J. Indian Inst. Sci. 65(C), June 1984, pp. 59-64

Short Communication

Food conversion efficiency and nitrogen balance in *Cirrhinus mrigala* fingerlings fed on three pelleted feeds compounded with wild legumes

SAMUEL PAUL RAJ* AND M.N. KUTTY**
Department of Fishery Science, Tamil Nadu Agricultural University, Coimbatore 641 003, India.

Received on November 19, 1983.

Abstract

Preliminary experiment was made to know whether the seed kernels of wild trees such as *Gliricidia maculata, Albizia lebbek* and *Enterolobium saman* can be used as a substitute for the costly oil cake of groundnut (*Arachis hypogaea*) presently used extensively as a protein source in the supplementary feed for fish culture in India. The fish fed with the feed containing wild tree seed kernels showed higher nitrogen assimilation than those fed with the feed containing groundnut oil cake. The metabolism of nitrogen was so high in the fishes fed with feed containing wild seed kernels that the nitrogen built up in the fish was 2 per cent of the actual consumption in the fishes fed with feed containing *Gliricidia* seed kernel against 13.3 per cent in the fish fed with the feed containing groundnut oil cake. It was nil and negative in the fish fed with feed containing *Albizia* and *Enterolobium* seed kernels respectively.

Key words: Conversion efficiency, pelleted feeds, wild legumes.

1. Introduction

Conventional sources of protein for commercial fish feeds have become scarce and expensive because of the growing worldwide demand for protein. Hence other sources of cheap protein for fish feeds will have to be explored as a reasonable substitute. The purpose of this study is to evaluate the use of some wild leguminous seed kernels as a substitute for groundnut (*Arachis hypogaea)* oil cake which is relatively costly and is presently used as major protein supplement in the feed for fish in India. Some investigations on the artificial feeding of carp[1-4] with cheaper and non-conventional agricultural and domestic wastes[5-7] have already been carried out.

The present paper summarizes the results of some feeding trials with *Cirrhinus mrigala* fingerlings using pelleted feeds compounded with seed kernels of three leguminous wild trees namely *Gliricidia maculata, Albizia lebbek* and *Enterolobium saman* which usually go unused.

* Present address: School of Energy, Environment and Natural Resources, Madurai-Kamaraj University, Madurai 625 021.

** FAO/UNDP African Regional Aquaculture Centre, PMB 6165 Port Harcourt, Nigeria.

2. Materials and methods

Feeding trial was carried out with dry pellets[7,8]. The dried ingredients were powdered individually by an electric grinder and sieved through a 500-micron sieve. Various food items (Table I) were mixed and kneeded well with sufficient quantity of water to obtain a hard dough. This dough was pressure cooked at a pressure of 15 lb/square inch for 15 minutes and extruded in the form of noodles using an extruder having 1mm dia perforations. The noodles were sundried and cut to 3mm length. The stability of the pellet in water was also determined[9]. The pellets were then dried at 100°C for 1 h and stored in desiccator for further use. The protein nitrogen and total nitrogen content of the feed were estimated by Lowry's and Microkjeldahl methods respectively (Table I).

The fish used in the trial were four-month old *Cirrhinus mrigala* fingerlings of the same stock. Fingerlings were sorted into 5 batches of 10 fish each. Each batch was kept and fed in a rectangular plastic trough (40×30×15cm) with 10 litres of water at room temp 28 ± 1°C. The ambient water in the troughs was aerated continuously with compressed air. The fish were fed with the control diet (pelleted feed 8, see Table I) for a week prior to the experiment. After a week, the fish were starved for a day and weighed individually. Fish from one of the plastic troughs were sacrificed and the nitrogen content estimated. The fish in the rest of the four troughs were fed *ad libitum* once daily with the test feeds (feed 8, 15, 16 and 18, see Table I) prepared with seed kernels and the control feed. The feeding trials were continued for 15 days[10].

Table I

Composition of various feeds used for feeding trials with fingerlings of *cirrhinus mrigala*

(The feed numbers given indicate the order of feeds prepared at the Department of Fishery Science, Tamil Nadu Agricultural University, Coimbatore)

Feed number	Components	Qty (Parts)	Nitrogen content (%)			Pellet stability %
			Total nitrogen	Protein nitrogen	Non-protein nitrogen	
8	Groundnut *Arachis hypogaea* oil cake powder	6	5.15	4.92	0.23	92.2
	Rice bran	3				
	Tapioca flour	1				
15	*Gliricidia maculata* seed kernel powder	6	5.33	4.48	0.85	96.9
	Rice bran	3				
	Tapioca flour	1				
16	*Albizia lebbek* seed kernel powder	6	4.73	3.93	0.80	93.0
	Rice bran	3				
	Tapioca powder	1				
18	*Enterolobium saman* seed kernel powder	6	5.67	4.59	1.08	95.8
	Rice bran	3				
	Tapioca flour	1				

Table II

Weight balance of *Cirrhinus mrigala* fed with different pelleted feeds

(All values are in grams and in dry wieght basis. Experimental period 15 days)

Feed number	Average initial weight of fish (W_1)	Average final weight of fish (W_2)	Mean weight of fish ($\bar{W}$)	Average production (P)	Average food consumption (C)	Average faecal output (F)	Relative growth rate/day ($P/\bar{W}/15$)	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 weight/day ($C/\bar{W}/15$)
8	0.538 ± 0.166	0.626 ± 0.154	0.582	0.088	0.336	0.107	0.010	0.229	0.141	68.15	26.19	38.43	0.038
15	0.549 ± 0.178	0.582 ± 0.169	0.566	0.033	0.266	0.086	0.004	0.180	0.147	67.67	12.41	18.33	0.031
16	0.520 ± 0.171	0.546 ± 0.157	0.533	0.026	0.336	0.092	0.003	0.244	0.218	72.62	7.74	10.66	0.042
18	0.426 ± 0.069	0.448 ± 0.118	0.437	0.022	0.170	0.035	0.003	0.135	0.113	79.41	12.94	16.30	0.026

$\bar{W} = (W_1 + W^2)/2$ $P = W_2 - W_1$

Feeding was done in the morning. After 3 h, the excess feed left in the troughs was removed and dried at 100°C for 1 h, desiccated sufficiently and weighed. Thus the actual feed consumed was known. The faecal matter was collected with a pipette every morning before feeding and dried. The dry weight of the faeces was also known. About 80 per cent of the water in the troughs was changed everyday causing the least disturbance to the test fish. Ammonia nitrogen and total nitrogen in ambient water were estimated from water samples taken just before and after the change of water. In a separate trough the same quantity of feed as given to fish lots, but without fish, was put and the feed was removed within 3 h in six equal instalments and the ammonia nitrogen and total nitrogen built up in water due to feed disintegration was estimated. Similarly, once in five days the faecal matter of a day was transferred to a fresh trough having water. The faecal transfer was made every hour and the nitrogen built up through disintegration of faeces per day also was found. Both the values from these tests were used for correction of nitrogen excretion values. The ammonia nitrogen in water was estimated colorimetrically[11].

The growth rate of *C. mrigala* fed with different pelleted feeds is indicated in Table II. The total nitrogen content in the ambient water and in fish muscle as a whole was estimated by Microkjeldahl method and protein nitrogen in feed by Lowry's method[12]. The nitrogen balance was worked out and presented in Table III[13].

3. Results and discussion

The average feed intake and faecal output in fish fed with feed 8 and 16 are on par, but the relative growth rate per day in fish fed with feed 8 is three times more than that of the other. Obviously, there is not much difference in the assimilation between the two, but the metabolism is higher in the latter and hence there is low net growth efficiency in the fish fed with feed 16 than that of feed 8. In all respects, the fish fed with feed 15 and 18 are almost identical and their growth efficiency is just 50 per cent to that of those fed with feed 8. In the fish fed with feed 18, percentage of nitrogen assimilation is as high as 95.3 (Table III) but the total nitrogen metabolism is very high to the extent that it is not sufficient for routine maintenance

Table III
Nitrogen balance of *Cirrhinus mrigala* fed with different pelleted feeds
(All values for 10 fish for 15 days)

Feed number	Total nitrogen consumed by all the fish (g)	Nitrogen excreted through faeces (%)	Nitrogen assimilated (%)	Nitrogen matabolised		Nitrogen excreted through catabolism of endogenous protein (%)	Nitrogen built in the fish (%)
				as ammonia nitrogen (%)	as non-ammonia nitrogen (%)		
8	0.1732	20.8	79.2	56.4	9.5	—	13.3
15	0.1418	13.8	86.2	61.3	22.9	—	2.0
16	0.1588	12.7	87.3	62.6	24.7	—	0
18	0.0961	4.7	95.3	59.3	38.08	2.08	(—)

and therefore showed a negative nitrogen balance. In the case of fish fed with feed 15 and 16 the nitrogen assimilation is higher (86.2 and 87.3 per cent) than that of fish fed with feed 8. In view of the higher non-protein nitrogen content in feed 15 it could make a poor nitrogen build up in the fish and feed 16 could just maintain the nitrogen balance in fish. In fish fed with feed 8, the nitrogen storage is higher and among the excreted nitrogen 50 per cent is excreted through the gills as ammonia nitrogen. Among the fish fed with various feeds, the nitrogen excretion through gills does not make any marked variation whereas its excretion of non-ammonia nitrogen is increased in the fish fed with pelleted feeds prepared out of wild legume kernels. It is known that the wild legume seed kernels tested contain tannin. These substances sometime act as inhibitors of protein synthesis so as to reduce growth in the fish fed with feeds mixed with kernels of the wild legume seeds. The present experiment does not suggest that these wild legumes can be safely utilized in fish feed inspite of its high protein value unless the toxic material is removed. Further experiments in this aspect are called for.

Acknowledgement

The authors are thankful to Dr. G. Rangaswamy, the former Vice-Chancellor, Tamil Nadu Agricultural University, for the facilities provided.

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