PRELIMINARY INVESTIGATION ON GROWTH RESPONSES OF CYPRINUS CARPIO L. FED ON LOCALLY FORMULATED ARTIFICIAL DIETS.

by

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ABSTRACT

The growth rate and feed conversion ratios of the common carp, Cyprinus carpio were measured for five test diets in 14 day replicate laboratory studies. The young carp (net weight $\bar{x}$ = 97.58 ± 5.31g) were fed with artificial test diets with crude protein contents ranging from 14.50 to 21.42 per cent. Within this range of feed characteristic optimum growth rates were obtained with diets containing 20.25 and 21.42 per cent crude protein.

The study of the effect of varying ration levels (1, 2 and 3% per body weight per day) showed that growth rates increased with increases of ration size, but the food converion efficiency and protein efficiency ratios decreased markedly as ration size was increased. Carps fed at 3% body weight per day did not perform significantly better than those fed at 2% body weight per day.

A graphical comparison of relative influence of ration levels on growth rates and food conversion efficiencies indicated that for the carp optional ration for the two indices is approximately 2.2% body weight per day, for the diet with crude protein level of 20.25%.

INTRODUCTION

Nutrition in fishes as in other animals relate to the effects of the quality and quantity of food nutrients taken into the body on the growth and other physiological responses of the individual. Many factors are known to affect the growth and food conversion coefficients of fishes. This have been reviewed by Brown (1957); Ivlev (1961); Paleheimo and Dickie (1966a; 1966b) and Philips (1969). These factors include the size of the fish, the water temperature, the amount of food eaten by the fish the frequency of feeding and the species involved. The knowledge of these relationships of fish is important in understanding production process, both in nature (Gerking, 1972) and in fish culture (Brett, 1974).

Cruz and Laudencia (1977) showed that the proportion of protein food needed by fish varied with the species, for example, 35% for channel catfish Ictalurus punctatus and 38% for the common carp Cyprinus carpio. Sin (1973a) has shown that the optimum protein requirement of carp is about 38.5%.

The quantity of particular food items are also known to affect digestibility. Windell et al (1978) observed in rainbow trout Salmo gairdneri that no difference was apparent in the digestibility of protein or lipid as rations of 0.4, 0.8 and 1.6% of the fish body weight. However, fish fed 1.6% of their body weight showed significantly lower digestibility for total dry matter, carbohydrate and energy.

This study was designed to examine the crude protein content of artificial formulated diet capable of yielding economic growth and to investigate whether growth rate, food conversion efficiency, protein efficiency ratio and other aspects of growth responses are influenced by varying the levels of such a diet in cultivated species Cyprinus carpio.

MATERIALS AND METHODS

The research was conducted in an underground rectangular pond measuring 225 x 315 x 94cm^3 at the aquatic Research Laboratory of University of Jos. The water level was maintained at a depth of 30cm. Suitable water quality was maintained by daily addition of tap water which has been exposed in a reservoir for 24 hours, giving room for dechlorination. The temperature of water during the experimental period was 26C ±-2.3°C.

Locally obtained beans was ground, sieved and autoclaved at 170°C for 4 minutes. The treatment was to destroy the growth inhibitors present in the beans following the method of Brandt (1979). The beans was thoroughly mixed with sieved growers marsh and treated cassava. Ingredients proportion used in Diets A to E are shown (Table 1).

Table 1. Major Ingredients of Test Diets Fed to Carp, Cyprinus carpio

Componants	D I E T S				
	A	B	C	D	E
Growers Marsh	100	100	100	75	50
Processed beans autoclaved at 170° for 4 minutes	-	10	20	35	45
Treated cassava (Garri)	25	25	25	35	50

All test diets were stirred separately in boiled water and made into a massive ball. The balled - samples were flattened and made into 12 x 10mm pellets. The fish used in the study were collected from the Panyam fish Farm and were stocked in the underground rectangular tank.

On the onset of the experiment to determine growth responses to diets of varying proximate composition, young carp (wet weight $\bar{x}$ = 97.58 ±7 -5.31g) were weighed individually and randomly allocated to 20 per rectangular compartment measured 60 x 64 x 36cm^3. The water level and the temperature remained similar to that used in acclimatisation. Each tank contained a single fish and there were four replicates for each diet. The fish in each tank was fed 1.5% of the total body weight twice daily at 9.00 a.m and 4.00 p.m (i.e. 3% of their body weight daily) from Monday to Sunday. An hour after each morning feeding 2/3 of the volume of water was siphoned out and this quantity was replaced by dechlorinated water from the reservoir. Feeding period lasted for 14 days.

In order to demonstrate the effect of ration level on the various aspects of growth responses diet D formulated above was used. This experiment was performed in six circular tanks containing 19 litres of water. Pet-craft aerator, model H 4405 was used to aerate the water whose temperature was maintained at 24°C ± 0.31 inside the University's Aquatic Research Laboratory. Young carp (wet weight $\bar{x}$ 52.43 ± 4.67g were divided into three replicate groups and acclimated to the above temperature. Following acclimation period of four days the fish were fed 1%, 2% and 3% of their body weight in two feedings per day. The water was changed by 11.00 a.m while the feeding period lasted for 14 days.

Each of the five artificially formulated diets was chemically analysed for water content, fat, crude fibre, crude protein, calcium and phosphorus. Water content was obtained from difference between wet and dry mater of feed. The fat was extracted by reflux distillation with petroleum ether over a 3 hour period. Crude fibre content was determined by incineration of the sample in a muffle furnace of 600°C for 24 hours to constant weight.

Crude protein content was determined by micro-Kjeldahl technique. Calcium content was computed from results obtained in the titration of calcium oxalate with 0.01 potassium permangenate solution. The phosphorus content was calculated using the calibration curve for phosphorus.

At the end of the experimental period the weight of each fish was recorded. Readings obtained were used to compute the mean growth rates, food conversion efficiencies and the protein efficiency ratio in both experiments.

RESULTS AND ANALYSIS OF EXPERIMENTAL DATA

(a) Proximate analysis of artificial feeds used for growth trials

Results of proximate analysis of the feed formulation used for growth trials are presented in Table.

Table 2. Proximate analysis for the different diets fed to carp Cyprinus carpio.

Components	D I E T S									
	A		B		C		D		E	
	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE
Fat	1.94	0.05	2.45	0.04	2.9	0.05	2.3	0.02	2.93	0.03
Ash	5.84	0.05	5.89	0.05	5.63	0.04	4.75	0.03	4.07	0.02
Crude fibre	5.56	0.10	5.65	0.02	6.67	0.10	3.72	0.02	3.95	0.01
Crude Protein	14.50	0.01	15.67	0.01	17.31	0.02	20.25	0.02	21.42	0.01
Nitrogen free extract	72.26	0.69	70.34	0.59	67.49	0.45	68.98	0.05	67.63	0.50
Moisture	7.85	0.04	7.78	0.05	7.61	0.03	8.05	0.04	8.45	0.35
Calcium	1.27	0.04	1.22	0.03	0.95	0.02	0.68	0.03	0.44	0.51
Phosphorus	0.60	0.01	0.56	0.01	0.93	0.02	0.83	0.03	0.78	0.02

From these data it is clear that the crude protein formed a major component of the diets and this increased with fortification with treated beans (Table 2). The fat, ash and crude fibre show considerable fluctuations while calcium and phosphorus occur in traces.

(b) Growth responses to different trial diets

Table 3 shows the effect of different trial diets on growth rate, food conversion efficiency and protein efficiency ratio of carp, Cyprinus carpio fed for 12-14 days.

The result shows that growth rate increased as the crude protein in the diet was enhanced. Analysis of variance using a fully randomised design showed that there were significant differences between growth rates given the different diets A, B and C. Diets D and E show no significant difference. The figures presented in Table 3 for growth rate has been used to construct figure 1 which summarises the growth rate of carp Cyprinus carpio fed on different diets.

Food Conversion Efficiency was calculated with the relation: weight gained/weight fed and the results were shown in Table 3. From the data it is clear that the least food conversion efficiency was recorded in fish fed on diet A. The conversion efficiency increased

as fortification with processed beans in the diets increased (Table 1) Although diet D had a slightly higher conversion efficiency than E the difference was not significant. The protein efficiency ratio was calculated with the relation. Unit weight gained/unit protein fed. The data obtained were shown in Table 3. The fish fed on Diet A had the least protein efficiency ratio. The protein efficiency ratio increased as the diets were supplemented with more processed beans (Table 1). However, with diets D and E, the ratio remained very close with D slightly higher.

Table 3. Effect of different trial diets on growth rate, food conversion efficiency and protein efficiency ratio of carp Cyprinus carpio fed five different diets for 12 - 14 days.

Diets	Growth rate mg/g/day	Food Conversion efficiency $\bar{x}$ - SE	Protein efficiency rate $\bar{x}$ ± SE
A	$\bar{x}$ = 0.90 ± 0.11	0.03 ± 0.01	0.21 ± 0.03
B	$\bar{x}$ = 2.18 ± 0.34	0.07 ± 0.01	0.47 ± 0.08
C	$\bar{x}$ = 3.79 ± 0.31	0.13 ± 0.01	0.75 ± 0.06
D	$\bar{x}$ = 4.91 ± 0.47	0.17 ± 0.02	0.84 ± 0.03
E	$\bar{x}$ = 5.03 ± 0.15	0.17 ± 0.01	0.81 ± 0.03

(c) Growth responses to different ration levels

Some changes were observed in the growth rate, food conversion efficiency and protein efficiency ratio of young carp, Cyprinus carpio fed on three different ration levels of diet D. These changes are shown in Table 4.

Table 4. Effect of different ration levels of diet D on growth rate, food conversion efficiency and protein efficiency ratio of carp, Cyprinus carpio.

Ration level (% body weight)	Mean growth rate mg/g/day $\bar{x}$ ± S.E	Food Conversion $\bar{x}$ ± S.E	Protein efficiency rate $\bar{x}$ ± S.E
1	4.57 ± 0.21	0.47 ± 0.02	2.33 ± 0.11
2	7.90 ± 0.35	0.42 ± 0.02	2.07 ± 0.10
3	7.87 ± 0.10	0.28 ± 0.01	1.37 ± 0.02

The least growth rate was recorded in fish fed on 1% of the body weight. Growth rate increased as ration level was increased but fish fed 2% body weight had slightly higher growth rate than those fed 3% of their body weight.

There was a general decrease in both the food conversion efficiency and protein efficiency ratio as the ration size increased although this decrease was not significant for fish fed 1% and 2% body weight per day.

The figures presented in Tables 3 and 4 were used to show a graphical comparison of relative influence of ration levels on growth rate and food conversion efficiency using diet D with crude protein content of 20.25%.

DISCUSSION

Results obtained from proximate analysis of the test diets (Table 2) showed that protein content in the diets increased as the processed beans content increased. When the control diet A was supplemented with 10g, 20g and 45g of processed beans, (autoclaved at 170°C for 4 minutes) corresponding values of 15.67%, 17.31%, 20.25% and 21.45% respectively were recorded in the crude protein content.

It is plausible that varying growth responses which the test diets elicit from the experimental animal were directly related to their crude protein contents. If this is so, then it would appear that fish fed with diets of higher protein levels performed better than on lower protein levels (Fig. 1). However, statistical analysis shows that there were no significant difference between fish given diets D and E. Perhaps this is as it should be since the differental in protein levels between the two diets is of the order of 0.001mg. Increase in growth rate as protein content increased has been recorded by Cruz and Laudencia (1977) while studying the protein requirements of Tilapia mossambica fingerlings. They observed that Tilapia mossambica grew faster when fed rations containing 29% to 38% crude protein than when fed ration with 20% crude protein. The level of protein needed varied with the species and the culture methods of which the fish is subjected. Feeds with 35% and 38% protein have been shown to produce optimum growth response for channel catfish Ictalurus punctatus as well as common carp, Cyprinus carpio, Cruz and Laudencia (1977). Sin (1973a) has shown that the optimum protein requirement of carp is about 38.5%. Nail (1962) found 25-27% protein level to yield economic growth of channel catfish fingerlings. Although there was a general increase in growth responses as the protein content of the test diets increased the optimum level needed by carp did not correspond to those reported by Sin (1973a); Cruz and Laudencia (1977). This observed difference may be due to such factors as ages of fish, weight and size ranges of fish and therefore growth stanza under investigation. Another possibility is the effect of protein to carbohydrate ratio on the growth response. Hickling (1962) noted that the best ratio of protein to carbohydrate in feeding carps is 1.7 or 1.8. In this experiment the protein to carbohydrate ratio in the test diets A, B, C, D and E were found to be 1.6; 1.5; 1.5; 1.4 and 1.4 respectively. The result indicates that the best growth responses were obtained in fish on test diets D and E which had the least carhohydrate ratio. These data agree with that reported for rainbow trout, Edwards et al (1977) where it was shown that fish fed meals of high carbohydrate ration showed poor utilization of protein. In this experiment carp with mean weight ($\bar{x}$ = 97.58 ± 5.31g) was used. Different experimental conditions as well as other components of the diet which can influence protein sparing must have also affected the growth responses.

Food conversion efficiency of fish fed on the different test diets appear on Table 3. The highest food conversion efficiency values were obtained in fish on test diets D and E. This indicates best conversion of food into flesh. Although the protein efficiency ration (P.E.R.) for fish on test diet D were observed to be slightly greater than that of E this difference was not significant.

The experiment dealing with the effects of ration level on growth responses of the fish showed that the quantity of food consumed influenced growth rate in fish (Table 4). The lowest growth rate ($\bar{x}$ = 4.57 ± 0.21) mg/9/day was recorded on fish fed 2% and 3% body weight per day. Those fed 2% and 3% body weight per day showed higher growth rates with values of ($\bar{x}$ = 7.90 ± 0.35) mg/9/day and ($\bar{x}$ = 7.87 ± 0.10) mg/9/day. Although no significant difference was found between the growth rates of carp fed 2% and 3% of their body weight per day, carp fed at 3% body weight per day did not perform better than those fed at 2% body weight per day indicating that the latter could be recommended as an economical optimum ration level, under conditions similar to those of this experiment.

Comparing the results obtained from the two feeding experiments (Table 3 and 4) it could be seen that lower growth rate ($\bar{x}$ = 4.91 ± 0.47) mg/g/day was obtained in the pond experiment as compared to ($\bar{x}$ = 7.87 ± 0.10) mg/g/day attained while using the circular tank aquaria. In each case the fish were theoretically fed the same diet at equal ration levels. This observed differences in the weight rates may be due to differences in the weights of the animals used, ($\bar{x}$ = 97.58 ± 5.31g) as against ($\bar{x}$ = 52.43g ± 4.47g). Apart from the fact that the experiment performed in the circular tank aquaria were considerably under stricter control, higher increases in the growth rates of fish held in these tanks may be attributed to better consumption of the food offered to the fish since the possibility of drifting dispersion of feed are considerably reduced.

Again the investigations on the effect of ration level on growth responses showed that there was a general decrease in both the food conversion efficiency and protein efficiency rations as the ration size increased although this decrease was not significant for fish fed on 1% and 2% body weight per day. This result indicates that as the ration level was increased the quantity of food converted into flesh decreased. These data agree with that reported for Brown trout, Salmo trutta, Elliott (1976) where it was shown that fish fed meals ranging from 10% to 100% of the maximum ration showed decreased conversion efficiency with increasing levels of energy intake. Other workers have also found decreased efficiency as meal size was increased (Kinne, 1960; Pandian, 1967; Solomon and Brafield, 1972).

Elliott (1975b) working on reduced rations showed that efficiency of food utilization was greatest at ration sizes close to the maintenance ration and smallest at ration sizes close to the maximum ration. He however, pointed out that at each temperature there was an optimum ration of which efficiency was maximal. Under condition of this experimentation, the relationship between growth rate and food conversion efficiency at different ration levels with 20.25% protein show that optimum economic growth could be obtained when fish are fed on 2.17% body weight per day.

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DISCUSSION

J. Chidobem of Unijos remarked that generally papers on aquaculture apid much attention to experimental designs. Mrs. Onobanjo also remarked that the aspect of cost was lacking in the papers on aquaculture and that this was essential for the field operators. Dr. Francis Sikoli of Unijos wanted to know if there were workers or people interested in fish parasitology and fishery management. Professors Awachie and Ukoli were mentioned as experts in fish parasitology.

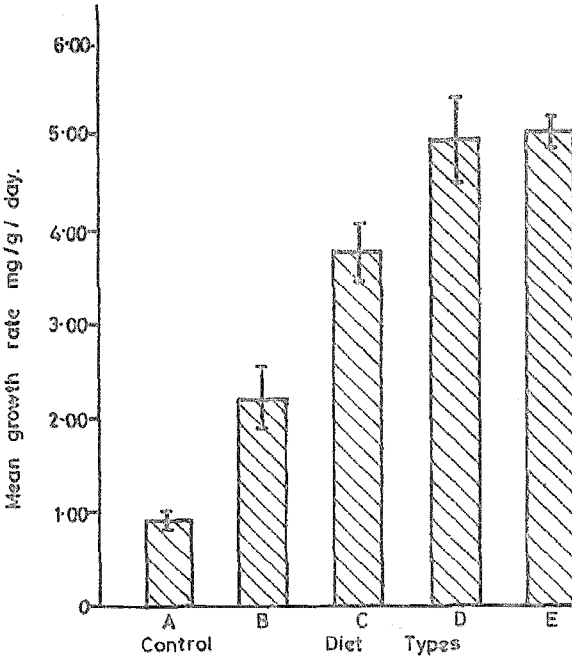

Fig. 1. Mean growth rates of carp Cyprinus carpio fed five different diets for 12—14 days.

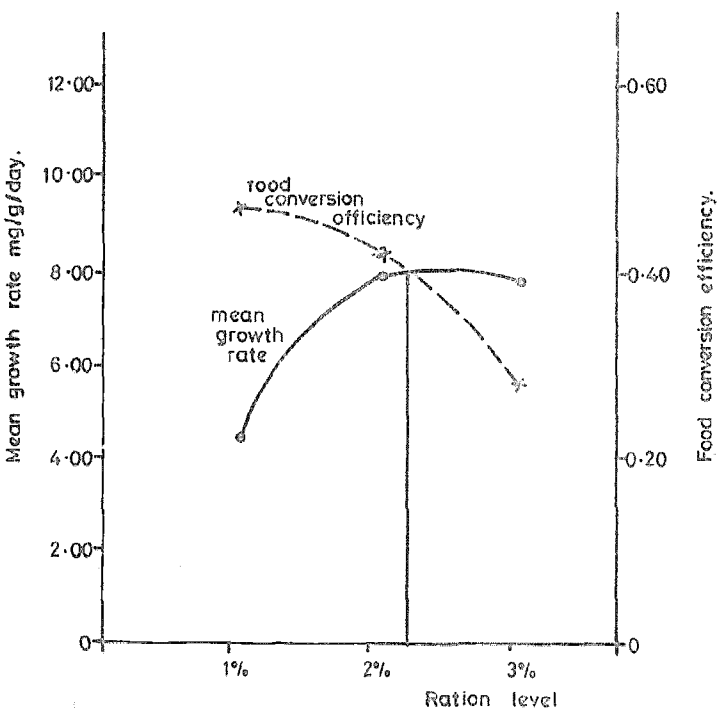

Fig. 2. Relationship between growth rate and food conversion efficiency of carp Cyprinus carpio fed three ration level for 14 days