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Effect of diethylstilbestrol on growth and food conversion of common carp, *Cyprinus carpio* (Linn.)

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Abstract. Diethylstilbestrol, an estrogen, was administered through diet to fingerlings of common carp, *Cyprinus carpio* at concentrations of 0, 1, 3 and 5 ppm over a period of 98 days and its effects on growth and food conversion efficiency were evaluated. The experiment was conducted in 12 cement cisterns of 25 m^2 area each. Fishes were fed daily at the rate of 5% of body weight. Diethylstilbestrol incorporated diets induced faster growth and better food conversion efficiency as compared to the control. Among the dosages tried, 3 ppm treatment yielded the best growth. The faster growth in diethylstilbestrol treated groups was significantly different ($P < 0{\cdot}05$) from that of the control.

Keywords. Diethylstilbestrol; *Cyprinus carpio*; growth.

1. Introduction

Hormones as feed additives are finding increased application in fish culture as a means of inducing fish growth, thereby bringing down the cost of fish production. A variety of hormones, both natural and synthetic, have been evaluated for their anabolic properties in fish. Of these, androgens have given more consistent results than estrogens, which have yielded contradictory growth responses in fish (Donaldson *et al* 1979). Diethylstilbestrol (DES), a synthetic estrogen, yielded negative growth response in channel catfish (Bulkley 1972), rainbow trout (Ghittino 1970; Matty and Cheema 1978) and coho parr (Fagerlund and McBride 1975). However, investigations on plaice, *Pleuronectes platessa* (Cowey *et al* 1973), *Channa striatus* (Nirmala and Pandian 1983) and carps (Reddy *et al* 1987; Basavaraja N, Nandeesha M C and Varghese T J, unpublished results) indicated its effectiveness as a growth promoter. Considering the relatively few trials conducted employing estrogens and also the encouraging results obtained in some of the earlier experiments, the present study was taken up to evaluate the growth promoting ability of DES in the common carp, *Cyprinus carpio*.

2. Materials and methods

The experiment was conducted in 12 similar cement cisterns of 25 m^2 ($5 \times 5 \times 1$ m) area each. The cisterns were cleaned thoroughly, dried and filled with freshwater to a depth of 65 ± 5 cm.

Eight fingerlings of common carp having an average size of 1·6 g, were stocked in each cement cistern. The water in the cisterns was periodically replenished to avoid deterioration in water quality and development of plankton. The experiment was conducted in triplicate for a period of 98 days.

Standard pelleted fish-feed developed at the College of Fisheries, Mangalore

(Varghese *et al* 1976) was used as the medium of hormone administration. Details of the composition of the experimental diets are given in table 1. The required quantities of DES were weighed accurately and dissolved in 95% ethanol. The hormone dissolved ethanol was sprayed on cooked and cooled feed mixture. The DES was incorporated in the diet at dosage levels of 1, 3 and 5 mg/kg. After thorough mixing, the dough was pelletized and dried at a temperature below 50°C to a moisture content of less than 10%. Control diet was also prepared in the same manner using only ethanol. The diet used had 30·48% protein, 5·26% fat, 11·37% fibre, 15·78% ash, 28·50% N-free extract and 13144 joules/g calorific content.

The experimental fish were sampled at fortnightly intervals to assess the growth. After every sampling, the quantum of feed to be given was readjusted in accordance with the fish weight. Water quality parameters of the experimental cisterns, such as pH, temperature, dissolved oxygen, free carbon dioxide and total alkalinity, were monitored at fortnightly intervals. On termination of the experiment, all the surviving fishes were collected by dewatering the cisterns and their individual weights recorded. Growth data were analysed by employing '*t*' test to test for significant difference between final average weights of experimental groups and the control. The percentage specific growth (SGR) and food conversion efficiency (FCE) were calculated using the following formulae.

$$\% \text{ SGR} = \frac{\log W_2 - \log W_1}{T_2 - T_1} \times 100.$$

Where W_2 = weight at time T_2; W_1 = weight at time T_1.

$$\text{FCE} = \frac{\text{Weight gain (g)}}{\text{Feed intake (g)}} \times 100.$$

3. Results

The survival of the experimental fish was 75% in control, 1 and 5 ppm treatments, whereas it was 83·3% in 3 ppm treatment. Data on the growth of fish in different treatments are given in table 2 and figure 1. From this data it is evident that the fish administered DES grew significantly faster than the controls ($P < 0{\cdot}05$). Average net gain in weight was the highest in 3 ppm treatment (64·60 g) followed by 5 ppm (54·90 g), 1 ppm (50·9 g) and control (45·20 g), the corresponding average daily increments in weight being 0·66, 0·56, 0·52 and 0·46 g. Specific growth rate values of

Table 1. Percentage composition of the experimental diets.

	Diets			
Ingredients	Control	1 ppm	3 ppm	5 ppm
Rice bran	40	40	40	40
Fish meal	25	25	25	25
Oil cake	24	24	24	24
Tapioca	10	10	10	10
Mineral mix (Nuvimin forte)*	1	1	1	1
DES (mg/kg)	—	1	3	5

*Sarabhai Chemicals, Baroda.

Table 2. Effect of DES supplementation on growth of *C. carpio.*

Parameter	Treatments			
	Control	1 ppm	3 ppm	5 ppm
Average initial weight (g)	1·60	1·60	1·60	1·60
Average final weight (g)	46·80 ± 15·27	52·50 ± 7·10*	66·20 ± 26·04*	56·50 ± 9·53*
Net weight gain (g)	45·20 ± 15·27	50·90 ± 7·10	64·60 ± 26·04	54·90 ± 9·53
Weight gain over control (%)	—	12·61	42·92	21·46
Food conversion efficiency (%)	43·09 ± 3·35	48·07 ± 0·92	51·21 ± 5·28	48·84 ± 8·02
Specific growth rate (%)	3·42 ± 0·34	3·56 ± 0·14	3·72 ± 0·39	3·60 ± 0·19

*Significant at 5% level.

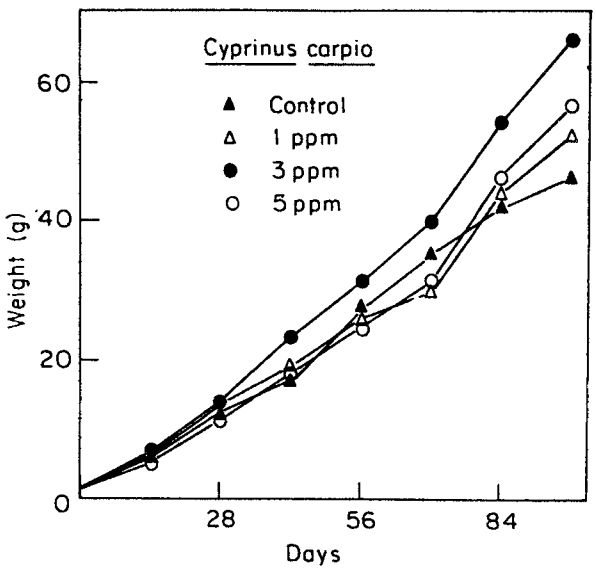

Figure 1. Average weight attained by common carp in different treatments.

3·42, 3·56, 3·72 and 3·60 were recorded for fishes under control, 1, 3 and 5 ppm treatments respectively. Better FCE was recorded in the steroid fed groups (table 2), the values being 43·09, 48·07, 51·21 and 48·84% in control, 1, 3 and 5 ppm treatments respectively.

4. Discussion

The results of the study clearly show that the dietary incorporation of DES significantly enhances growth ($P < 0·05$) in common carp. The percentage weight gains over control in the different treatments were 12·61, 42·92 and 21·46 in 1, 3 and 5 ppm treatments respectively. On the basis of the net percentage weight gain over the control, it appears that DES at 3 ppm level induces the best growth. Values of specific growth rate obtained also support this observation. While treating common carp with DES at concentrations of 5 and 10 ppm it was observed that the former

dosage induced growth and the latter resulted in growth depression (unpublished results). Hence, at higher levels DES appears to act catabolically resulting in growth depression. Growth promotion on DES administration was reported by Cowey *et al* (1973) and Nirmala and Pandian (1983). On the other hand, Bulkley (1972), Chittino (1970), Fagerlund and McBride (1975) and Matty and Cheema (1978) observed depression of fish growth on treatment with DES. However, trials conducted in carps have given encouraging results (Reddy *et al* 1987; Basavaraja N, Nandeesha M C and Varghese T J, unpublished results). The results of the present study also support the anabolic properties of DES on carps and indicates that the optimum dosage of DES required for growth promotion in common carp is around 3 ppm.

Increase in FCE was noticed in the steroid treated groups. The percentage increase in FCE were 11·56, 18·84 and 12·95 in case of 1, 3 and 5 ppm treatments respectively. The results of the present study have great economic implications in intensive carp culture since supplementary feeding alone accounts for about 50% of cost of fish production. The percentage increase in food conversion efficiency in 3 ppm DES treatment reveals that the cost of production can be brought down considerably by incorporation of DES in the diet at this level. Due to incorporation of DES at 3 ppm level, the cost of feed will increase only by about 20 paise per kg at the present price of the steroid. Though steroid hormones are reported to be metabolised and excreted from the body quickly, it is necessary to reconfirm this before advocating the use of DES as a feed additive in carp culture.

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References

Bulkley R N 1972 Diethylstilbestrol in catfish feed; *Trans. Am. Fish. Soc.* **101** 537–539

Cowey C B, Pope A J, Adron J W and Blair A 1973 Studies on the nutrition of marine flatfish. The effect of oral administration of diethylstilbestrol and cyproheptadine on the growth of *Pleuronectes platessa*; *Mar. Biol.* **19** 1–6

Donaldson E M, Fagerlund U H M, Higgs D A and McBride J R 1979 Hormonal enhancement of growth; *Fish Physiol.* **8** 456–598

Fagerlund U H M and McBride J R 1975 Potential for sex steroids as growth promoters in salmon culture; *Proc. 13th Pacific Sci. Congr.* Vancouver, Canada, Vol. 2, pp 139–145

Ghittino P 1970 Risposta delle trote d'allevanento al diethylstilbestrolo e metiltiuracile; *Riv. Ital. Piscic. Ihiopatol.* **5** 9–11

Matty A J and Cheema J R 1978 The effect of some steroid hormones on the growth and protein metabolism of rainbow trout; *Aquaculture* **14** 163–178

Nirmala A R C and Pandian T J 1983 Effect of steroid injection on food utilisation in *Channa striatus*; *Proc. Indian Acad. Sci. (Anim. Sci.)* **92** 221–229

Reddy P K, Gowrishankar K A and Varghese T J 1987 The effect of feeding 17α-methyltestosterone and diethylstilbestrol on the growth and food conversion characteristics of the Indian major carp, *Labeo rohita* (Ham.); *Indian J. Anim. Sci.* **57** 1329–1332

Varghese T J, Devaraj K V, Shantharam B and Shetty H P C 1976 Growth response of the common carp, *Cyprinus carpio* var. *Communis* to protein-rich pelleted feed; *Symposium on Development and Utilisation of Inland Fishery Resources*, Colombo, Sri Lanka pp 408–416