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Research Paper

Molluscicidal activity of synthetic derivatives of acrylic acid on adult terrestrial snail *Achatina fulica* (bowdich) from Nashik district (M.S.) India

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Abstract

The present studies deals with toxicity of synthetic compound and experimental work was conducted in Zoology Research Laboratory, K.T. H.M. College, Nashik (M.S.) India. A series of 3-(5-{Aryl}-thiophen-2-yl)-acrylic acid were synthesized and assayed their bioactivity against the adult terrestrial snail *Achatina fulica* (Bowdich) to different concentration (10-ppm, 20-ppm, 30-ppm, 40-ppm) for 96 h. Highest LC₅₀ values were obtained for nitro phenyl (0.872±0.498) and lowest LC₅₀ values (1.359 ±0.0786) for methoxy phenyl.

Keywords: Acrylic acid derivatives, *Achatina fulica*, Molluscicidal activity, Nashik district.

Introduction

The Giant African land snail *Achatina fulica* (Bowdich) is a Gastropod (Molluscs)^[1,2]. Economically it is most serious land snail pest in the world, and has spread to most of the Indo-specific areas including India, Srilanka, Malaysia, China, Taiwan, Japan, Philippines, Hawaii, Saoa, Tahiti, New Guine & Indonesia^[3]. Several reports have been published toward the bioactivity of synthetic and natural products on this land snail. At present scenario, control of snail and slug is heavily dependent on synthetic pesticides, which are most convenient method for controlling terrestrial gastropod^[4,5]. Niclosamide and Nicotinamide are toxic to all stages of the *Lymnaea luteola* snails^[6]. Number of compounds have been derived from 3-(un) substituted 4-hydroxyquinolin-2 (1H) which directly affect hatchability of *Biomphalaria alexandrina* and *Lymnaea natalensis* snails^[7]. A toxicity of pyrazoline and isoxazoline were synthesized and shown activity to *Machrochlamys indica* reported by Toche et al.,^[8]. A new series of 1,2,4 -triazole derivatives were synthesized & examined as molluscicide against terrestrial snail, *Helix aspersa* and *Theba pisana* by contact or bran bait^[9]. Thiophene, Thiadiazole & Pyrazole are new derivative of thiophene showed toxic action on snail^[10]. Acrylic acid and methacrylic acid have diversified uses in industry & medicine. It shows activity in the mouse lymphoma and inactive in the *Salmonella typhimurium* reported by^[11].

The pesticides Thiamethoxam and diafenthiuron were shown to present toxic activity on terrestrial snail *Macrochlamys indica*^[12]. New thiophenedicarboxamide 2a-c and dicyanothiopheneacetamide 3a-c were synthesized and reported their bioactivity against *Indoplanorbis exustus* snails^[13]. Bayluscide, a synthetic compound of ethanalamine salt of niclosamide used as molluscicides, but it is toxic to fish and other

aquatic animal^[14]. *Achatina fulica* is a hermaphrodite with high reproductive rate, during monsoon season and laying two to three clutches of eggs in a year and make surrounding area dirty and intolerable. The purpose of the present study is to check the molluscicidal activity of synthesized acrylic acid derivatives on adult snail as a part of control measures.

Materials and Methods

The study area and collection

The present study was carried out at Zoological Research laboratory, Department. of Zoology, K.T.H.M College Nashik-2 having Latitude 19.9942° N, longitude 73.7972° E. *Achatina fulica* (Bowdich) were collected early in the morning and late in the evening from infested paddy and grape fields and surrounding agriculture fields from Nashik, Niphad, Dindori, Satana places, during rainy season as it is the favorable period for their growth and reproduction. The snails were brought and acclimatized to laboratory conditions.



Figure 1: Location map of Nashik District in Maharashtra state (India)

Rearing of Snails

The collected snails were released in glass aquarium simulating natural condition. The aquarium was covered with mosquito net on the top & contain about 4 cm of moist soil as a natural habitat of *Achatina fulica* (Bowdich) at temperature range 23 ± 1 °C, Humidity 60-65 % and photoperiod (L:D) 11-13. Water was sprinkled at a regular interval to maintain suitable moisture & temperature and snails were fed with green leaves of cabbage, coriander and papaya leaves.

Molluscidal Bioassay

The healthy active adult snails of same age, size and weight were selected for toxicity test. For the experimental work the snails were divided into five groups containing 10 snails in each group and exposed to concentration 10 ppm, 20 ppm, 30 ppm, 40 ppm to adult for 96 h for 6 chemical compounds (C₁ to C₆) separately. The behavioral changes such as mucous secretion, sluggishness, immobility and mortality were recorded for *Achatina fulica*. The LC₅₀ value, regression equation, heterogeneity, and variance were calculated following Finney method^[15].

Results and Discussion

Table1 lists LC₅₀ values, Regression equation, Heterogenicity, Variance and Fiducial limit. The values depict that all the organic derivatives of 3-{5-(Aryl)- thiopene-2-yl}-acrylic acid are toxic to adult *Achatina fulica* (Bowdich) land snails. In the present studies *Achatina fulica* snails were exposed to derivatives of acrylic acid at different concentrations at 10 ppm, 20 ppm, 30 ppm,40 ppm for 96 hours.

Table 1: LC₅₀ values of synthetic derivatives of acrylic acid against adult snails of *Achatina fulica* (Bowdich)

Compound Name	Dose in ppm	Mortality in %	LC ₅₀ ppm± S.E.	Regression Equation Y= a + bx	Heterogenicity Equation X ² (n-1)	Variance	Fiducial Limit
7-3-(5-(3-Methoxy-phenyl)-thiophen-2-yl)-acrylic acid.	10 20 30 40	20 40 60 80	1.359±0.786	Y=1.355+2.69(x)	0.2727	0.00619	M1=1.504 M2=1.195
6 3-(5-(3-hydroxyl-phenyl)-thiophen-2-yl)-acrylic acid	10 20 30 40	20 30 50 80	1.299±0.083	Y=1.259+2.664(x)	1.1513	0.00702	M1=1.463 M2=1.134
3-(5-(3-formyl-phenyl)-thiophen-2-yl)-acrylic acid	10 20 30 40	20 30 40 80	1.273±0.9648	Y=1.55+2.399(x)	2.3456	0.00931	M1=1.4611 M2=1.085
3-(5-(phenyl-thiophen-2-yl)-acrylic acid	10 20 30 40	20 20 60 80	1.14±0.1499	Y=1.81+2.036(x)	35.674	0.0224	M1=1.438 M2=0.851
3-(4-(4-fluro-phenyl)-thiophen-2-yl)-acrylic acid	10 20 30 40	20 20 40 60	1.058±0.786	Y=2.168+2.699(X)	0.315	0.00619	M1= 1.2120 M2=0.904
3-(5-(4-nitro-phenyl)-thiophen-2-yl)-acrylic acid	10 20 30 40	20 20 60 80	0.087±0.498	Y=2.688+1.820(x)	1.9161	0.2487	M1=1.849 M2=0.1056

The data is the average of three replicates and significant at < 0.05 %.

The lethal concentration (LC₅₀) value for nitrophenyl (0.0872 ± 0.498) and methoxy (1.359 ± 0.786) and were obtained at 40 ppm and snails become sluggish, secrete excess mucus and stop feeding. The present research showed molluscicidal potency on *Achatina fulica* and agreed with preliminary reports [16,17,18]. Radwan et al. [9] reported that ortho and para position of phenyl ring with chlorine and bromine give higher molluscicidal effect on *Helix aspersa* and *Thebe pisana*. It acts as stomach and contact poison and this is agreed with Mahrous et al. [19].

The snails secreted excessive mucous and according with the report ^[20,21]. Similarly, lack of tactile response and immobility ^[22,23]. Fadda et al. ^[10] reported that Thiophene, thiadiazole & Pyrazole derivative were effective but this chemicals, decreased the consumption level in glycolysis pathway, ultimately death of snail and agreed with another report of ^[24]. Kanawade et al. ^[13] state that ethanol amine salt of niclosamide as molluscicide, but it was lethal to fishes and other aquatic animal. Irritative, avoidance, behaviour observed by Evan et al., ^[25,26,27] in pulmonate snails, *Bulinus* and this is similar with the present observation. The report compared with earlier work and authors agreed with earlier workers. The activity of this synthesized compound can be arranged in ascending order of their toxic activity as Methoxyl phenyl < Hydroxyl phenyl < Formyl phenyl < Phenyl thiophene < Fluro phenyl < Nitro phenyl. The activity decreased with increasing the concentration at 40 ppm for adults.

Conclusion

Results from the present study have shown that synthetic derivatives of acrylic acid have significant activity against *Achatina fulica* at concentration of 40 ppm and highest LC₅₀ (0.087 ± 0.498) for Nitrophenyl and compared with other derivative Flurophenyl (1.058 ± 0.786), Phenylthiophen (1.14 ± 0.149), Formylphenyl (1.273 ± 0.964), Hydroxylphenyl (1.299 ± 0.083) and lowest for Methoxyphenyl (1.359 ± 0.786). The toxic effect would result in excessive mucus secretion which make them immobile, inactive & lack of tactile response, feeding behavior is reduced and shell become dry, pale yellow. This suggests that this nitrogroup does irritate the mucous cell in the skin but also affects the digestive tract as well as foot of *Achatina fulica*. The results need further investigation of synthesis of organic derivative in order to characterized their molluscicidal effects.

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