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NOTE

THE EFFECT OF MERCURY ON THE GROWTH EFFICIENCY OF *TILAPIA MOSSAMBICA* (PETERS)

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ABSTRACT

Three concentrations of mercury (0.01, 0.04 and 0.4 ppm) were used for experiments on growth efficiency of *T. mossambica*. Growth efficiencies were determined on a dry weight basis. High concentration of mercury (0.4 ppm) caused considerable reduction in the growth rate and conversion efficiencies.

Key-words : Growth efficiency, mercury, *Tilapia mossambica*.

Many metals occur in nature and their presence in traces in the aquatic environment is essential for the normal metabolism of aquatic organisms. Literature on this subject is mostly devoted to discussions on the effects of these metals on the mortality of aquatic animals (Connor, 1972; Calabrese, Collier, Nelson and McInnes, 1973). Nevertheless, physiological damage may also be as important as mortality.

Growth of any organism, such as fish, can be regarded as a positive indication of a process tending to increase the body mass due to adequate food intake and conversely of a process tending to decrease the body mass due to metabolic expenditure (Huisman, 1976). The efficiency with which food is converted into body tissue is termed as 'growth efficiency'. Experimental work on growth efficiency may offer some important clues in regard to the ecological success of an organism (Kinne, 1960).

In the present investigation, the effects of 3 different concentrations of mercury (0.01, 0.04 and 0.4 ppm), on the growth rate and conversion efficiencies of the fish *T. mossambica* have been studied. Dry pelleted feed, made from a mixture of prawns and wheat flour in the proportions of 4 : 1 was used as experimental food. This food was readily accepted by the fish and was found to provide enough nutrition to maintain them in an active condition. The 48-h LC50 value of mercury to *T. mossambica* was 1.0 ppm (Menezes and Qasim, 1983).

Specimens of *T. mossambica* (5.8–7.6 cm) were sorted in 4 groups of 10 each. They were acclimated to the respective food combinations (dried prawns 4 parts, wheat flour 1 part) for 10 days at 29 ± 1°C. Food was withheld for 48 hrs before the test.

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At the beginning of the experiment, five fishes were selected randomly from each tank and were sacrificed, to determine the initial weight. From the stock preparation of the metal (mercuric chloride), serial dilutions were made using fresh water to yield the desired concentrations of 0.01, 0.04 and 0.4 ppm of mercury respectively. Five fishes from each stock tank were subjected to each of the test concentrations and the same numbers were maintained in freshwater as the controls. The test solution (20 litres) were aerated continuously to maintain the required concentrations of dissolved oxygen. The fishes were fed *ad libitum* and the amount of food consumed throughout the experimental period was recorded. The faecal matter was collected every morning from each tank and its dry weight was recorded. The medium was changed every alternate day without disturbing the individuals. At the end of the experiment, all the fishes were sacrificed for determining the final weight changes. All analyses were made on the material dried in an oven at 80°C until weight constancy was attained. The experiments were duplicated and satisfactory reproducibility in the results was noted. Calculations of energy conversion were made using the equations given by Crisp (1971) and Qasim and Easterson (1974). The basis, however, of calculation was dry weight and not calories. Throughout the dry weights were used for the actual conversion indices from food to animal tissue (growth efficiency or conversion rates).

The results of the experiments on food consumption and growth rates are summarized in Table I. Fish in the control tanks fed voraciously and feeding became progressively less intense in the test tanks from 0.01 to 0.4 ppm

Table .I. Food intake and growth efficiencies of *T. mossambica*, exposed to different concentrations of mercury. The values are in dry weight (g) per animal. Experimental period was 13 days.

Experimental series (ppm, mercury)	No. of fishes tested	Initial average wt. W_1	Final average wt. W_2	Mean wt. $\bar{W}$	Production $P=W_2-W_2$	Food consumption C	Faecal output F	Relative growth rate $P/\bar{W}/13$
Control	5	1.05	1.71	1.38	0.66	3.168	0.166	0.03678
(0.01)	5	1.0	1.42	1.21	0.42	2.638	0.134	0.02670
(0.04)	5	1.02	1.29	1.155	0.27	1.99	0.10	0.01798
(0.4)	5	1.32	1.15	1.235	—	0.642	0.009	-0.01058

Experimental level (ppm, mercury)	Assimilation A C–F	Metabolism R A–P	Assimilation efficiency A/C (%)	Gross growth efficiency $K_1=P/C$ (%)	Net growth efficiency $K_2=P/A$ (%)	Consumption unit wt/day C/W/13
Control	3.002	2.342	94.76	20.83	21.98	0.18
0.01	2.504	2.084	94.92	15.92	16.77	0.17
0.04	1.89	1.62	94.97	13.56	14.28	0.10
0.4	0.633	0.803	98.59	—	—	0.04

of mercury. Higher concentrations of mercury also caused considerable reduction in the growth rate at the end of the test period which lasted for 13 days. The consumption of food was markedly reduced in the test tanks. In the 0.4 ppm, only 0.64 g food was consumed in 13 days as compared to 3.16 g in the control. Growth was completely suppressed in 0.4 ppm mercury thus yielding a loss in weight of 0.17 g. The growth efficiencies (K_1 and K_2) values showed a decreasing trend from the control to 0.4 ppm mercury used. In the controls, the growth efficiency (K_1) was about 21% while in 0.01 and 0.04 ppm of mercury, it was 15.9 and 13.56% respectively.

Pandian and Raghuraman (1972) obtained growth efficiencies (K_1) of 5, 9 and 24% for *T. mossambica* fed on *Tubifex tubifex* worms at the maintenance, optimum and maximum feeding levels respectively. The assimilation or absorption efficiency of the fish in the control was found to be 94.76%. Mathavan, Vivekanandan and Pandian (1976) also obtained high absorption efficiencies of 94% for *T. mossambica* fed on different combinations of plant and animal foods. In 0.01, 0.04 and 0.4 ppm of mercury, the assimilation efficiency of the fish was higher, but K_1 and K_2 values, relative growth rate and consumption per unit wt. were low, thereby showing that the food was in readily assimilable form but the fishes ate a small quantity and converted little of it into body tissue.

Mercury enters organisms by absorption through free surface such as skin or gills (Hannerz, 1968), by intake of water or food containing mercury compounds. Once in the organism, mercury and its compounds show pronounced and manifold biological effects (Friedman, 1957). Significant changes were seen in the serum protein patterns of *T. mossambica* after 48 hrs and 72 hrs exposure to 0.4, 0.6 and 0.8 ppm of mercury (Menezes and Qasim, 1984). The biological effect of mercury is strongly dependent on its concentration, chemical form and the organism and seem to be proportional to their ability to yield active inorganic mercury ions (Rowland, 1952) which probably react with thiols in proteins and enzyme systems forming mercury mercaptidt (Webb, 1966). Most experiments have lasted only a few hours or days and relate to acute toxicity; hence, reported toxic concentrations may be misleadingly high. Growth is an important index of the well being of natural fish populations. In other words, a measure of change in the growth rate of a species could be used as a criterion of pollution as outlined by Davis and Warren (1968).

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