

Toxicity of *Solanum surattense* against freshwater host snail *Indoplanorbis exustus*

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Abstract-Fascioliasis is a serious parasitic zoonotic disease caused by *Fasciola*. The carrier of *Fasciola* is a freshwater host snail *Indoplanorbis exustus*. The population of snail control is may be an effective technique for the control of fascioliasis infections. Synthetic molluscicides are effective for control of snail population but their cause's adverse effect on non-target organisms and aquatic environment. Some plant families are potent sources of molluscicides. The present studies were designed for the evaluation of the molluscicidal efficacy of the medicinal plant *Solanum surattense* against snail *I. exustus*. Toxicity experiment of dried leaf powder of *S. surattense* and their organic extracts (ether, chloroform, methanol, acetone, and ethanol) and column purified was exposed against *I. exustus* and observed up to 96 hours (96h) at different concentrations of the treatments. Toxicity against *I. exustus* was noted at 24h interval up to 96h exposure and calculates lethal values and different parameters. Lethal Concentrations (LC₅₀) of leaf powder of *S. surattense* were 24h exposure 185.26mg/l and at 96h 180.30 mg/l. The ethanolic extracts of dried leaf powder of *S. surattense* were more toxic against *I. exustus* among all the extracts. The present study shows that the *S. surattense* is a potent source of molluscicides and their different preparations revealed the new approaches that how the active components of this plant perform mode of action in the snail body.

Keywords-*Solanum surattense*, *Indoplanorbis exustus*, Molluscicides, Liver fluke, Fascioliasis.

I. INTRODUCTION

Liver cirrhosis is common disease which caused by liver fluke (*Fasciola*) among sheep, cattle, goat, buffaloes and other vertebrates including human. It's has a significant role in the growth and development of livestock keepers and economic significance [1-3]. Trematode species of *Fasciola* are causes fascioliasis worldwide among ruminants and the human population which have a complex lifecycle in intermediate host snails [4-6]. These diseases are mainly caused by trematode fluke of *Fasciola hepatica* and *F. gigantica* [7-9]. However, in a various part of India, these parasitic diseases are mainly caused by species of *F. gigantica* [10]. In the Eastern part of Uttar Pradesh (India), freshwater snail *Indoplanorbis exustus* is an intermediate host of *F. gigantica* [3, 11-15]. Snails and slugs are also causing greater economical loss by damaging agricultural fields [16]. The best method for the control of fascioliasis and control of economic loss is to delink the life cycle of the *Fasciola* by control of vector snails [17]. Several synthetic chemicals are uses as molluscicides for the control of carrier hosts of the snail's population [18]. It may be harmful to the aquatic environment and non-target species. The plant derives molluscicides against harmful snail is safer than synthetic and effective for control of snail [19]. The reduction of the snail population, thereby breaking the life cycle of *Fasciola* [3, 9, 15, 20] and reduce the incidence of fascioliasis and several economic loss.

Medicinal plant *Solanum surattense* is widely present in tropical and subtropical parts of South East Asia [21]. It traditionally uses for the treatment of dropsy, fever, leprosy, cough, dysmenorrheal hypertension, epilepsy, cardiac disorder, asthma, and depression [22-24]. Pharmacologically *S. surattense* were evaluated for analgesia [25], antibacterial, antidiabetic, antinociceptive, antioxidant, antifungal, and larvicidal [26] activities. It have also antioxidant, antipyretic [27], antiulcer, antimicrobial, anti-inflammatory, and anthelmintic [28] activity. The objective of the research work is to the determination of toxic efficacy of medicinal plant *S. surattense* against intermediate host snail *I. exustus*.

II. MATERIAL AND METHODS

Experimental animals:

Snail *I. exustus* (0.84±0.35 cm in length) were collected from different ponds and low-lying submerged fields from Muhammadabad Gohna, Mau (U.P.) India. Snails were acclimatized for 48 hours in laboratory conditions (26±5°C) with dechlorinated tap water.

Preparation of crude powder from plant material:

The fresh leaf of *Solanum surattense* was collected from the college campus. It was washed with fresh tap water and dried in sunlight for 3 to 5 days and pulverized in an electric grinder machine for dried crude powder. This leaf

powder was used for the determination of toxicity against snail *I. exustus*.

Extraction of leaf powder:

Five hundred milligram gram dried leaf powder of *Solanum surattense* were extracted in 500 ml of organic solvents (97.8% ether, 98.5% chloroform, 98.1% methanol, 97.3% acetone, and 94.8% ethanol) at lab temperature for 48h. Separately each extraction was filtered through filter paper (Whatman No-1) and extract was evaporated under a vacuum machine [9]. Extracted leaf powders of *S. surattense* were obtained 235 mg in ether, 218 mg in chloroform, 234 mg in methanol, 273 mg in acetone, and 236 mg in ethanol organic solvents. The residues, thus obtained, were used for the determination of toxicity against *I. exustus*.

Column extracts:

The ethanolic column extract of leaf powder of *S. surattense* was prepared by chromatography through a 5x45 Cm column (Mesh size 60-120, Qualigens glass). Two litter fractions of column extract with ethanolic solvents (94.8%) were obtained. Collecting fractions were evaporated through a vacuum machine and obtained solids column extract which was used for determination of toxicity against *I. exustus* (Kumar and Singh, 2006).

Determination of toxicity:

The toxicity of different preparations of *S. surattense* was set up at laboratory temperature (26.5 C⁰) in different groups. Six aquariums were set for each concentration

which containing 3 litter tap water. In each aquarium, 10 snails were kept for toxicity determination for each preparation. The mortality of snails was observed 24h up to 96h exposure Kumar and Singh, [9]. The control groups of test animals were kept in an equal experimental setup without any treatment. The snail mortality was observed at 24h intervals up to 96h. Snail mortality was confirmed by the behavioral activities like no response to touch by needle probe. Lethal Concentration values (LC₅₀) and their different parameters (LCL, UCL, t- ratio, slope values, 'g' value, and heterogeneity factor) were calculated by the using software POLO computer program [29].

III. RESULTS

Toxicity of dried leaf powder of *S. surattense*, different organic extract (ether, chloroform, methanol, acetone, and ethanol), and column extract was tested against *I. exustus* which shows time and concentration-dependent toxicological effects. The lethal concentration (LC₅₀) values of leaf powder of *S. surattense* were 24h exposure 185.26 mg/l and at 96h exposure 180.30 mg/l (Table-1). Whereas, the ethanolic extract of leaf powder of *S. surattense* was highly toxic in different exposure periods. The LC₅₀ values after 24h, 48h, 72h and 96h exposure were calculated 162.11, 159.20, 156.33 and 149.25 mg/l, respectively (Table-1). Likewise, the ethanolic column extract of leaf powder of *S. surattense* has more toxicity against *I. exustus* were after 24h and 96h exposure the LC₅₀ values are 145.22 and 135.23 mg/l, respectively (Table-1).

Table: 1. Toxic effect of dried leaf powder of *S. surattense* and their organic extracts, column extract against *I. exustus* at various exposure periods.

Exposure periods	Experimental Values	Molluscicidal preparations (mg/l)						
		<i>S. surattense</i> dried leaf powder	Ether extract	Chloroform extract	Methanol extract	Acetone extract	Ethanol extract	Column extract
24h	LC ₅₀	185.26	179.52	175.65	180.66	176.18	162.11	145.22
	LCL	180.31	175.33	170.61	177.20	170.80	158.25	142.25
	UCL	189.90	183.80	179.81	186.31	181.30	165.63	149.60
	Slope Value	1.61±0.74	1.35±0.32	1.23±0.71	1.25±0.32	1.25±0.12	1.64±0.70	1.51±0.18
	t-ratio	3.51	5.13	2.83	2.36	3.25	2.77	2.63
	g-value	0.13	0.39	0.18	0.28	0.32	0.34	0.27
	Heterogeneity	0.23	0.19	0.22	0.21	0.21	0.21	0.32
48h	LC ₅₀	184.32	176.70	173.12	178.68	173.63	159.82	142.13
	LCL	179.70	172.30	166.50	172.80	168.51	155.50	138.54
	UCL	187.92	181.23	178.85	183.87	176.61	162.31	145.81
	Slope Value	1.51±0.27	1.33±0.31	1.25±0.74	1.61±0.32	1.27±0.51	1.83±0.34	1.71±0.42
	t-ratio	2.25	2.13	4.85	3.53	3.30	3.52	4.21
	g-value	0.28	0.18	0.23	0.29	0.19	0.24	0.30
	Heterogeneity	0.19	0.22	0.18	0.24	0.35	0.12	0.33
72h	LC ₅₀	182.31	172.51	172.60	175.41	170.82	156.33	139.18
	LCL	178.22	167.51	167.50	171.84	168.61	151.60	136.30
	UCL	185.30	176.30	179.62	179.32	174.70	160.84	141.71
	Slope Value	1.83±0.96	1.71±0.14	1.41±0.30	1.41±0.52	1.35±0.26	1.83±0.72	1.75±0.61
	t-ratio	2.75	3.15	3.82	3.33	2.64	3.61	2.24
	g-value	0.24	0.16	0.26	0.22	0.24	0.28	0.19
	Heterogeneity	0.31	0.31	0.28	0.25	0.25	0.30	0.12
96h	LC ₅₀	180.30	170.86	169.60	170.82	167.95	149.25	135.23
	LCL	179.82	165.33	163.61	167.81	165.81	144.63	130.61
	UCL	184.96	176.83	175.91	176.35	173.60	153.70	138.84
	Slope Value	1.81±0.72	1.60±0.35	1.28±0.91	1.71±0.32	1.40±0.83	1.73±0.70	1.82±0.71
	t-ratio	3.55	3.28	2.31	3.46	2.55	3.56	3.55
	g-value	0.27	0.25	0.16	0.32	0.26	0.28	0.17
	Heterogeneity	0.30	0.26	0.22	0.25	0.23	0.31	0.22

In six groups (each group contains 10 snails) the experimental snails were exposed to various concentrations of *S. surattense* which was formulation for the above treatment. The mortality of snails was counted after every 24h exposure up to 96h.

Abbreviation: LCL= Lower Confidence Limits, UCL= Upper Confidence Limits.

IV. DISCUSSION

The results section demonstrates that the dried leaf powder of *Solanum surattense* is a potent and useful source of plant-derived molluscicides. These toxicological studies against freshwater host snail *I. exustus* revealed towards the molluscicidal components are present in the leaf of medicinal plant *S. surattense* and it is soluble in water. The toxic efficacies of the dried leaf powder and column fractions of *S. surattense* are time and concentration-dependent. It is clear from calculations of LC₅₀ values of different exposure at different concentrations. Ethanolic extract was more toxic among all the extract which revealed towards the toxic components have high solubility in ethanol organic solvents. The time-dependent LC₅₀ of different preparation of *S. surattense* are maybe the active phytochemicals of this plant gradually accumulates in the snail body and bind with the enzymatic system. These phytochemicals may be diffused through exposure parts of the snails. Garedaghi and Khaki, [30] were investigated that ethanolic extract of *S. surattense* has a significant role in the reduction of *Plasmodium* protozoon in mice.

The toxic effect of *S. surattense* is time and concentration dependant which may be possible that active components are dissolved in aquarium water and gradually diffuses in snail body through an exposed area of the snails and causes mortality with increases in the exposure period. Suhas et al., [31] have been investigated that the methanolic extract of *S. surattense* shows antibacterial properties against gram (+) bacteria *Bacillus subtilis* and *Streptococcus aureus* at 50, 75, and 100 µg/ml concentrations. It's also having active components of flavonoids and their glycosides [32], several alkaloids [33], saponin [34], sterols [35], tannins, and gums [36]. The leaf extracts of *S. surattense* have larvicidal efficacy against *Culex quinquefasciatus* [37]. The toxic phytochemicals are found in different families of plants that have potent molluscicidal properties [38]. The chloroformic, alcoholic, petroleum, and ether extract of leaf powder of *S. surattense* are uses as antiulcer products for the treatment of ulcers [39]. The fruit of *S. surattense* has flavonoids, like quercetin, apigenin luteolin, and fisetin which have potent inhibition efficiency in cancerous cell proliferation [40]. This plant is also used in the treatment of insomnia, cold, worms [41], laxative, enlargement of liver, aphrodisiac activities [42, 43], anti-nociceptive, molluscicidal, and anti-fungal activity [44]. Therefore, the active components of *S. surattense* can be used in different vital activities.

V. CONCLUSION

The present toxicity study of medicinal plant *S. surattense* revealed towards the phytochemical of this plant has

potent molluscicides which can use as source molluscicides for control of snails. The finding of this result allied to the use of plant products in the control of another pest, because could make the aqueous extract, organic solvent extract, low cost, natural products, and biodegradable. It revealed in the new researches that how the different active phytochemical components of *S. surattense* act at the molecular level in the snail body.

Conflict of interest: The author has no conflict of interest.

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