant-origin molluscicides.

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