

Two Novel Protein Sources of Marine Origin for the Nursery Rearing of *Chanos chanos* Fry*

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Artificial feeds compounded from two new marine protein sources - clam meal (CM) and squid meal (SQM) were compared with the usually used protein sources like fish meal (FM) and prawn head waste meal (PHM) in *Chanos chanos* fry. The food conversion ratio (FCR), protein efficiency ratio (PER) and protein and lipid digestibility coefficients of fish fed on various feeds for 42 days indicate that the protein from clam meal and squid meal were better utilized for growth purposes than others. The PER value ranged from 0.23 (PHM) to 1.43 (CM) and protein digestibility coefficient from 97.24 (CM) to 65.23% (PHM). Lipid digestibility values were also high for CM (98.08%) and SQM (97.12%). The survival rate, gain in length and weight, and specific growth rate indicate the superior performance of the feed compounded from CM, followed by SQM, FM and PHM.

Key words : Milkfish, *Chanos chanos*, fry feeds.

Milkfish (*Chanos chanos*) is the most widely cultured warm water finfish in the traditional brackishwater culture systems throughout Asia and Far East. The seasonal availability of its seed in nature necessitates an efficient, nursery rearing practice for making available maximum number of quality seeds for culture purposes. Hence formulation of fry feeds, which give good survival, growth and food conversion ratios are highly warranted. Studies on the use of marine sources of protein are limited in *C. chanos* except for the use of fish meal and shrimp head meal (Santiago *et al.*, 1983; 1989; Alava & Lim, 1988; Seneriches & Chiu, 1988). So in the present study two novel protein sources viz., clam meal and squid meal were compared with the commonly used protein sources in fry feeds of milkfish like fish meal and prawn head waste meal.

Materials and Methods

The experiment was conducted in plastic tanks of 50 l capacity filled with brackishwater of 5‰ salinity. Aeration

was provided to the tanks throughout the experiment.

C. chanos fry of 1.79 cm (0.017 g) size, which were previously acclimatized to a salinity of 5‰ and accustomed to artificial feeding, were used for the experiment. Eight numbers of fry were introduced in each tank.

Four feeds viz., FM, SQM, CM and PHM were prepared with fish meal, squid meal, clam meal and prawn head waste meal respectively as major sources obtained from local processing factories. The percentage composition of ingredients used in the formulation of feeds and the proximate composition of each feed are given in Tables 1 & 2. For the preparation of feeds weighed ingredients (except vitamin, mineral mixtures and cod liver oil) were mixed, autoclaved at ambient pressure for 30 min, cooled, rest of the ingredients added, pelleted and then dried in an oven at 60°C, till the moisture content was less than 10%. The feeds were ground and passed through No. 40 sieve (425 µm) before being fed to

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the fry. All the feeds were isocaloric and isonitrogenous (Table 2).

Table 1. Percentage composition of formulated feeds

Ingredients, %	Feeds			
	FM	SQM	CM	PHM
Fish meal	42	-	-	-
Squid meal	-	36.5	-	-
Clam meal	-	-	60	-
Prawn head waste meal	-	-	-	61
Groundnut oil cake	25	25	25	25
Tapioca powder	30	35.5	12	11
Cod liver oil*	1	1	1	1
Vitamin mixture**	1	1	1	1
Mineral mixture+	1	1	1	1

* Commercial grade

** Supplevite-M, Sarabhai Chemicals, Bombay

+ USP XIV, SISCO Research Lab., Bombay

The fry were given any one of the four feeds (in four replicates) *ad libitum*, twice daily for 42 days. The feed remains were collected from the tank each time before the next feeding. Faeces were also collected

from the second week onwards for a period of 20 days for digestibility studies following the method described by Cho *et al.* (1982). One third water was exchanged daily and complete exchange of water was done weekly. Water quality parameters were monitored at regular intervals.

Moisture, crude protein (N x 6.25) crude fibre and nitrogen-free extracts (NFE) were analysed using the methods of AOAC (1975), Pearson (1976) and Hastings (1976), respectively. Crude fat was extracted using petroleum ether (B.P.: 40-60°C) in a soxhlet extraction apparatus for 16 h. The ash content was estimated by heating the sample at 550±10°C for 6 h in a muffle furnace.

The parameters used for the evaluation of feeds compounded from various protein sources were protein efficiency ratio (PER), protein and lipid digestibility coefficients, food conversion ratio (FCR), gain in length and weight, specific growth rate and survival rate. Statistical analysis of the data was carried out using ANOVA.

Table 2. Proximate composition of formulated feeds*

Components	Feeds			
	FM	SQM	CM	PHM
Moisture, %	9.45±0.95	9.38±1.01	8.50±0.98	8.60±0.95
Crude protein ^a , %	40.28±1.10	40.44±0.96	39.78±1.40	39.86±0.98
Crude fat, %	6.50±0.61	7.10±0.62	8.10±0.54	7.20±0.86
Crude fibre, %	3.59±0.19	4.90±0.24	5.82±0.60	6.70±0.16
Ash, %	13.48±2.00	12.18±1.80	13.50±1.82	17.04±2.01
Nitrogen free extract (NFE), %	26.70±3.90	26.00±4.00	24.30±3.10	20.60±2.14
Energy ^b , kcal g ⁻¹	3.30±0.01	3.33±0.04	3.33±0.07	3.13±0.11

* Average of 4 values; a : Total nitrogen x 6.25;

b : Calculated

Results and Discussion

The fluctuations of salinity, temperature, pH and dissolved oxygen in the present study were 4 to 6‰, 27.1 to 39.8°C, 7.6 to 8.2 and 6.8 to 8.8 ppm, respectively. These were well within the tolerance limits of *C. chanos* and hence had no negative effect on growth of fish. The PER, protein and lipid digestibility coefficients of various feeds are given in Figs. 1 and 2. FCR, gain in length and weight of fish, specific growth rate and survival rate are given in Table 3.

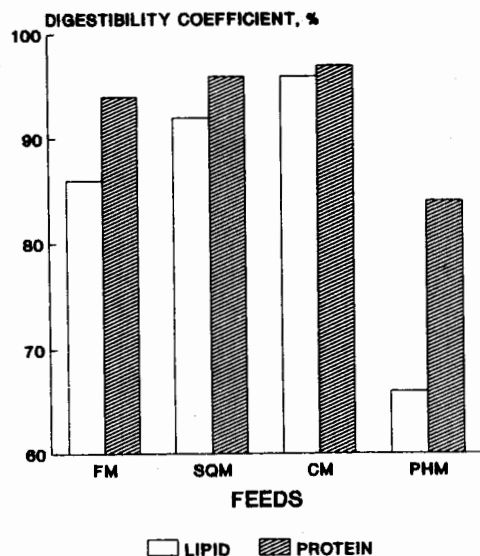


Fig. 1. Protein and lipid digestibility coefficients of different feeds fed to *Chanos chanos* fry

The FCR and protein digestibility coefficient of fish fed on CM (1.74; 97.24%, respectively) was significantly ($p < 0.05$) better, followed by SQM (2.94; 91.86%, respectively), showing that protein from clam meal and squid meal are better utilized for growth purposes than others. Surya Narayana & Alexander (1972) have reported clam meat (*Villorita* sp.) as a good source of protein. Besides, the lipid digestibility and lipid content of CM was

the highest (98.08% and 8.10%, respectively) of all the feeds used in the present study. The lipid in clam meal might have spared the protein for growth purposes. These factors appear to have resulted in the superior performance of fish fed on CM as reflected in the maximum gain in growth (2.55 cm) attained by them and the minimum FCR obtained for this feed.

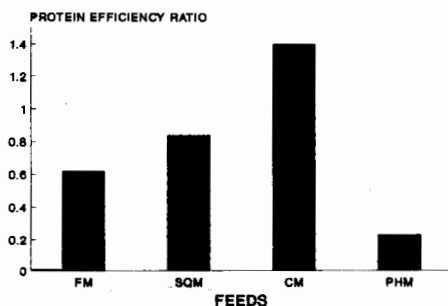


Fig. 2. Protein efficiency ratio of various feeds fed to *Chanos chanos* fry

Squid meal is also reported to contain high levels of protein and amino acids (Deshimaru & Shigueno, 1972). Earlier reports of Deshimaru & Shigueno (1972), Lovell (1989) and Seneriches & Chiu (1988) show that a combination of squid meal and groundnut oil cake (the ingredients used in the SQM feed) could provide amino acids almost similar to that of milkfish fry. Squid meal also contains some natural feed attractants (Paulraj, 1989). The lipid digestibility of SQM was also of a high order (97.12%) in the present study and was second only to CM.

The PER (0.68), protein digestibility (86.57%), lipid digestibility (93.85%) and gain in length (1.8 cm) and weight (0.288 g) of fish fed on FM was significantly lower ($p < 0.05$) and hence the performance of FM was next to CM and SQM. Although Santiago *et al.* (1983) and Seneriches & Chiu (1988) have reported the superior nature of fish meal in the feeds of *C. chanos* juveniles,

Table 3. Growth response of *C. chanos* fry fed on formulated feeds*

	Feeds			
	FM	SQM	CM	PHM
Survival rate, %	90.63±10.36 ^a	96.88±5.41 ^a	96.88±5.41 ^a	81.25±18.75 ^a
Gain in length, cm	1.80±0.24	2.18±0.05	2.55±0.06	0.60±0.216
Gain in weight, g	0.288±0.007	0.372±0.008	0.450±0.006	0.104±0.006
Specific growth rate	6.63±0.080 ^b	7.96±0.49 ^b	7.98±0.52 ^b	4.78±0.54
Food Conversion ratio	3.65±0.009	2.94±0.025 ^c	1.74±0.025 ^c	10.95±1.54

No. of fish used for experiment : 8

* Treatment means with the same superscript in each row are not significantly different at $p > 0.05$. The values are the average of 4 replications.

protein sources like clam meal or squid meal have not been substituted for fish meal so far in *C. chanos*. However, there are also reports of lower values of growth rate and protein utilization in *Lates calcarifer* fed on fish meal from Thailand and Norway (Cho, 1985). According to Cho (1985) the quality of fish meal influences the growth performance of fish fed on them.

The performance of PHM feed was the poorest in *C. chanos* fry as revealed by the lowest gain in growth (0.6 cm), PER (0.23) and the highest FCR (10.95). This may be because of the lower content of true protein in prawn head waste. About 10 to 15% of prawn head waste is non-protein nitrogen (Lovell, 1989) which is mainly chitin. Chitin is intimately associated with Ca salts and pigments (Lindsay *et al.*, 1984). So, although prawn head waste contains high amount of digestible proteins, its utilization may be hampered by the Ca and chitin present in it (Simpson *et al.*, 1981). Besides, the protein digestibility of PHM (65.23%) used in the present study was the

lowest, although lipid digestibility was fairly good. These factors may also have hampered the growth of *C. chanos* fry fed on them.

Based on these observations it can be presumed that clam meal and squid meal are superior protein sources for *C. chanos* fry than fish meal, while prawn head waste is a poor protein source. Development of alternative protein sources and their incorporation in fish feeds, according to Tacon & Jackson (1985) will reduce the reliance on fish meal in feed manufacturing industry and ensure the farmers a relatively stable and high quality ration.

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