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Carcass composition of Red-bellied pacu (*Piaractus brachypomus*) fed with different dietary protein sources

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Abstract
The study was conducted to evaluate the combined effects of various dietary protein sources on the carcass composition of *Piaractus brachypomus.* Fish were fed twice daily with nine diets prepared with GNC, FM and CSM each varying in protein content (20%, 25% and 30%) and their growth rate and proximate composition were recorded for comparison. Carcass composition of *P. brachypomus* showed, the highest protein content in pacu fed with FM30 diet (61.3%). Lowest protein was found in the initial sampling (55.5%). Highest ether extract was recorded in initial sampling fed (19.58%). Lowest ether extract was found in FM30 (19.10%). Ash content was high in fish fed with FM20 and FM30 diet (17.3%) and low during initial sampling (17.08%). There was a significant difference ($P < 0.05$) observed in proximate composition among the treatments regarding moisture, crude protein, ether extract and total ash.

Keywords: *Piaractus brachypomus*, carcass composition, ground nut cake, fish meal, cottonseed meal

1. Introduction
Fish is known to be one of the cheapest sources of animal protein and other essential nutrients required in human diets [21]. The nature and quality of nutrients in most animals are dependent upon their food type. Results from analysis differ greatly depending on species, age, sex, environment, feeding season and physical activity [1]. Biochemical composition of the whole body indicates the fish quality. Therefore, proximate composition of a species helps to assess its nutritional and edible value in terms of energy units compared to other species.
In fish, variation in body chemical composition relates closely to feed intake (Oyelese, 2006). Diets are the largest expenditure in intensive aquaculture operations (40 -70% of the production costs), and protein is the most expensive dietary component [23]. In view of depleting wild stocks, fish meal, the conventional protein source in fish feeds, needs to be substituted to allow for sustainable aquaculture development [11].
Dietary protein is the single most important nutritional factor that influences the growth performance of fish and feed cost; hence the success of aquaculture. It is generally accepted that the growth rates of fish increase with increasing levels of dietary protein. However, there is a limit to which dietary protein could be incorporated into aquaculture feeds beyond which there may not be any significant impact on yields. To raise fish economically, dietary protein levels need to be considered, because cost of fish production is dependent on protein utilization.
Red bellied pacu (*Piaractus brachypomus*) is a freshwater fish indigenous to the Plate River Basin in South America [6]. It is an omnivorous fish and feeds preferentially on leaves, flowers, fruits and seeds of superior plants. At the moment, *P. brachypomus* has become one of the most cultured fish is due to its easy adaption to culture conditions, its omnivorous characteristics, its rapid growth and good flesh quality [12].
Most of the previous researches involving pacu were feasibility studies for their culture in cages, ponds, etc. and to determine the optimal feeding rate and levels of protein in their diet. Merola (1988) [14] tested the effect of three dietary levels of protein (30, 35, and 40%) and obtained superior yields and weight gains with the 35% protein diet. Carneiro *et al*., (1994) [7] reported better growth rates of pacu at the highest protein and lowest energy levels. Carneiro *et al*., (1994) [7] noted an increase in the mean transit time through the gastro - intestinal tract. They also noted increasing protein digestibility with increasing energy levels at low crude protein levels.

The body tends to assimilate nutrients in quantities it will satisfactorily utilize, and these quantities can be established by performing a proximate analysis on the carcass using standard procedures [8, 1]. Results from proximate nutrient body compositions have been widely used as a guide to developing well formulated artificial diets in fish [13], however limited data exists regarding the levels of nutrients necessary to promote growth of red bellied pacu (*Piaractus brachypomus*) under culture conditions.

The present study is aimed to evaluate the effects of fishmeal, ground nut cake and cotton seed meal on the proximate composition of *Piaractus brachypomus*.

2. Material and Methods

2.1 Transportation and Distribution of Fish to Treatments

Fry staged Red bellied pacu (*Piaractus brachypomus*)with an initial weight of 1.00±0.02 g (270 nos.) procured from farmers at Bhimavaram, west Godavari district, AP and they were randomly and evenly distributed in 60×30×40 cm aquarium tanks (10 fishes per tank) at the wet lab of the College of Fishery Science, Muthukur. In these tanks, each three tanks are triplicates of nine treatment diets. The treatments are GNC, FM and CSM of each 20%, 25% and 30% protein respectively (Table No.1). All the tanks are continuously aerated and bottom cleaned for every three days; complete water exchange for every three weeks. Fish were fed twice daily.

Table 1: Feed formulation of the diets (Ingredients g/100 g):

Ingredients	Diets								
	GNC20	GNC25	GNC30	FM20	FM25	FM30	CSM20	CSM25	CSM30
Groundnut Cake	32.36	50	69.54	-	-	-	-	-	-
Fish meal	-	-	-	20	31.5	43	-	-	-
Cottonseed meal	-	-	-	-	-	-	30.5	48.2	65.8
De-oiled rice bran	32.82	24	14.23	39	33.25	27.5	33.75	24.9	16.1
Maize	32.82	24	14.23	39	33.25	27.5	33.75	24.9	16.1
Vitamins and mineral mixture	2	2	2	2	2	2	2	2	2
Total	100	100	100	100	100	100	100	100	100

GNC 20,25,30 = Groundnut Cake Diet containing 20%,25% 30% protein
FM20,25,30% = Fish Meal Diet containing 20%,25%,30% protein
CSM 20,25,30 = Cottonseed Meal Diet containing 20% 25% 30%

Table 2: Proximate composition of the ingredients (% on dry matter basis):

Composition	Ingredients			
	Groundnut cake	Fish meal	Cottonseed meal	De-oiled ricebran
Moisture	8.80	7.03	7.69	7.70
Crude Protein	38.40	55.00	40.00	12.50
Ether extract	7.30	4.02	16.65	22.50
Total ash	5.60	3.47	3.53	3.90
Acid insoluble ash	7.60	5.60	4.24	15.80

2.2 Water Conditions during Growth Period

Water analysis was done to record Temperature, Dissolved Oxygen, pH, Total Alkalinity and Total Hardness were performed fortnightly according to titrimetric methods (APHA, 2005).

2.3 Processing of Pacu

At the termination of experimental trail, three fishes from each tank (15 from each treatment) with an average weight of 117.13±0.26 for GNC20, 119.85±0.37 for GNC25, 121.90±0.28 for GNC30; 119.12±0.51 for FM20, 126.50±0.26 for FM25 and 126.01±0.34 for FM30; 117.23±0.33 for CSM20, 123.52±0.26 for CSM25 and 122.52±0.36 for CSM30, were sacrificed and dressed to determine the proximate composition.

2.4 Proximate Analysis

2.4. a Moisture

A known weight of the feed sample was taken and dried in an oven at 105^{0}C to constant weight and the moisture content was calculated by using the following formula:

Moisture (%) = (Wt of wet sample - Wt of dried sample) ÷ Weight wet of sample] x100

2.4. b Crude protein

Nitrogen content of the sample was estimated by Kjeldahl method and the crude protein was estimated by multiplying nitrogen percentage by a constant factor 6.25.

Crude protein (%) = Nitrogen (%) x 6.25

2.4. c Ether extract

Ether extract was estimated by soxhlet apparatus using petroleum ether as a solvent.

Ether extract (%) = [(Wt of initial sample – Wt after extraction) ÷Weight of initial sample] x100

2.4. d Ash

Ash content was estimated by taking a known weight of sample in silica crucible and placing it in a muffle furnace heated at 600 ^{0}C for 6 hours.

$$\text{Ash (\%)} = \frac{\text{Weight of ash}}{\text{Weight of sample}} \times 100$$

3. Statistical Analysis

The data was analysed via variance of ANOVA for randomised block design using Web Agri Stat Package Program.

4. Results and Discussion

The study was conducted in order to find out the composition of *Piaractus brachypomus* fed with nine treatment diets. The proximate composition is the percentage of moisture, protein, lipids and ash. Balance among these components and variability after death influence the fish quality, an important factor for the industry and consumers. The proximate composition (moisture, crude protein, ether extract and ash) are given in table 3. The statistical analysis shows that

moisture, protein, lipid and ash contents vary significantly different between all the treatments.

Among all the treatments, the pacu fed with GNC30 and CSM30 diets contained highest moisture content (80.7%); the pacu fed with FM30 diet contained highest crude protein (61.3%); ether extract and ash content were in the same range in all treatments i.e., 19.14±0.04 and 17.27±0.03 respectively. There was a significant difference observed in moisture, crude fibre, ether extract and ash among all treatments.

Table 3: Proximate composition of *Piaractus brachypomus* fed with different dietary protein

	Diets									
Components	**Initial**	**GNC20**	**GNC25**	**GNC30**	**FM20**	**FM25**	**FM30**	**CSM20**	**CSM25**	**CSM30**
Moisture	82.5	80.4	80.4	80.7	80.6	80.6	80.3	80.5	80.5	80.7
Crude Protein	55.5	58.8	59.6	59.8	60.1	60.7	61.3	59.1	59.9	60.1
Ether Extract	19.58	19.16	19.16	19.14	19.18	19.12	19.10	19.17	19.16	19.13
Total Ash	17.08	17.27	17.27	17.28	17.26	17.3	17.3	17.24	17.28	17.29

The percentage of water in the composition is a good indicator of the relative energy, protein and lipid content; the lower the percentage of water, the greater the lipids and protein content and higher the energy density of the fish [3, 1]. The present study agrees with this.

Several studies have been done to establish the proximate body composition in fish [9, 3, 1], and results from some of these have been used to establish the nutritional requirements in fish [17]. Based on the information from such research, appropriate fish feed formulae have been developed.

Prabal Barua (2011) [19], has concluded that the proximate crude protein composition of *P. brachypomus* is relatively high (66.49±2.90%), compared to that in *clarias gariepinus* 19.3±0.52, Ayinla 1993) [4], and *Tilapia guineensis* (18.65%, Abimola *et al*., 2010), but close to that observed in the northern pike (60 – 85.8%, Salam and Davies, 1994) [22]. This implies that P. brachypomus formulated diets will be much superior to those currently available on the aquaculture feed market that are specifically made for tilapia, catfish and carps. Some observers have suggested that this highly proteinious feed could be very expensive therefore making the culture of *P. brachypomus* very costly.

The reduced carcass fat content with increased protein content of groundnut cake (GNC), fishmeal (FM) and cottonseed meal (CSM) in diet is also coincide with the earlier findings of different fish species. (Mohsen and Lovell, 1990; Reigh and Ellis, 1992; Elamgovan and Shim, 2000; Venou *et al*., 2006; Biswas *et al*., 2007) [15, 20, 10, 25, 5]. However, the GNC 20 and GNC 25 fat content of the carcass composition is same in the present investigations.

Prabal Barua (2011) [19] indicated the presence of ash, and this suggests that minerals are one of the compositions of the eggs and body of *Piaractus brachypomus*, Observations further indicate that the ash levels in *P. brachypomus* increased steady with increasing fish length. This agrees with the present investigations in the case of plant protein only, whereas the ash content in Fish meal, content decreases with the increase in protein level.

In conclusion, the carcass composition of pacu, the protein content is high in all the 30% protein irrespective of plant and animal sources.

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