Piscicidal activity of methanolic extract of Capparis stylosa on the freshwater fish Channa punctatus (Bloch.)

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Abstract

Laboratory evaluations were made to asses the piscicidal activity of methanolic extract of Capparis stylosa root against predatory fish Channa punctatus and their behavioural changes. Capparis stylosa root extract shows the piscicidal activity of LC50 values at 144.54, 118.30, 104.13 and 89.33 ppm for 24, 48, 72 and 96 hr respectively. It shows there was significant negative correlation between LC50 values and exposure periods i.e., LC50 value decreased if exposure periods increased. During the toxicity experiment the fish shows the behaviourial changes such as suffocation, rapid movement, spiraling and convulsion period to death. These activities shows the concentration and time dependant. Thus it was believed that methanol extract of Capparis stylosa root can be used in aquatic environment for controlling predatory fish Channa punctatus population. Their piscicidal activity may be due to their adverse effect on respiratory as well as energy production of fish. The nature of the piscicidal action could be advantageous in aquatic environment.

INTRODUCTION

The presence of predatory and weed fishes in cultured pond is a serious problem for culturing edible freshwater fishes. These fishes adversely affect the cultured fish population in culture pond by sharing food and habitat of major cultivated carps. Channa punctatus is the common predatory fish which have low food value and due to predatory nature, they engulf the fingerlings of cultured carp at several stages of their rearing [1] and thus adversely effect the cultured carp production and put a great loss to the fish farmer. For eliminating the unwanted population of Channa punctatus from cultured ponds, fish farmers made several efforts, by using of synthetic pesticides [2]. Due to their long term persistence in the water and fish body, they adversely affect both the quality of fish and their status [34]. A better alternative for these harmful synthetic piscicides is environmentally safe plant origin piscicides which are less expensive, biodegradable, readily available, easy to handle and safe to mankind and environment [56].

A large number of plants belonging to different families [7] and their products [8] have been used for controlling unwanted fish population not only in India but also all over world [910]. The toxicity of plant extract to the fresh waterfish have been studied by number of investigators [879]. But the piscicidal activity of Capparis stylosa on the freshwater fish is not studied. Hence, the present paper deals with the piscicidal activities of methanolic extract of Capparis stylosa root on the common air breathing of predatory fish Channa punctatus.

MATERIALS AND METHODS

COLLECTION AND PREPARATION OF EXTRACT OF CAPPARIS STYLOSA ROOT

Capparis stylosa (Family – Capparidaceae) were collected locally from Kalvarayan kill in Villupuram district in Tamilnadu. Collected roots of Capparis stylosa were dried and ground to fine powder. The dried powdered roots were extracted in a Soxhlet apparatus by methanol for about 10 hours. The solvent was evaporated by atmospheric temperature. The dried extract was stored in airtight desiccators for further experiments.

COLLECTION AND STORAGE OF EXPERIMENTAL ANIMALS

Fish Channa punctatus (15.0 ± 2.5 cm length, 15.5 ± 2.5 g body weight) were collected from lakes situated in and around of Chidambaram, Cuddalore district and used as test animal. The collected fish were maintained in plastic trough containing 100 L of de-chlorinated tap water for acclimatization in laboratory condition at room temperature for one week. The trough water was aerated continuously and food was provided in the form of dried, oil cake, boiled

egg albumin and insect etc. Water was changed at every 24 hr. The dead animals (if any) were removed as soon as possible from test container to prevent water fouling.

TOXICITY EXPERIMENTS

The toxicity experiments was performed by the standard method [11]. The fishes were exposed for 24, 48, 72 and 96 hours at different concentration of methanolic root extract. Mortality was recorded at every 24 hr upto 96 hr exposure period. Fishes were considered dead if they failed to respond to stimulus provided with glass rod. The recorded mortality data was used to calculate the LC_{50} values, upper and lower confidence limits slope function and regression results according to probit log method [11]. The presumable harmless concentration of the toxicant was calculated using the formula given by Sprague [12].

RESULTS

ACUTE TOXICITY STUDIES OF THE CAPPARIS STYLOSA ROOT EXTRACT ON CHANNA PUNCTATUS

The acute toxicity studies of root extract Capparis stylosa were determined at different time intervals and presented Table 1 and Figure 1. The LC_{50} values for 24, 48, 72 and 96 hr were 144.54, 118.30, 104.13 and 89.33 ppm respectively. There was a significant negative correlation between LC_{50} values and exposure periods i.e. LC_{50} values decreased from i.e., 24 to 96 hr. If exposure periods increase the LC_{50} values decreases. 144.54 ppm (24 hr) > 118.30 ppm (48 hr) > 104.13 (72 hr) and > 89.33 ppm (96 hr). The similar trends were also observed in case of upper and lower confidence limits. The upper and lower confidence concentration of the plant extracts were 131.31, 169.67; 106.56, 129.78; 91.50, 114.68; 79.22, 97.40; for 24, 48, 72 and 96 hr respectively.

The slope functions were 1.3423, 1.3139, 1.3217, 1.999 for 24, 48, 72, 96 hr respectively. The regression equations were Y = 0.0972 x + 0.0087; Y = 0.1004 x – 0.00174; Y = 0.0998 x + 0.001; Y = 0.0998 x – 0.00061 for 24, 48, 72 and 96 hr respectively. The chi-square values were 0.740, 3.498, 1.566 and 0.431 for 24, 48, 72 and 96 hr. These chi-square values denote that there was no significant different between observed and expected mortality during the acute toxicity study.

The toxicity study shows the overall picture of test progress and indicates that the rate of mortality increased with increasing concentration of plant extract in a linear fashion.

The presumable harmless concentration of the plant extract to the fish, Channa punctatus was found to be 29.04 ppm during the present study of 96 hr exposure periods.

Figure 1

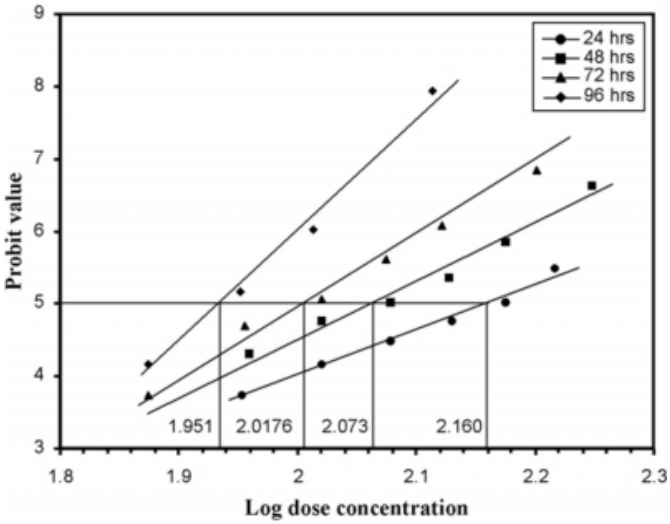
Table 1: LC values and regression equation results for treated with extract

Exposure period in hours	LC_{50} ppm	LCL ppm	UCL ppm	Slope function (S)	Regression equation	χ^2
24	144.54	131.31	169.67	1.3423	Y = 0.0972x + 0.0087	0.740^{NS}
48	118.30	106.56	129.78	1.3139	Y = 0.1004x – 0.00174	3.498^{NS}
72	104.13	91.50	114.68	1.3217	Y = 0.0998x + 0.001	1.566^{NS}
96	89.33	79.22	97.40	1.999	Y = 0.0998x – 0.00061	0.431^{NS}

LC_{50} – 50% Mortality
LCL – Lower confidence limit
UCL – Upper confidence limit
NS = No significant difference between observed and expected values

Figure 2

Figure 1: Acute toxicity of root extract on



BEHAVIOUR STUDIES OF THE CAPPARIS STYLOSA ROOT EXTRACT ON CHANNA PUNCTATUS

During acute toxicity studies of exposures to methanol root extract of Capparis stylosa caused significant behavioural changes in the test fish Channa punctatus. During the exposure period the fish initially settled down at the bottom of the test trough. Within 5-10 minutes, the fishes felt suffocation and they came to the water surface for gasping the air. As exposure period increases surfacing phenomenon of fish increases, showed rapid movement, faster opercular

activity, erratic swimming with rapid jerky movements, hyper excitability, spiraling, convulsion and tendency of escaping from the plant extract of Capparis stylosa toxicant water. However, the above activities of Channa punctatus related to concentration of plant extract. These prominent changes were increased in higher concentration of plant extract during short term exposure. It was observed that with increasing exposure time, these activities were relatively increased initially and subsequently reduced expressing the sign of distress. Besides an interesting observation was noted that the fish had visible increase in body dispigmentation along with profuse mucus secretion and coagulation all over the body with an increase in exposure time in acute (96 hrs) exposure. The fish slowly moved upward in a vertical direction. Thereafter fish became progressively lethargic and lost their sense of equilibrium completely. Ultimately the fish laid down on the bottom of fish trough at 96 hours of short term exposure.

DISCUSSION

The toxicity data of the present study indicate that the significant positive correlation between dose and mortality. It may be due to increased concentration of extract in trough water and resulted in more intake or entry of active moieties in the fish body. This trend is also dependent on several factors such as, rate of penetration, nature of slope, variability of active moieties, etc. [$_{13}$].

The steep slope values indicate that there is a large increase in the mortality of fishes with relatively small increase in the dose of different treatments. There is no significant different between observed and expected mortality. Since calculated chi-square values are less than the table chi-square value. Thus, it is expected that Capparis stylosa will be a useful for killing predatory fish in fish and shrimp farms.

Toxicity experiments showed that methanol extract of Capparis stylosa root, caused significant behavioural changes in fish Channa punctatus. Animal behaviour is a neurotropically regulated phenomenon, which is mediated by neurotransmitter substances [$_{14}$]. In the present study the abnormal behaviour of the fish may be accumulation of acetylcholine in the neuromotor regions. The initial increase in opercular movement can be taken as index of the stress felt by the fish exposed to plant extract trough. Subsequent decrease in opercular movement may be construed a passive response to prevent excess entry of extract molecule present in the medium to minimize damage to gill epithelium [$_{15}$]. Similar behavioural responses were also observed in exposed fishes [$_{1617}$].

The potential for using root extract of Capparis stylosa for killing predatory fish in freshwater fish farm. However, the effective concentration must be determined against the predatory air-breathing fishes such as Clarias sp., Channa punctatus, Channa striatus and Anabas testudineus that are generally more tolerant of toxicants than other fishes. The demand for good piscicides (cheap, efficient and safe for consumers) has increased with the further expansion of aquaculture.

The control and eradication of unwanted fishes in the pond requires the use of effective piscicides. Most of the fish farmers resort to the use of chemical piscicides that prove to be very effective although these chemicals are rather dangerous to the environment and can do more harm than good. Alternative piscicides that are not hazardous to the environment and have shorter residual effects must be used. The results of the study showed that locally available plants to be used as piscicide which can be an alternative to harmful chemical piscicides that can be widely used today to eradicate unwanted fishes in the ponds.

Further studies must be conducted to suitability of the extract on other species of the ecosystem. The use of other extraction methods and other predatory fishes must be considered in future investigations.

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References

1. Jhingran V.G. (1975). Fish and fisheries of India. Hindustan Publishing Corporation (India), New Delhi, pp. 954.
2. Marking L.L. (1992). Evaluation of toxicants for the control of carp and other nuisance fishes. Fisheries 17: 6-12.
3. Cullen M.C. and Connell D.W. (1992). Bioaccumulation of chlorohydrocarbon pesticides by fish in the natural environment. Chemosphere 25(11): 1579-1587.
4. Waliszewski S.M. et al. (1999). Organochlorine pesticides residues in Human Blood Serum of inhabitants of Veracruz, Mixco. Bull Environ Contam Toxicol 62: 397-402.
5. Marston A. and Hostettmann K. (1985). Plant

molluscicides. Phytochemistry 24: 639-652.
6. Singh A. Singh D.K. Mishra T.N. and Agarwal R.A. (1996). Molluscicides of plant origin. Biol Agri Hort 13: 205-252.
7. Kulakkattolickal A.T. (1989). Piscicidal plants of Nepal: ripe fruit of Catunaregam spinosa (Thunb.) (Rubiaceae) and leaves of Polygonum hydropiper L. (Polygonaceae) as fish poisons. Aquaculture 78: 293-301.
8. Bhatia H.L. (1970). Use of Mahu oil cake in fishery management. Indian Farming 20: 39-40.
9. Tiwari S. (2003). Studies on toxicological and biochemical effect of active compounds extracted from some common plants on fresh water predatory fish Channa punctatus. Ph.D. Thesis, DDU Gorakhpur University, Gorakhpur, India.
10. Chiayvareesajja S. Mahabusarakam W. Maxwell J.E. Wiriyachitra P. and Towers G.H.N. (1987). Thai piscicidal plants. J Sci Soc Thailand 13: 29-45.
11. Finney, D.J. (1971). Probit analysis. S. Chand and Company Ltd. Ram Nagar, New Delhi, pp. 333.
12. Sprague, J.B. (1971). Measurement of pollutant toxicity to fish bioassay methods for acute toxicity. Water Res 5: 245-266.
13. Bullock T.H. et al. (1977). In: Introduction to nervous system (ed. D. Kennedy), W.H. Freeman and Company, San Francisco.
14. Sambasiva Rao K.R.S. (1999). Pesticide impact on fish metabolism. Discovery Publishing House, New Delhi (India), pp. 66-70.
15. Gill T.S. Pandey J. and Tewari H. (1991). Individual and combined toxicity of common pesticides to teleost, Puntius conchonius, Hamilton. Indian J Exp Biol 29(2): 145-148.
16. Siva Prasad Rao K. (1980). Studies on some aspects of metabolic changes with emphasis on carbohydrate utility in the cell free system of the teleost, Tilapia mossambica under methyl parathion exposure, Ph.D. Thesis, S.V. University, Tirupati, India.
17. Goodmann L.S. Gillman A.G. Rall T.W. and. Murad F. (1985). The pharmacological basis of therapeutics. Macmillan Publishing Company, New York.

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