



Studies on Fish feed Formulation of Indian Major Carps from Aquatic Macrophytes, *Lemna minor* and *Eichhornia crassipes*

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ABSTRACT

In the present study, highest SGR (Specific Growth Rate) was obtained in 20% in *Lemna minor* and 10% in *Eichhornia crassipes*. The leaves of aquatic plants had considerable amount of crude protein and crude lipid, which improves the growth of fingerlings of fish upto a certain levels of inclusions, thereby reducing the feed cost. The slow growth performance might be due to absence of natural feed in the laboratory culture. The leaf meals inclusion has much advantage in growth performance of fish. However these leaf meals need processing to lower their fibre content, which to be used as fish feed.

KEYWORDS: Fish Feed, *Lemna Minor*, *Eichhornia Crassipes*, Cost Effective, Aquatic Macrophytes

INTRODUCTION

Artificial feed plays an important role in semi intensive fish culture, where it is required to maintain a high density of fish than the natural fertility of water can support (Jhingran, 1991). Feed is undoubtedly the single largest operating cost in intensive fish culture especially using cat fish, which needs high protein (Otubusin *et al.* 2007). Proteins are major organic material in fish tissue constituting 65%-75% of dry weight (De Silva, 1989). Lipids constitute 6.28% of fish diet. Lipids for fish are important source of energy and help in transportation of fat soluble vitamins and steroids. Essential fatty acids promote normal larval development, fish growth and reproduction (Mishra and Mukhopadhaya, 1996). Fish feed generally constitute 60%-70% of operational cost in intensive and semi intensive aquaculture systems (Singh *et al.*, 2006). To increase protein retention from the diet, the quality and mixture of different proteins and the inclusion of partly pre-digested proteins have shown good results (Calheiros, 2003, FAO, 2004, Lunger *et al.*, 2007).

MATERIALS AND METHODS

Feed Ingredients: Fish meal, ground nut oil cake, rice bran, soybean meal were collected from local market. The two aquatic weeds used in the feed, *Lemna minor* and *Eichhornia crassipes* were collected from local water bodies.

Feed Additives: Sunflower oil, Cod liver oil and Vitamin mineral premix. Cod liver oil and vitamin were collected from local medicine store. For vitamin mineral premix Ambiplex, Brihans lab, Pune and Argimin, Glaxo India Ltd., Mumbai was used. Sunflower oil was collected from local grocery store.

Equipments Used: Mixer grinder, Sieve, Balance, Pelletizer

Preparation Method: The feed ingredients other than leaf meal were collected from local market and sundried. They were grounded thoroughly and passed through fine meshed sieve to ensure homogeneity. *Lemna minor* and *Eichhornia crassipes* plants were collected from local water bodies. Leaves were collected in case of *Eichhornia* and sundried. Dried leaves were grounded thoroughly and sieved to obtain fine powder. Powdered ingredients were subjected to proximate analysis following procedures of AOAC (2000).

Proximate Analysis

Moisture: Weighed amount of sample (W1) was placed in the oven for 12 hours at 105°C. The dried sample again kept in oven until constant weight (W2) was obtained. The loss weight was recorded.



$$\text{Moisture (\%)} = \frac{W2-W1}{W1}$$

Ash: Total Ash(%) was determined by burning 2gm of dried sample which then placed in a muffle furnace for ignition at 550-600°C till the residue was obtained. Which then cool and weight.

$$\text{Ash (\%)} = \frac{\text{Wt. Of Ash} \times 100}{\text{Wt. Of Sample}}$$

Organic matter (%) = 100(%) – Ash (%)

Crude Protein: Crude protein was estimated using micro Kjeldhal method.

Crude Protein (%) = N2(%) × 6.25, whereby;

$$(N) (\%) = \frac{\text{Volume of H}_2\text{SO}_4 \text{ used} \times \text{Normality of H}_2\text{SO}_4 \times 0.014 \times 250 \times 100}{\text{Weight of Sample} \times 10}$$

Where 0.014 = Standard volume of 0.1N H₂SO₄ used to neutralise 1ml of Ammonia

250 = Dilution of digested mixture

100 = for % of N₂

10 = Volume of the digested and diluted sample used

6.25 = Assumed factor for equation of N% to crude lipid

Crude Lipid: Crude lipid content was determined using soxhlet apparatus.

$$\text{Crude Lipid (\%)} = \frac{\text{Weight of crude lipid}}{\text{Weight of Sample}} \times 100$$

RESULTS AND DISCUSSION

Proximate analysis of feed ingredients such as fish meal, soybean meal, GNOC, leaf meals were made (Table- 1). Crude protein (% CP) of fishmeal was 63.02, ground nut oil cake was 42.5 and soybean meal was 35.3 and rice bran 12.3. The leaves of two aquatic macrophytes contains 20.3%, crude protein (*Lemna minor*) and 13.5% (*Eichheronia crassipes*) respectively. Crude lipid (CL %) content of the fishmeal was 11.3%, followed by rice bran and GNOC which were 10% each and soybean contained 20% CL. The two leaves used had CL content of 4.3% and 2.6% in *Lemna* and *Eichhornia* respectively. Ash content was highest in fishmeal (22.75%) followed by *Eichhornia* leafmeal (21.7%) and was lowest in *Lemna minor*(13.5%). Ricebran had 8.5% ash and soybean had 5% ash.

Table 1. Proximate Analysis (% of dry matter) of ingredients used for fish feed formulation

Ingredients	Moisture	CP	CL	Ash
Ricebran	7.6	12.1	10.0	8.5
GNOC	8.4	42.5	10.3	10.6
Soybean meal	9.1	35.4	2.1	5.1
Fish meal	13.73	63.4	11.2	22.73
Lemna minor leaf meal	3.01	20.4	4.1	13.5
Eichhorniacrassipes leaf meal	1.05	13.5	27	21.7

However, proximate composition of feed 1 containing *Lemna minor* leafmeal was presented in table-2. Proximate analysis of feed 1 containing *E. Crassipes* leafmeal was presented in table-3. The crude protein(%) of control feed containing fishmeal but no leaf



meal was slightly higher (37.3%) and T₁, T₂ and T₃ have CP level 35.6%, 34.1% and 33.6% respectively. The crude lipid (%) of control feed was 8.3% and T₁, T₂ and T₃ had 6.7%, 6.85% and 5.6% respectively. The ash (%) of control feed was highest i.e., 13.6% followed by T₁, T₂ and T₃, 11.3%, 11% and 10.7% respectively. Moisture % of control feed was found to be 2.4%, T₁, 1.3% T₂ and 1.7% T₃ respectively.

Table 2: Proximate Composition (% of dry matter) of Feed 1 containing *Lemna minor* leaf meal

Ingredients	Inclusion level of Lemna leaf meal			
	0% Control	10% T1	20% T2	30% T3
Lemna minor leaf meal	0	3.6	7.0	10.5
Fish meal	19.9	16.4	12.8	10.4
GNOC	39.1	39.0	39.2	39.3
Rice Bran	39.0	39.0	39	38.8
Sunflower Oil	1.0	1.0	1.0	1.0
Vitamin and Mineral premix	1.0	1.0	1.0	1.0
	100	100	100	100

Table 3: Proximate analysis of Feed 1

Experimental Feed 1	Crude Protein %	Crude Lipid %	Ash %	Moisture%	OM %
Control	37.3	8.0	13.6	2.4	84.51
T1	35.6	6.7	11.6	1.3	85.44
T2	34.1	6.7	11.1	1.3	85.51
T3	33.6	5.6	10.7	1.7	85.16

Accordingly the proximal composition and proximal analysis of feed-2 containing *Echhornia* leafmeal were presented in table-4 and table-5 respectively. The crude protein (%) of control feed was 36.73%, which was slightly higher due to higher percentage of fishmeal. Other three feeds D₁, D₂ and D₃ had 35.43%, 35.23% and 35.14% of crude protein. The crude lipids (%) of the four feeds were 5.07%, 4.7%, 4.6% and 4.39% in controls D₁, D₂ and D₃ respectively. The ash was highest in D₃(5.33%) followed by D₂ (4%) and D₁ (3.1%). Ash (%) was lowest in control feed (2.1%). Moisture (%) of D₁ was highest (8.1%) followed by 8.1% in D₂, 8.2% in D₃ and 7% in control.

Table 4: Proximate Composition (% of dry weight) of Feed 2 containing *Eichhornia crassipes* leaf meal

Ingredients	Inclusion level of Lemna leaf meal			
	0% Control	10% D1	20% D2	30% D3
Eichhornia crassipes leaf meal	0	10	20	30
Fish meal	20.0	15	13	8
GNOC	20.0	21	19	21
Soybean meal	27.9	26	23	19
Rice Bran	30.1	26	23	20.0
Cod liver oil	1.0	1.0	1.0	1.0
Vitamin Mineral Premix	1.0	1.0	1.0	1.0
	100	100	100	100

**Table 5:** Proximate analysis of Feed 2

Experimental Feed 2	Crude Protein %	Crude Lipid %	Ash %	Moisture%	DM %
Control	36.76	5.08	2.1	7.0	94
D1	35.44	4.86	3.0	8.3	91.8
D2	35.26	4.56	4.0	8.1	91.84
D3	35.14	4.37	5.33	8.0	92.0

Most conventional ingredients used in fish feed are fishmeal, soybean meal, groundnut oil cake etc which in developing countries are scarce and costly to farmers (Fasakin *et al.*, 1999) causing hardship of gaining due profit from aquaculture. Fishmeal is often used in aqua feeds as they are essential source of amino acids, vitamins and minerals and they generally enhance palatability (Davies and Arnold, 2000). However, nearly all researchers agree that an alternative ingredient should be used in aqua feed industry in place of fishmeal, whose supplies are limited although demand for it is expected to rise (Yilmaz *et al.*, 2005).

Considerable attention has been devoted to replacement of fishmeal with plant protein sources such as soybean meal (Oliva Teleset *et al.*, 1994), groundnut oilcake (Davies and Ezenwa, 2010), mucuna seed meal (Sidduraju and Becker, 2001), winged bean (Fagbenro, 1999) and various legumes (Hossain *et al.*, 2001).

Now day's serious efforts are made towards use of non conventional feed sources as ingredients in fishfeed (Ali *et al.*, 2006). Utilization of aquatic macrophytes commonly occurring in freshwater bodies can serve two benefits at a time. 1. These may be used as alternative ingredients for making farm based aquafeeds, and 2. Their use as ingredients in making fishfeed can reduce their wastage and minimise cost of fishfeed production along with supply of sufficient nourishment to fish without affecting the ambient environment (Mandal *et al.*, 2010). With high abundance as well as excessive proliferation, aquatic macrophytes are easily available in fresh water ecosystem (Mandal *et al.*, 2010). However their utilization as fishfeed component is not much remarkable despite their unique nutrient status (Mandal *et al.*, 2010). *Lemna minor* is found to be the most promising one, 40% of which is blended with commercial feed has exhibited significant performance (Elsafai, 2004) advocated inclusion of 20-40% duckweed in fish diet on dry weight basis as it had better digestibility Coefficient than any other commercial plant material used. Stetlikova and Adamek (2004) opined that *Elodea Canadensis* as having higher concentration of phosphorus, potassium and ash than that of *Myriophyllum spicatum*, *Potamogeton pectinatus* and *Spirodella polyrrhiza* and reasonably the most preferred plant to *Nile tilapia* than others. Tender leaves of *Myriophyllum spicatum* were more preferable to tilapia because young leaves contained higher concentration of protein and mineral than does older leaves (Begon *et al.*, 1997). Bairagiet *et al.*, 2002 reported successful utilization of *Lemna* leafmeal as a dietary ingredient in the diet of *Labeo rohita* fingerlings upto 30% inclusion. Robinsion *et al.*, 2001 found that inclusion of *Lemna minor* meal into channel catfish diets had no effects on the rate of feed conversion.

CONCLUSION

It is concluded that inclusion of *Lemna* meal into commercial diets would not significantly affect feed quality and that duckweed meal may be a suitable protein source for practical diets of channel catfish. The use of leafmeal as a possible fishmeal substitute is receiving increasing attention by fish nutritionists throughout world to reduce feed cost (Bairagi *et al.*, 2004). It is however important that the selected plant sources do not conflict with the interests of human food security or their domestic animals (Amisah *et al.*, 2009). Inclusion of such aquatic macrophytes as food and feed may serve dual purpose, i.e., bringing more plant derived foodstuff for aquaculture and making aquaculture more cost effective for farmers. Therefore, a combined effort comprising plant taxonomists, nutritionists, physiologists and fish culturists is warranted for making use of untapped potential of these macrophytes as feed for fish.

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