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SS Rathore
Karnataka Veterinary, Animal and Fisheries Sciences University, Mangalore, Karnataka, India

A Chandravanshi
Chhattisgarh Kamdhenu Vishwavidyalaya, Durg, Chhattisgarh, India

D Sahu
Chhattisgarh Kamdhenu Vishwavidyalaya, Durg, Chhattisgarh, India

P Chandravanshi
Chhattisgarh Kamdhenu Vishwavidyalaya, Durg, Chhattisgarh, India

Correspondence
SS Rathore
Karnataka Veterinary, Animal and Fisheries Sciences University, Mangalore, Karnataka, India

Growth, feed utilization and body composition of magur (*Clarias batrachus*) fed diets containing different plant proteins: Partial or total substitution of fish meal

SS Rathore, A Chandravanshi, D Sahu and P Chandravanshi

Abstract
A 60 days feeding trial was conducted on magur, *Clarias batrachus* fingerlings (10.85 ± 0.14 g), fed six isonitrogenous (40% crude protein) diets were: diet T1, fish meal (FM), mustard meal (MM) and cooked rice (CR); diet T2, MM and soybean meal (SM); diet T3, FM, MM and CR; diet T4, equal amounts of FM, MM and groundnut meal (GNM); diet T5, MM, SF and GNM:CR (1:1) and diet T6, MM, SF and GNM:CR (1:2). Fish were stocked in triplicate (100 fish/25 m^2 earthen tanks) and fed thrice daily (09:00, 13:00 and 18:00 hrs) to apparent satiation. At the end, fish fed diet T6 exhibited the significantly (P<0.05) highest values for weight gain, specific growth rate, average daily gain, protein efficiency ratio and improved food conversion ratio. In conclusion, diet T6 was more effective than other diet combination groups could completely replace FM in the practical diet of magur.

Keywords: Feed utilization, fish meal, groundnut meal, mustard meal, soybean meal

Introduction
The overall growth in aquaculture production remains relatively strong owing to the increasing demand for food fish among most producing countries. Between 1980 and 2014, world aquaculture production volume increased at an average rate of 8.6 percent per year. World food fish aquaculture production more than doubled from 32.4 million tonnes in 2000 to 73.8 million tonnes in 2014 [1]. *Clarias batrachus* is recognized as an important candidate species for aquaculture, as it meets many economic criteria for a candidate species. Its hardy nature to adverse ecological conditions enables its culture with high stocking densities at a production up to 100 tons per hectare [2]. Nutrition is the most expensive component in the intensive aquaculture industry, where it represents over 50% of operating costs. Moreover protein itself represents about 50% of feed cost in intensive culture, therefore, the selection of proper quantity and quality of dietary protein is a necessary tool for successful aquaculture practices [3]. Plant protein sources, which are more consistently available and cheaper to produce than fish meal/other animal proteins, have been extensively used in combination with fish meal in aquafeeds. Among the plant protein sources considered, soya flour has been preferentially used for replacement of fish meal due to its high protein content, fairly balanced amino acid profile [4, 5] and global presence. In many parts of India, groundnut (peanut) and mustard oil cake are used as dietary protein source in fish feed. Though these are highly palatable and has better binding properties for pelleting than soybean meal [6], there use in fish feed is limited because of low lysine and methionine contents, and inconsistent supply [7, 6].
The present study was investigated to observe the effects of feeding soybean meal (SBM), groundnut meal (GNM), mustard meal and cooked rice (CR) with or without fish meal (FM), on growth performance, feed utilization and carcass composition of *Clarias batrachus* fingerling.

Materials and methods
Experimental fish
The experiment was conducted at a private fish farm, Poonam Fisheries, Tirga, Durg, Chhattisgarh, India over a period of 60 days. Fingerlings of magur with weight of (10.85 ± 0.14) g were selected for the experiment. Magur fingerlings were produced and reared in the

same fish farm. Fishes were selected randomly from the rearing tank, weighed and then transferred to the experimental tanks one week before the start of the experiment for acclimatization to experimental conditions.

Experimental set-up

The experimental set-up consisted of 18 earthen tanks (25 x 25 m^2). 1800 fishes were randomly distributed in six distinct experimental groups in triplicate, following a completely randomized design. Each earthen tank was stocked with 100 fish. 25% water exchange was carried out during the trial period.

Diet preparation and feeding

Ingredients such as fish meal, soya flour, mustard oil cake, groundnut oil cake, corn flour, rice flour, wheat flour, tapioca, sunflower oil, vitamin and mineral mixture (Valaenza Pharmaceuticals Private Limited) and cod liver oil (Sanofi India Limited, Sanofi Consumer Healthcare Division) were used for feed formulation. Raw materials were procured from local shops. All the ingredients were grinded first then mixed together and made a dove and cooked in autoclave for 10 minutes separately for each experiment. Then pelleted those into 1 mm sizes and dried in mechanical drier and then dry feeds were stored in air tight plastic bottles.

Six isonitrogenous (40% crude protein) experimental diets were formulated. The diets were designated as T1, fish meal (FM), mustard meal (MM) and cooked rice (CR); T2, MM and soybean meal (SM); T3, FM, MM and CR; T4, equal amounts of FM, MM and groundnut meal (GNM); T5, MM, SF and GNM:CR (1:1) and T6, MM, SF and GNM:CR (1:2). Formulation and proximate composition of treatment diets used in experiment are shown in Table 1 and 2. Feeding was done at the rate of 10% of body weight initially, and after 10 days fishes were fed ad libitum till the end of each experiment. The daily ration was divided into three equal parts and was given at 09.00, 13.00 and 18.00 hrs.

Table 1: The formulation of control and experimental diets

Ingredients	Diets					
	T1 (Control)	T2	T3	T4	T5	T6
Fish meal	42	0	41	30	0	0
Soya flour	0	43	0	0	41	41
Mustard oil cake	42	43	41	30	41	41
Groundnut oil cake	0	0	0	30	4	4
Cooked rice	0	10	10	0	4	8
Corn flour	3	0.5	1	1.5	2	1
Rice flour	3	0.5	1	1.5	2	1
Wheat flour	3	0.5	1	1.5	2	1
Tapioca	3	0.5	1	1.5	1	0.5
Sunflower oil[1]	1	0.5	1	1	1	0.5
Fish oil[2]	2	0.5	2	2	1	1
Vitamin premix[3]	1	1	1	1	1	1
Total	100	100	100	100	100	100

CP-Crude protein

[1]Gemini sunflower oil

[2]Seven sea cods

[3]Vitamin and mineral mixture/Kg premix: Vitamin A-7,00,000IU, VitaminD3-70,000IU, Vitamin E-250 mg, Nicotinamide-1000 mg, Cobalt-150mg, Copper-1200mg, Iodine-25g, Iron-1500 mg, Magnesium-6000 mg, Manganese-1500 mg, Potassium-100mg, Sodium- 5.9mg, Sulphur-0.72%, Zinc-9600 mg, Calcium-25.5%, Phosphorus-12.75%.

Table 2: Proximate analysis of control and experimental diets (determined on dry matter basis)

	T1 (Control)	T2	T3	T4	T5	T6
Crude protein	39.95	40.32	39.56	40.26	39.93	40.05
Ether extract	14.54	16.17	18.73	19.93	21.05	21.67
Ash	17.58	15.81	16.05	16.42	15.77	14.76
Moisture	8.25	7.81	7.24	6.09	5.92	5.48
Nitrogen free extract	19.68	19.89	18.42	17.3	17.33	18.04

Chemical analysis

Proximate composition of diets and whole body determined by the standard methods [8]. The crude protein percentage was obtained by multiplying nitrogen percentage by a factor of 6.25. Fat was estimated by Soxhlet apparatus, the moisture content was determined using hot air oven, ash content by muffle furnace, carbohydrate by difference method by summed all the other constituents in the feed (protein, fat, moisture, ash) and subtracted from the total weight of the food (Table 1, 4).

Calculation

The following calculations were made:

Crude protein (%) = N_2 (%) ×6.25

Ether extract (%) = (Weight of the ether extract/Weight of the sample) × 100

Moisture (%) = [(Wet weight of sample – Dried weight of sample)/ Wet weight of sample] x 100

Ash (%) = (Weight of ash/Weight of sample) x 100

Nitrogen-free extract=10-[Weight in grams (protein+lipid+moisture+ash) in 100g food

Feeding Rate, FR (% Body weight/day) = [Dry feed intake/60 days× (Final body weight+Initial body weight)/2)×100

Food conversion ratio, FCR=Total amount of the feed consumed (g)/Wet weight gain (g)

Protein efficiency ratio, PER=Increment in body weight (g)/Protein intake (g)

Protein Productive Value, PPV (%) = [Body wet protein gain (g)/Protein intake (g)] x 100

Protein growth rate, PGR (%/day) = [(Log_e final protein content – Log_e initial protein content)/Days of feeding]×100

Survival (%) = (Number of fish survived after rearing/Number of fish stocked) × 100

Statistical analysis

One way Analysis of Variance (ANOVA) and least significantly difference (LSD) [9] was applied to test the level of significance amongst the treatments.

Results

Growth performance and feed utilization data for magur fingerling fed diets containing SM, MM, GNM and CR with or without FM, are presented in Table 3. Percent weight gain, specific growth rate and average daily gain (ADG) were significantly (P<0.05) higher in fish fed diet T6. Same trend was followed for feeding rate, protein efficiency ratio (PER), protein productive value (PPV) and protein growth rate (PGR). Feed conversion ratio (FCR) were better (P<0.05) in

fish fed diet T6. Carcass composition data are given in Table 4. Ether extract of the fish ranged from 9.89% to 10.3% from T1 to T6 diet and whole body moisture of magur decreased from 26.23% to 25.29% fromT1 to T6 diet. However, Protein, ether extract, ash, moisture and nitrogen free extract did not vary significantly (P>0.05) among dietary groups.

Table 3: Growth and feed efficiency parameters and survival of *C. batrachus* fed the test diets for 60 days

Parameters	Treatment					
	T1	T2	T3	T4	T5	T6
W_1 (g)	10.7±0.07^{bc}	10.83±0.08^{b}	10.53± 0.10^{bc}	10.43±0.11^{c}	11.30±0.15^{a}	11.33±0.14^{a}
W_2 (g)	17.13±0.13^{e}	16.03±0.29^{f}	19.98±0.27^{d}	20.63±0.15^{c}	24.05± 0.12^{b}	24.90±0.25^{a}
Weight gain (%)	60.05±0.62^{d}	48.03±2.31^{e}	89.82±2.75^{c}	97.88±1.83^{b}	112.96± 3.49^{a}	119.97± 3.49^{a}
FR (% bw day^{-1})	2.02±0.03^{a}	1.60±0.02^{b}	1.99±0.03^{a}	1.98±0.06^{a}	2.00±0.01^{a}	2.03±0.04^{a}
SGR	0.34±0.00^{d}	0.28±0.01^{e}	0.46±0.01^{c}	0.49±0.01^{b}	0.55±0.01^{a}	0.57±0.01^{a}
ADG (g day^{-1})	0.11±0.00^{e}	0.09±0.00^{f}	0.16±0.00^{d}	0.17±0.00^{c}	0.21±0.00^{b}	0.23±0.00^{a}
FCR	2.53±0.04^{a}	2.58±0.12^{a}	1.93±0.07^{b}	1.81±0.05^{bc}	1.67±0.01^{c}	1.63±0.02^{c}
PER	0.99±0.02^{c}	0.98±0.05^{c}	1.30±0.05^{b}	1.39±0.04^{b}	1.50±0.03^{a}	1.54±0.02^{a}
PPV (%)	41.63±0.66^{c}	41.09±1.96^{c}	55.34±1.82^{b}	58.72±1.64^{b}	63.29±1.28^{a}	64.76±0.80^{a}
PGR (% day^{-1})	0.47±0.00^{d}	0.43±0.01^{e}	0.54±0.01^{c}	0.56±0.00^{b}	0.60±0.01^{a}	0.62±0.01^{a}
Survival (%)	100±0.00^{a}	100±0.00^{a}	100±0.00^{a}	100±0.00^{a}	100±0.00^{a}	100±0.00^{a}

*Mean±SE within a row followed by with different superscripts are significantly (P<0.05) different from each other.

FR- Feeding Rate; SGR- Specific Growth Rate; ADG- Average Daily Gain; FCR-Food Conversion Ratio; PER- Protein Efficiency Ratio; PPV- Protein Productive Value; PGR- Protein growth rate

Discussion

After the end of the 60 days feeding trial, highest growth was obtained in fish fed combined diet (Diet T6). Amongst several plant protein sources, soybean meal was reported to be most efficiently utilized by *C. batrachus* fingerling [10]. The present study also reveals that growth and feed utilization were poorer in fish fed diets T1 (FM + MM + CR), T2 (MM + SBM), T3 (FM + MM + CR) and T4 (FM + MM + GNM) than those receiving diet containing MNG +GNM + SBM + CR (Table 3).

However, growth rate improved when fish were fed oilseed proteins (MNG +GNM + SBM + CR) in combination without FM (Diet T6). Significantly (P<0.05) higher feeding rate, PER, PPV and PGR were observed in the diet T5 and T6 (Table 3). It might be due to higher intake of those particular diets by fish and because of good binding capacity of the CR which enhanced the pellet ability. The result of the present findings was in disagreement with several other works performed by [11-15]. In general, fish shows poor utilization of oilseed proteins in comparison to FM, may be attributed to one or more reasons such as improper balance of essential nutrients, especially amino acids, and/or presence of antinutritional factors. But the diet containing the combination of MNG +GNM + SBM + CR in the present investigation, showed the best result with respect to growth, feed utilization and survival. It may be due to the synergetic effects of SBM and MM with minor role of CR.

Generally, nutrients are deposited in fish body at a rate proportional to their levels in diets [16]. The inverse between moisture and lipid in the carcass of treated fish in the present investigation is in agreement with the findings of previous workers [17, 18]. Carcass protein contents were higher than the initial; indicative of the fact that experimental treatments favored body protein deposition as much as the control, and confirmed an adequate protein digestibility in dietary treatments [18] (Table 4).

Table 4: Proximate carcass composition (% dry weight) of magur (*C. batrachus*) fed the experimental diets for 60 days

Parameters	T1 (Control)	T2	T3	T4	T5	T6
Crude protein	40.82±0.01	40.72±0.01	41.2±0.06	41.19±0.02	41.16±0.02	41.2±0.01
Ether extract	9.89±0.05	9.96±0.09	10.12±0.40	10.26±0.34	10.27±0.42	10.3±0.37
Ash	21.81±0.88	21.55±0.83	21.49±1.07	21.45±1.08	21.25±0.58	21.18±0.61
Moisture	26.23±1.01	26.01±1.23	25.95±0.39	25.87±0.62	25.64±0.69	25.59±0.65
Nitrogen free extract	1.25±0.15	1.76±0.29	1.24±0.18	1.23±0.21	1.68±0.43	1.73±0.43

Conclusion

It may, therefore, be concluded that combination of MM + GNM + SBM + CR was the most efficiently utilized, and could totally replace FM in diets for *C. batrachus* fingerling, when supplemented with vitamins and minerals, under the conditions of this study. These plant protein sources will definitely reduce the dependency on fish meal and cost effectiveness as well and thus, this will be strengthen the small scale fish farmers to uplift their economy.

References

1. FAO. Fisheries and Aquaculture Information and Statistical Branch. Food and Agricultural Organization, United Nations, 2016.
2. Areerat S. *Clarias* culture in Thailand. Aquaculture. 1987; 63:355-362.
3. El-sayed AM, Mansour, CR, Ezzat AA. Effects of dietary protein levels on spawning performance of Nile tilapia (*Oreochromis niloticus*) brood stock reared at different water salinities. Aquaculture. 2003; 220:619-632.
4. Lovell RT. Use of soybean products in diets for aquaculture species. J. Aquat. Products. 1988; 2:27-52.
5. Lim C, Akiyama DM. Full-fat soybean meal utilization by fish. Asian Fish. Sci. 1992; 5:181-197.
6. Lovell RT. Feed formulation and processing. In: Nutrition and Feeding of Fish (Lovell, R.T., ed.), Van Nostrand Reinhold, New York, NY. 1989, 107-127.
7. Robinson EH, Wilson RP. Nutrition and feeding. In: Channel Catfish Culture (Tucker, C.S. ed.), Elsevier, New York, NY, 1985, 323-404.
8. Association of Official Analytical Chemist. Official methods of analysis of AOAC International, 16th edn:

Washington, DC, USA, 1995, 1,
9. Snedecor GW, Cochran WG. Statistical Methods. 6th ed. Oxford and IBH Pub. Co., New Delhi, 1968, 593.
10. Khan MA, Jafri AK, Anwar MF, Hassan MA, Erfanullah. Nutritional efficacy of oilcakes in diets compounded for fingerlings of Indian major carp *Labeo rohita* (Ham). In: Proceedings of National Symposium on New Horizons in Freshwater Aquaculture, Association of Aquaculturists and Central Institute of Freshwater Aquaculture, Kausalyagang, Bhubaneswar, India, 1991, 73-77.
11. Reigh RC, Ellis SC. Effects of dietary soybean and fish protein ratios on growth and body composition of red drum (*Sciaenops ocellatus*) fed isonitrogenous diets. Aquaculture. 1992; 104:279-292.
12. Webster CD, Yancey DH, Tidwell JH. Effect of partially or totally replacing fish meal with soybean meal on growth of blue catfish (*Ictalurus furcatus*). Aquaculture. 1992; 103:141-152.
13. Khan MA, Jafri AK. In: Replacement of fish meal with soybean meal in diets formulated for fingerling carp, *Labeo rohita* Hamilton. Proceedings of the Third Asian Fisheries Forum (Chou, L.M., Munro, A.D., Lam, T.J., Chen, T.W., Cheong, L.K.K., Ding, J.K., Hooi, K.K., Khoo, H.W., Phang, V.P.E., Shim, K.F., & Tan, C.H. eds.), Asian Fisheries Society, Manila, Philippines. 1994, 663-666.
14. Gomes EF, Rema P, Kaushik SJ. Replacement of fish meal by plant proteins in the diet of rainbow trout (*Oncorhynchus mykiss*): digestibility and growth performance. Aquaculture. 1995; 130:177-186.
15. Fontainhas-Fernandes A, Gomes E, Reis-Henriques MA, Coimbra J. Replacement of fish meal by plant proteins in the diet of Nile tilapia: digestibility and growth performance. Aquacult. Int. 1999; 7:57-67.
16. ImorouToko I, Fiogbe E, Kestemont P. Growth, feed efficiency and body mineral composition of juvenile vundu catfish (*Heterobranchus longifilis*, Valenciennes 1840) in relation to various dietary levels of soybean or cottonseed meals. Aquaculture Nutrition. 2007; 13:1-11.
17. Mukhopadhyay N, Ray AK. Effect of fermentation on the nutritive value of sesame seed meal in the diets for rohu, *Labeo rohita*, fingerlings. Aquaculture Nutrition. 1999; 5:229-236.
18. Alegbeleye WO, Obasa SO, Olude OO, Moronkeji T, Abdulraheem I. Growth performance and nutrient utilization of African mud catfish (*Clarias gariepinus*) fingerlings fed different levels of fermented pigeon pea (*Cajanus cajan*) meal. Israeli J Aquac Bamidgeh. 2012; 64:731-739.