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Toxicology.

EFFECTS OF SOME PLANT TOXINS ON FEEDING AND GROWTH RATE OF *BARILIUS BENDELISIS* (HAM.)

WPŁYW NIEKTÓRYCH TOKSYN NA INTENSYWNOŚĆ ŻEROWANIA I SZYBKOŚĆ WZROSTU *BARILIUS BENDELISIS* (HAM.)

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Tests conduced in the laboratory indicated that feeding rate in *B. bendelisis* exposed with safe concentrations of *Aesculus indica* (10 mg^{-1}), *Engelhardtia colebrookiana* (8 mg^{-1}), *Lyonia ovalifolia* (20 mg^{-1}) and *Zanthoxylem alatum* (2 mg^{-1}) was reduced 37.3%, 39.0%, 17.12%, 47.3% (natural) and 33.5%, 48.0%, 16.3%, 51.5% (artificial) respectively as compared to the non toxicated fish. Growth analysis made at chronic level showed that initially, there was a decline in the weigth of fish due to less uptake of food and gradually the length was retariled. The study suhhested that since the active compounds of piscicidal plants, at safe concentration level affected the laste system of fishes. Consequently the rate of fedding was inhibited. The less feedinig and metabolic discorders found expression as a decline in the total growth of treated fish. It was evident that the proncíples of *A. indica* and *E. colebrookiana* were comparatively more growth inhibitors than *L. avalifolia* and *Z. alatum*.

INTRODUCTION

Feeding and growth being important parameters of fish bilogy and in fisheries mangement, have already been studied by numerous ichthyologists and the impacts of aquatic hazard process on fish are also assessed in recent past by Rosenthal and Alderdice (1976), Nagendran and Shakuntala (1979), Stebbing (1981), Cairns (1984), Woltering (1984), Dave (1984), Dąbrowski (1984), Sarkar and Konar (1985), Arunachalam et al (1985) and others. But the information about the effects of plant toxins on feeding and growth of fish is scanty (Leonard, 1942; Marking, 1970; Loeb and Heg, 1970; Bhatt and Singh, 1985, 1988; Bhatt et al, 1987). However, because of poor feeding and slow experienced growth among the individuals of *Barilius bendilisis*, it was desirable to find out the fall in the both of the aforesaid parameters for the extracts of *A. indica*, *E. colebrookiana*, *L. ovalifolia* and *Z. alatum*.

MATERIAL AND METHODS

A. Collection of plants and extraction of their active proinciples.

Piscicidal plants viz *Aesculus indica*, *Engelhardîta colebrookiana*, *Lyonia ovalifolia* and *Zanthoxylem alatum* oftenly used in Garhwal region were collected, air dried, powdered mechanically and extraced with 70% ethanol. The extracts then concentrated at reduced pressure were finally dried in vacum desicator. The residues were fractinated with Benzene, n-Butanol an chloroform – methanolw – water. The fractions of each plant so obtained have been subjected to isolate thair actiwe principles through coluum chromatography (Farswan, 1988). The isolated compounds were dried and 1% aquous solution of each compound was prepared to be used.

B. Acclimatization of test fishes.

Fry of 16 - 22 mm and 15 - 40 mg and adukts of 79 - 210 mm and 35 to 239 mg (*Barilius bendelisis*) collected from the shallow pockets of nearby streams. They were acclimatized in the laboratory (water temp. 16 - 20° C, pH 7.62, Do 6.54, free Co2 3.5 pp. and experiments and were fed daily with the algae and rice cakes.

C. Measurements on growth rate.

Before starting experiments, the initial length and weigth was recorded on 40 individuals of each group. The same number of fry and adults were placed into the different (4.4) glass troughs inclui ng their respective control sets. Bioassays were conduced at the sublethal concentration levels of *A. indica* (10 mg^{-1}), *E. colebrookiana* (8 mg^{-1}), *L. ovalifolia* (20 mg^{-1}) and *Z. alatum* (2 mg^{-1}) and *Z. alatum* (2 mg^{-1}) for 32 daxs. The total growth of controlled and toxicated fishes was calculated at the termination of experiments using the least aquare method or straight line equation,

$$\text{Log } Y = a + b \log x$$
$$Y = \text{body weigth}$$

x = body length
a and b = parameters

D. Effect on food consumption;

The healthy adults of *Barilius bandelisis* acclimatized in the laboratory for 7 days, were devided in two groups and five fishes from each gropup were kept into the experimental troughs (4.4) including the control sets. Individuals of one set were provided the semidried algae and others were fed with rice cake. The food was put in patre dishes. The observations on each set of experiments were made for seven days and repeated twice. The balance food from the patre dishes was separated, dried and weighed. The rate of feeding was expressed in mg food (live fish) day (Maynard and Looshi, 1962; Arunachalam et al 1985).

RESULTS AND DISCUSSION

Abundant information is availvble in the deleteroius effects of the industrial, agricultural and domestic on the feedings and early growth of fish. However, the effects of piscicidal compounds of plants on fish have not so far been studied in detail. The results of the present study (Table 1) indicated that

Table 1

L c 50 Value (mg^{-1}) of plant principles to *B. bendelisis* (Ham)

Plant Principle	Time interval (hrs)				
	12	24	48	72	96
Aesin based glycoside (*A. indica*)	125.5	114.5	101.5	94.5	83.5
Quercetine base glycoside (*E. colebrookiana*)	64.0	55.0	42.0	35.0	27.0
Glycoside freesterol (*L. ovalifolia*)	183.0	167.0	145.0	130.0	115.0
Bitter Principle (*Z. altum*)	12.1	10.2	9.0	7.0	5.5

a small dose of *A. indica* (100 mg^{-1}), *E. colebrookiana* (40 mg^{-1}), *L. ovaliflia* (140 mg^{-1}) and *Z. alatum* (8 mg^{-1}) was quite lethal to the fry and adults of *B. benelisis*.

Feeding being a major activitx of fish, many fold impacts of hazard on food cinsuption of various fish species have already been described by several workers in past. Bask and Konar (1977) reported thet Carp, Singhi and Tilapia reared in an insecticide (Dimethoete) showed a very low rate of feedind and they could, consume 10 - 19% abd 19 - 34% less amount of food in a comparision to the normal fishes. Similarly, regular decrease in the uptake of food was observed in *T. mossambica* exposed with ammonium sulphate for a longer

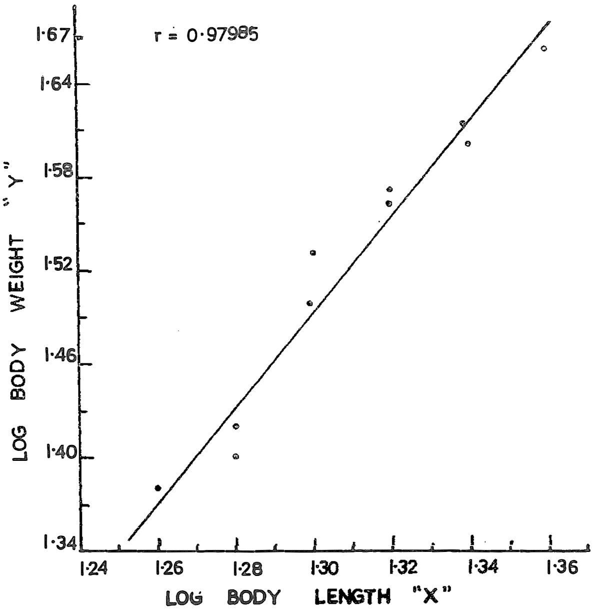

Fig. 1. Growth rate in normal fry of *B. bendelisis*

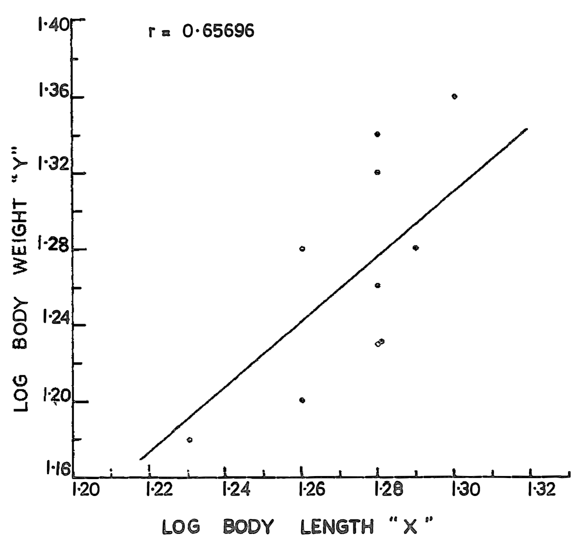

Fig 2. Growth rate in *A. indica* treated fry of *B. bendelisis*

period (Sarkar and Konar, 1985). However, recently Marking et al (1984) illustarted that rainbow trout treated with eleven chemicals, fed normally. Arunachalam et al (1985) found that *C. puntatus* put in 5 ppm carbaryl solution consumed 0.92 mg dry food (live fish) day as compared to normal fishes those consumed 4.7 mg dry food (live fish) day.

Such contradictory findings of the earlier workers need to be explained in terms of aeveral factors. The food cinspuption certainly depended upon the nature and mode of action of the toxicant, dietary habit and sensitivity of a particular fish species, and length of the exposure. During the tenure of present study (Fig. 6, 7) *B. bendelisis* exposed with safe concentrations of *A. indica* (10 mg^{-1}) *E. colebrookiana* (8 mg^{-1}) *L. ovalifolia* (20 mg^{-1}) and *Z. alatum* (2 mg^{-1}) consumed 37.33%, 39.9%, 17.16%, 47.33% (natural) and 33.53%, 48.00%, 16.33%, 51.5% (artificial) respectively in contrast to the toxicated fish. At this level fish neither expered nor presented any visible response to the poisons but feeding was significantly inhibited. Fishes exposed below these concentrations fed in an usual manner, while those treated with higher doses sould not survive.

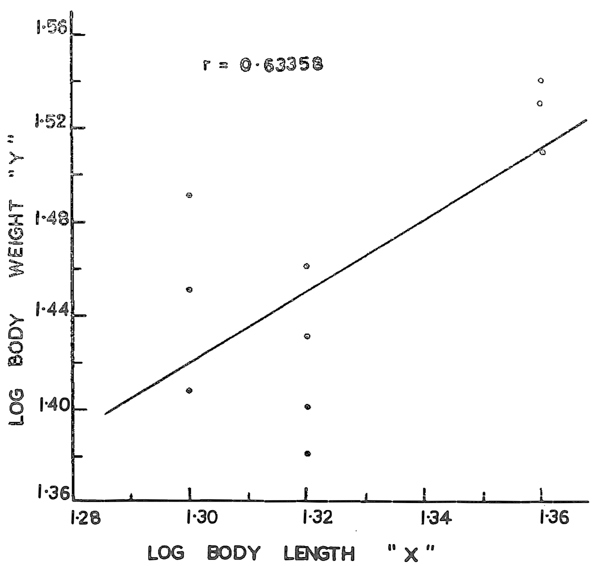

Fig. 3. Growth rate in *E. colebrookiana* treated fry of *B. bendelisis*

Since vision (Bhatt and Singh, 1980), teaste (Atema, 1971) and olfaction (Kapoor and Ojha, 1973) play an important and leading role in the feeding of osh, the most probable consequence of their degradation moght have adversely influenced the rate of food uptake in fish. *B. bendelisis* besides sight, also feed with mouth taste (Badola and Singh, 1980). Bardach et al (1965) have stated

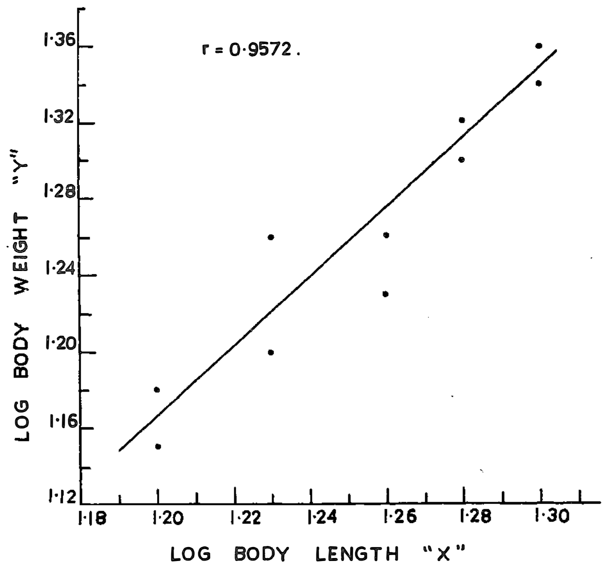

Fig. 4. Growth ratw in *L. ovalifolia* treated fry of *B. bendelisis*

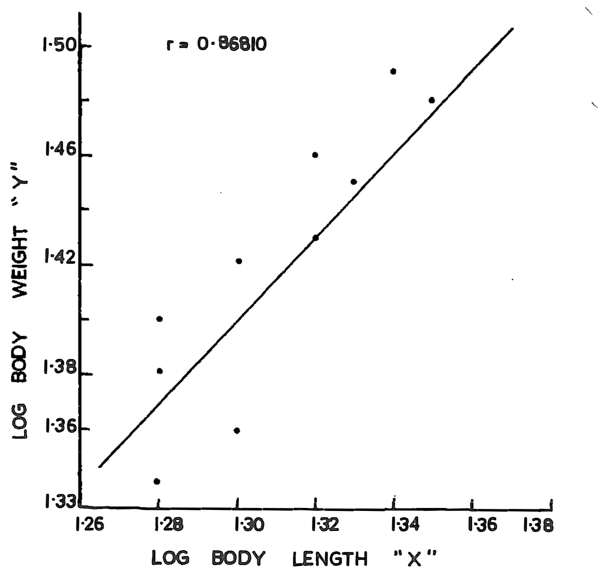

Fig. 5. Growth rate in *Z. alatum* treated fry of *B. bendelisis*

that the rate of food consumption in a detergent treated fish was degraded due to the degeneration of taste buds. Since these plant toxins affected the receptor of fish (Bhatt and Singh, 1985), certainly they inhibited the food finding ability of fish.

Sprague (1970, 1976) opined thet growth should routinely be measured in all chronic experiments and he considered it one of the 75 Critaria, as a basis for the hazard evaluation. Rosenthal and Alderdice (1976) reviewed that the primary (hidden) effects of certain toxicants on the early development stages come as the secondary quantifiable effects whose consequences later on, may find expression as tertiary effects. Many toxicants are known to have the deleterious effects on the survival, growth and reproduction of fish (Jonson, 1968; Epa Ram 1971; Mckim et al 19788 Manoharam and Subbiah, 1982; Sarkar and Konar, 1985; Mani and Konar, 1985 and Arunachalam et al 1985).

Jhingaran (1982) in his book "Fish and Fisheries of India", reported that a rabge of 12 - 28° C temperature, 5 - 10.5 ppm dissolve oxygen, 7.45 - 8.3 pH and 72 - 212 ppm alkalinty is suitable for the normal growth of fish. During the course of present study, therefore, the physio-chemical parameters of the test water were maintained with in the above prescribed range in order to avoid their ill effects on fish. Hence, the fry of *B. bendelisis* exposed with the concentration, 2 mg^{-1}, 8 mg^{-1}, 10 mg^{-1} and 20 mg^{-1} of *Z. alatum*, *E. Cilebrookiana*, *A. indica* and *L. ovalifolia* respectively for 32 days, showed a remarkable decline in their growth (Fig. I). According to Rosenthal and

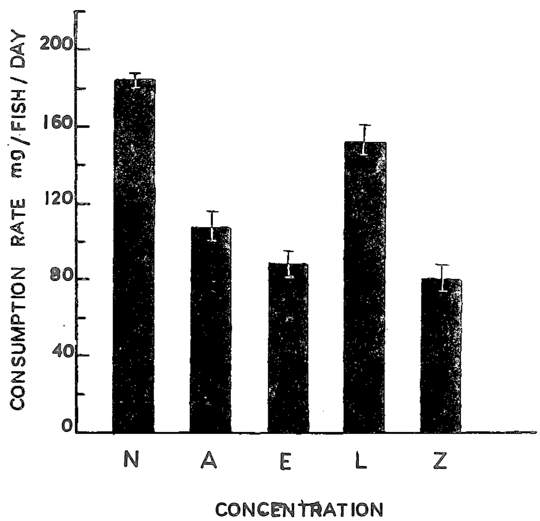

Fig. 6. Mean of food (artificial) consumption rate in *B. bendelisis* at different exposures N – Fry not treated (normal fry); A – *Aesculus indica*; E – *Engelhardtia colebrookiana*; L – *Lyonia ovalifolia*; Z – *Zanthoxylem alatum*

Alderdice (1976) the toxicated fish become more susceptible to be damaged and diseased that might be due to less consumption of food and indequate conversion efficiency in such unviduals (Larsson et al 1985; Leduc, 1978 and Rowe et al 1983 b). The molicular basis of these finding later on, are interpreted by Stebbing (1981, 1982), Taylor (1985) and Lewis and Weber (1985). Who have stated that the toxicant induced stimulations (hormesis) influence the interation of fish towards the food particle. This condition evidently inhibited the development of fish. Thus inefficiency to compete the suitable habitat, delayed maturation and reproduction, abnormal behaviour and physiological disorders are all possible out breaks of reduced growth, However, the toxic principlas of *A. indica*, *E. colebrookiana*, *L. ovalifolia* and *Z. alatum* affected the feedings, respiration and sensory mechanism in *B. bendelisis* (Bhatt and Singh 1985, 1988). Such alterations might have disturbed te metabolic pathways in the fish.

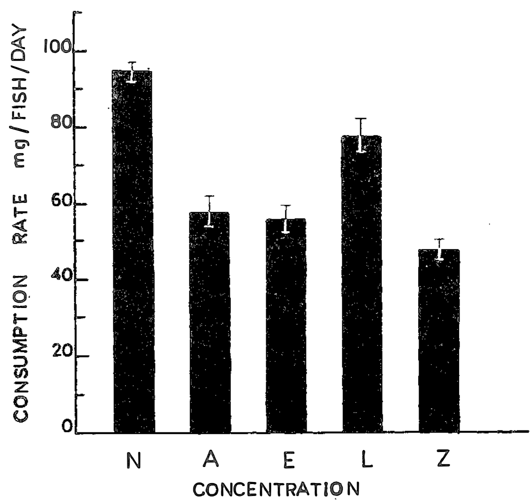

Fig. 7. Mean of food (natural) consumption rate in *B. bendelisis* at different exposures N – Fry not trested (normal fry); A – *Aesculus indica*; E – *Engelhardtia colebrookiana*; L – *Lyonia ovalifolia*; Z – *Zanthoxylem alatum*

Primarily there appeared a fall in the weight which gradually followed by the decline in the length (Fig. 4, 5, 6, 7). Thus the present findings support the study of Webb and Brett (1973) and Manoharan and Subbiah (1982), who have expressed that pesticides, in general act as Metabolic stressors and centainly may decline the conversion efficiency and growth of fish. Present study also showed that the inhibition in the growth was more among the individuals exposed with *E. colebrookiana* (r = 0.633 and *A. indica* (r = 0.659) than those treated with *Z. alatum* (r = 0.868) and *L. ovalifolia* (r = 0.957).

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WPŁYW NIEKTÓRYCH TOKSYN ROŚLINNYCH NA INTENSYWNOŚĆ ŻEROWANIA I SZYBKOŚĆ WZROSTU *BARILIUS BENDELISIS* (Ham.)

STRESZCZENIE

Przeprowadzone w warunkach laboratoryjnych badania wykazały spadek intensywności żerowania *B. bendelisis* pod wpływem uznanych za bezpieczne stężeń toksyn *Aesculus indica* (10 mg^{-1}), *Engelhardtia colebrookians* (8 mg^{-1}), *Lyonia ovalifolis* (20 mg^{-1}) i *Zanthoxylem alatum* (2 mg^{-1}).

Spadek ten wynosi odpowiednio 37,3%, 39,0%, 17,2% i 47,3% (dla pasz naturalnych) oraz o 33,5%, 48,0%, 16,3% i 51,5% (dla pasz sztucznych w porównaniu z próbą kontrolną.

Analiza wzrostu ryb wykazała początkowy spadek ich masy ciała wynikający z mniejszego pobierania pokarmu, przy jednoczesnym, stopniowym hamowaniu przyrostu długości. Wyniki badań sugerują, że aktywne związki wytwarzane przez rośliny wodne w bezpiecznych stężeniach, oddziaływały na ryby, hamując intensywność żerowania. Mniejsze pobieranie pokarmu i zaburzenia metabolizmu znalazły wyraz w spadku wzrostu doświadczalnych ryb. Jednocześnie związki wytwarzane przez *A. indica* i *E. colebrookiana* hamowały wzrost ryb w większym stopniu niż *L. ovalifolis* i *Z. alatum*.

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