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INFLUENCE OF ANIMAL PROTEIN INGREDIENT ON GROWTH FACTORS OF TWO MAJOR CARPS, *LABEO ROHITA* AND *CIRRHINUS MRIGALA*

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Abstract: **Fishes are known as healthy food items; they are an excellent protein source that also delivers various minerals and vitamins necessary for good health. Scientists reported that societies with high fish intake have considerably lower rates of acute myocardial infarctions, other ischemic heart diseases and atherosclerosis. The present availability of protein is much below the minimum daily requirements and the livestock sector alone will not be able to meet the protein requirements of ever increasing human population. Fish is an excellent and relatively a cheaper protein source of high biological value. Therefore its use may help bridge the protein gap because of its multifarious economic advantages and nutritional significance. Fish proteins contain all the essential amino acids (not synthesized and need to be provided in the diet) in the required proportion and hence have a high nutritional value, which contribute to their high biological value. Cereal proteins are usually low in lysine and/or the sulphur-containing amino acids like methionine and cysteine, whereas fish protein is an excellent source of amino acids. In diet based mainly on serials a supplements based on fish therefore raise the biological value significantly. The chemical score or amino acid score of fish protein compares well with that of whole egg protein which is considered a standard protein source and slightly more than that of cow's milk Similarly the protein efficiency ratio of fish proteins is 3.5 against that of egg protein (3.9), beef (2.3) and milk protein (2.5).Fish is also rich in the non-protein amino acid taurine, which has a unique role in neurotransmission. Evaluation of growth factors is the best way to judge the acceptability and suitability of artificial feed for fish hence the present investigation was carried out to study the influence of earthworm protein on freshwater fishes.**

Keywords: **earthworm, growth factors, and freshwater fish.**

1. INTRODUCTION

Fish, like other animals, have requirements for the essential nutrients such as proteins, carbohydrates, fatty acids, vitamins and minerals in their diets, in order to grow properly (Lovell, 1989). When fish is placed in an artificial environment (culture practices), feed containing these essential nutrients must be supplied for better growth. Conversely the feed may be given as supplementary feed, where part of the nutritional needs is supplied by natural feeds present in the aquatic environment (Burel, *et al* 1996).Basically animal protein has a balanced combination of all the amino acids; as it is called "complete protein". Protein is one of the basic components of animal tissues which constitute 45 to 47 % tissue dry matter (Murai, 1992). Therefore, it is an essential nutrient for body maintenance and growth of fishes.

Feed Conversion Ratio (FCR) is an appropriate way to judge the acceptability and suitability of artificial feed for fish. In animal husbandry, Feed Conversion Ratio (FCR), Feed Conversion Rate, and Feed Conversion Efficiency (FCE), is a measure of animal's efficiency in converting feed mass into increased body mass. FCR is the mass of the food eaten divided by the body mass gain, all over a specified period. It is dimensionless, i.e. there is no measurement units associated with FCR. Animals that have a low FCR are considered efficient users of feed. FCR value is used to measure the gross utilization of food for growth in fish (Teugels 1982, 1984).Protein Efficiency Ratio (PER) is widely used for evaluating the quality of protein in feed. It is based on the weight gain of a test subject divided by its intake of a particular food protein during the test period. The feed industry has been using PER as the standard for evaluating the protein quality of feed. Nutritional value of protein is used as guide to the effectiveness of protein source in requirements. PER is one of the most popular methods for quantifying the nutritional value of protein. It is an expression which relates the gram of weight gained to the gram of crude protein fed. Specific Growth Rate (SGR) is defined as the increase in cell mass per unit time. The information of SGR on locally available ingredients will provide the basis to develop the acceptable fish feed. Along with water temperature and fish size, this parameter is closely associated with daily feeding rate or ration size (Hung, *et al*, 1989). Gross Conversion Efficiency (GCE) It is often used as an indicator of the bioenergetics physiology of fish under different experimental conditions. This parameter measures the growth rate relative to feed intake of the fish. Both growth rate and feed intake are related to body size. Modeling biomass flow in aquatic ecosystem indicates knowledge of conversion efficiency from one tropical level to another. Small fishes have higher relative feeding rate than large fishes and therefore have greater potential impact on the ecosystem in terms of food consumed or biomass produced per unit biomass of feed. Feed Conversion Efficiency (FCE) is a composite measure that combines feed intake with growth rate to estimate the effectiveness by which feed is converted to saleable meat product, and is a major determinant of production system efficiency. The most commonly used measures of FCE are Feed Conversion Ratio, which is feed intake as a ratio of weight gain over a specified time period, or its inverse feed are efficiency. These measures of gross FCE, because they do not distinguish between the amount of feed used for growth and the amount used for body maintenance. Such a distinction is made by measures of net FCE, such as residual feed intake, which is the difference between actual feed intake and that predicted from mean observed requirements for growth and body weight maintenance (Koch, *et al* ;1963).

Feed costs are a major input to aquaculture production systems, and genetic improvement in FCE may therefore have an important influence on profitability. FCE is usually expressed by a composite measure that combines feed intake and growth rate. The two most common measures are Feed Conversion Ratio (feed intake/weight gain over a specified time interval) and its inverse, feed efficiency. Feed Conversion Ratio and feed efficiency are measures of gross FCE, because they do not distinguish between the separate energy requirements of growth and maintenance. There is abundant evidence of substantial genetic variation in FCE and its component traits in terrestrial livestock species and, the same is for cultured fish species. FCE is an indicator of biological function that combines feed intake (the input variable) with growth or weight (the output variable). Significant improvements in FCE using genetic and non-genetic methods have been made in other animal production systems, especially the pig and poultry industries (Lee, *et al.* 2000). There is no reason to think the same would not occur in fish production.

Aquaculture research effort has primarily focused on non-genetic means for improving FCE (Kolkovski,*et al;* 1997; Tacon, (1990).FCE has been shown to vary with temperature (Brown, 1957), size and age (Brett 1979), feeding level (Fontaine *et al*. 1983), nutritional content of feeds (Shyong *et al*. 1998).

2. MATERIALS AND METHODS

Formulation of feeds:

Fully grown earthworms of species *Eisenia faetida* of about 20 to 30 cms were collected. They were brought to the laboratory, washed, cleaned and weighed. Then they were sacrificed by introducing them in boiling water. Sacrificed earthworms were then squashed using mortar and pastel. Ingredients such as corn flour, milk powder, agar powder, turmeric powder, garlic paste, cumin powder and pepper powder were added. The mixture was boiled till it became semisolid mass. Then it was cooled to room temperature. After cooling vitamin mixture and cod liver oil was added. The mixture in semisolid form was kept in refrigeration at temperature 15^0C for 12 hrs. After 12 hours it was removed from refrigeration, brought to room temperature and then squeezed over polythene sheet and dried for 48 hrs. The dried nodules were crushed into small pellets. Pellets were sun dried to avoid fungal infection, weighted and stored in the bottles.

Following the above procedure the feeds were formulated in five combinations, viz. 100% conventional feed (100% deoiled groundnut cake), 100% formulated feed (100% earthworm),75% formulated feed (75% earthworms + 25% deoiled ground nut cake), 50% formulated feed (50% earthworms + 50% deoiled groundnut cake) and 25% formulated feed (25% earthworms + 75% deoiled groundnut cake).

Experimental protocol:

The fingerlings of freshwater fish *Labeo rohita* and *Cirrhinus mrigala* (measuring about 4 to 5 cm in length and 2 to 4 gm in weight) were obtained from the Fish Seed Rearing Centre, Rankala, Dist. Kolhapur, unit of Department of Fisheries, Government of Maharashtra, during the experimental period. After obtaining them, they were brought to the laboratory and acclimatized in rectangular glass aquaria of 36x12"with 60 liters capacity containing aerated water for seven days. During acclimatization adequate aeration was maintained and temperature was maintained from 28^0C to 30^0C. The fishes which survived during acclimatization were distributed randomly into five aquaria (15 in each) and labeled as per the feed combination. They were fed at the rate of 2% of total body weight. The feeding was done once in a day. The body weights and lengths were recorded at each time interval i.e.30, 45, 60, 75 and 90 days throughout the experimental period respectively. The nutritional parameters were calculated by using respective formulas.

i) Food Conversion Ratio (FCR): (Elliot and Davison, 1976)

FCR (expressed in Kg) denotes the amount of dry feed necessary to produce 1 Kg of fish.

$$FCR = \frac{\text{Total dry weight of food}}{\text{Total wet weight gain}}$$

ii) Protein Efficiency Ratio (PER): (Laird and Needham, 1998)

PER is calculated as:

$$PER = \frac{\text{Total wet weight gain (growth of fish)}}{\text{Total dry weight protein fed}}$$

iii) Specific Growth Rate (SGR): (Elliot and Davison, 1976)

$$SGR = \frac{\log W_t - \log W_0}{t} \times 100$$

Where, W_t = Final weight, W0 = Initial weight, and t = duration / time.

iv) Gross Conversion Efficiency (K): (Elliot and Davison, 1976)

$$GCE = \frac{\text{Specific Growth Rate}}{\text{Relative Food Intake (RFI)}} \times 100$$

Where,

$$RFI = \frac{F}{0.5\ \{(Wt_2 - Wt_1) \times (t_2 - t_1)\}} \times 100$$

Where,

F is the gross faecal energy which consists of undigested food and metabolic products,

i.e. food ingestion – wt. of faces.

Log Wt_1 is the log of weight of animal at time 1

Log Wt_2 is the log of weight of animal at time 2

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v) **Feed Conversion Efficiency (FCE):** (Elliot and Davison, 1976)

$$FCE = \frac{\text{Wet weight gain of fish}}{\text{Dry weight of feed consumed}}$$ (FCE – Food conversion efficiency)

3. RESULTS

Table No. 1: Total weight gain (gm) of *Labeo rohita* fed on conventional and combinations of formulated feeds

Duration in days	100% Conventional fish feed	100% Formulated fish feed	75% Formulated fish feed	50% Formulated fish feed	25% Formulated fish feed
30	1.64±0.82	2.47±1.14***	1.96±0.70***	2.54±1.21***	1.93±1.24***
45	1.83±0.98	2.75±0.83**	2.26±0.81 NS	2.46±0.97***	2.12±0.79**
60	2.04±0.80	3.50±0.55*	3.12±0.81***	2.64±0.83**	2.45±1.05***
75	2.37±0.88	2.45±0.56**	3.31±0.98**	3.02±0.88*	2.71±0.91***
90	2.94±0.87	4.32±0.95***	4.12±1.21***	3.54±0.80 ***	3.35±1.09***

(Value expressed is mean of n (n=5); ±: SD)

*P<0.05, **P< 0.01, ***P< 0.001, NS – Non Significant

Table No.2: Feed Conversion Ratio (gm) of *Labeo rohita* fed on conventional and combinations of formulated feeds

Duration in days	100% Conventional fish feed	100% Formulated fish feed	75% Formulated fish feed	50% Formulated fish feed	25% Formulated fish feed
30	4.55±1.11	3.03±1.19***	3.76±1.51***	3.95±1.39***	3.48±1.26***
45	6.97±1.71	4.12±1.30***	4.70±1.48***	5.18±1.37**	5.00±1.60*
60	8.13±1.49	4.66±1.50**	4.82±1.34***	5.88±1.84***	6.38±1.58***
75	6.99±1.70	5.72±1.47*	5.82±1.68**	6.72±1.84***	6.98±1.98**
90	7.19±1.74	6.53±1.65***	6.36±1.44***	7.00±1.46***	7.44±1.48*

(Value expressed is mean of n (n=5); ±: SD)

*P<0.05, **P< 0.01, ***P< 0.001, NS – Non Significant

Table No. 3: The Protein Efficiency Ratio (gm) of *Labeo rohita* fed on conventional and combinations of formulated feeds

Duration in days	100% Conventional fish feed	100% Formulated fish feed	75% Formulated fish feed	50% Formulated fish feed	25% Formulated fish feed
30	0.90±0.12	1.15±0.43***	0.98±0.11***	0.80±0.22**	1.08±0.35***
45	0.83±0.08	0.84±0.09**	0.77±0.13***	0.61±0.07**	0.75±0.11**
60	0.50±0.06	0.74±0.06***	0.75±0.10***	0.53±0.05*	0.58±0.11***
75	0.58±0.09	0.60±0.04***	0.62±0.09***	0.47±0.04**	0.52±0.09***
90	0.56±0.07	0.53±0.06**	0.57±0.09***	0.45±0.07***	0.50±0.09***

(Value expressed is mean of n (n=5); ±: SD)

*P<0.05, **P< 0.01, ***P< 0.001, NS – Non Significant

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Table No.4: Specific Growth Rate (%) of *Labeo rohita* fed on conventional and combinations of formulated feeds

Duration in days	100% Conventional fish feed	100% Formulated fish feed	75% Formulated fish feed	50% Formulated fish feed	25% Formulated fish feed
30	0.57±0.068	0.98±0.043***	0.73±0.049***	0.68±0.036**	0.86±0.072***
45	0.54±0.033	0.76±0.048***	0.62±0.099**	0.58±0.063**	0.56±0.032***
60	0.44±0.052	0.74±0.045***	0.70±0.060***	0.51±0.043***	0.45±0.087**
75	0.44±0.043	0.61±0.060*	0.59±0.082***	0.47±0.087***	0.44±0.087*
90	0.47±0.072	0.56±0.051**	0.52±0.077**	0.49±0.083*	0.48±0.093***

(Value expressed is mean of n (n=5); ±: SD)

*P<0.05, **P< 0.01, ***P< 0.001, NS – Non Significant

Table No.5: Gross Conversion Efficiency (%) of *Labeo rohita* fed on conventional and combinations of formulated feeds

Duration in days	100% Conventional fish feed	100% Formulated fish feed	75% Formulated fish feed	50% Formulated fish feed	25% Formulated fish feed
30	9.62±1.017	7.66±1.050***	4.59±0.769***	5.37±0.544**	7.11±1.462*
45	3.79±0.747	5.96±1.350*	6.76±1.474***	6.25±1.374***	5.28±0.997***
60	3.47±1.204	6.04±1.322**	7.36±1.051**	5.44±1.486**	3.85±0.917***
75	6.04±1.298	5.25±0.766***	5.86±1.512**	5.29±1.481**	4.08±1.021**
90	5.91±1.469	4.98±1.140**	5.53±1.528***	5.16±1.209***	4.12±0.933**

(Value expressed is mean of n (n=5); ±: SD)

*P<0.05, **P< 0.01, ***P< 0.001, NS – Non Significant

Table No.6: Feed Conversion Efficiency (gm) of *Labeo rohita* fed on conventional and combinations of formulated feeds

Duration in days	100% Conventional fish feed	100% Formulated fish feed	75% Formulated fish feed	50% Formulated fish feed	25% Formulated fish feed
30	0.21±0.077	0.33±0.101***	0.26±0.089***	0.25±0.105***	0.28±0.096***
45	0.14±0.111	0.24±0.093**	0.21±0.103**	0.19±0.103***	0.17±0.104*
60	0.12±0.091	0.21±0.092***	0.20±0.074***	0.17±0.117***	0.15±0.072**
75	0.14±0.065	0.17±0.070**	0.16±0.120*	0.14±0.088**	0.14±0.080***
90	0.11±0.078	0.15±0.086*	0.15±0.099**	0.14±0.070***	0.13±0.086***

(Value expressed is mean of n (n=5); ±: SD)

*P<0.05, **P< 0.01, ***P< 0.001, NS – Non Significant

Table No.7: Total body weights (gm) of *Cirrhinus mrigala* fed on conventional and combinations of formulated feeds

Duration in days	100% Conventional fish feed	100% Formulated fish feed	75% Formulated fish feed	50% Formulated fish feed	25% Formulated fish feed
30	1.90±0.280	2.41±0.125***	2.03±0.265***	2.15±0.114*	1.92±0.274*
45	2.01±0.198	2.56±0.259***	2.58±0.225***	2.38±0.174*	2.11±0.322***
60	2.41±0.386	3.20±0.387**	3.02±0.385***	2.55±0.230***	2.49±0.426***
75	2.42±0.265	3.58±0.529*	3.51±0.359**	2.91±0.301**	3.21±0.233*
90	2.55±0.221	3.95±0.841***	4.16±0.481***	3.61±0.335***	3.45±0.544***

(Value expressed is mean of n (n=3); ±: SD)

*P<0.05, **P< 0.01, ***P< 0.001, NS – Non Significant

Table No.8: Feed Conversion Ratio (gm) of *Cirrhinus mrigala* fed on conventional and combinations of feeds

Duration in days	100% Conventional fish feed	100% Formulated fish feed	75% Formulated fish feed	50% Formulated fish feed	25% Formulated fish feed
30	4.35±1.66	3.05±1.52***	4.22±1.83***	4.23±1.64***	4.75±2.02***
45	5.94±1.78	4.33±1.17***	4.56±1.04*	5.40±1.41*	5.85±1.30*
60	6.53±1.72	4.87±1.25 NS	5.29±1.34 NS	6.59±1.52*	6.27±1.58 NS
75	7.75±1.82	5.71±1.65*	5.98±1.76*	7.17±1.56*	6.29±1.62NS
90	8.82±1.85	6.53±1.72*	6.56±2.04***	7.31±1.69**	7.21±1.72*

(Value expressed is mean of n (n=3); ±: SD)
*P<0.05, **P< 0.01, ***P< 0.001, NS – Non Significant

Table No.9: The Protein Efficiency Ratio (gm) of *Cirrhinus mrigala* fed on conventional and combinations of formulated feeds

Duration in days	100% Conventional fish feed	100% Formulated fish feed	75% Formulated fish feed	50% Formulated fish feed	25% Formulated fish feed
30	0.94±0.082	1.14±0.152***	0.86±0.143***	0.75±0.071*	0.80±0.106***
45	0.69±0.109	0.80±0.059***	0.79±0.064***	0.58±0.061***	0.64±0.095**
60	0.62±0.068	0.71±0.058**	0.68±0.079**	0.47±0.065***	0.59±0.075***
75	0.52±0.046	0.82±0.058*	0.60±0.074***	0.44±0.088**	0.59±0.0792***
90	0.46±0.070	0.53±0.044***	0.55±0.066***	0.43±0.079*	0.52±0.082***

(Value expressed is mean of n (n=3); ±: SD)
*P<0.05, **P< 0.01, ***P< 0.001, NS – Non Significant

Table No.10: Specific Growth Rates (%) *of Cirrhinus mrigala* fed on conventional and combinations of formulated feeds

Duration in days	100% Conventional fish feed	100% Formulated fish feed	75% Formulated fish feed	50% Formulated fish feed	25% Formulated fish feed
30	0.60 ± 0.087	0.64 ± 0.081*	0.63 ± 0.072**	0.63 ± 0.071*	0.54 ± 0.061 NS
45	0.45 ± 0.088	0.70 ± 0.099***	0.65 ± 0.051*	0.51 ± 0.067 NS	0.46 ± 0.073***
60	0.47 ± 0.037	0.69 ± 0.053***	0.60 ± 0.068***	0.43 ± 0.046***	0.47 ± 0.049***
75	0.38 ± 0.058	0.61 ± 0.146***	0.57 ± 0.047*	0.42 ± 0.052*	0.52 ± 0.048**
90	0.34 ± 0.055	0.56 ± 0.054**	0.48 ± 0.082***	0.46 ± 0.048*	0.47 ± 0.056**

(Value expressed is mean of n (n=3); ±: SD)
*P<0.05, **P< 0.01, ***P< 0.001, NS – Non Significant

Table No.11: Gross Conversion Efficiency (%) of *Cirrhinus mrigala* fed on conventional and combinations of formulated feeds:

Duration in days	100% Conventional fish feed	100% Formulated fish feed	75% Formulated fish feed	50% Formulated fish feed	25% Formulated fish feed
30	6.16±1.611	4.82±1.159*	6.42±1.339*	10.89±1.849***	4.45±1.034**
45	5.16±1.186	5.26±1.441***	4.10±1.655***	4.19±1.266***	4.76±1.246***
60	5.09±1.168	5.46±1.327***	4.18±1.010*	3.97±1.285***	4.45±1.263***
75	4.43±1.062	5.23±0.675*	5.41±1.359***	4.12±0.847 NS	5.22±0.711 NS
90	3.37±1.149	4.97±1.137***	4.71±1.287**	4.38±1.034*	4.51±1.069**

Value expressed is mean of n (n=3); ±: SD)
*P<0.05, **P< 0.01, ***P< 0.001, NS – Non Significant

Table No.12: Feed Conversion Efficiency (gm) of *Cirrhinus mrigala* fed on conventional and combinations of formulated feeds

Duration in days	100% Conventional fish feed	100% Formulated fish feed	75% Formulated fish feed	50% Formulated fish feed	25% Formulated fish feed
30	0.21±0.085	0.32±0.095***	0.23±0.084**	0.23±0.089*	0.22±0.070 NS
45	0.16±0.095	0.23±0.068**	0.21±0.054*	0.18±0.076*	0.17±0.073*
60	0.15±0.066	0.20±0.088***	0.18±0.071***	0.15±0.079***	0.15±0.078***
75	0.12±0.080	0.17±0.066***	0.16±0.087***	0.13±0.103***	0.15±0.079*
90	0.11±0.085	0.15±0.079***	0.15±0.078*	0.13±0.102***	0.13±0.102***

Value expressed is mean of n (n=3); ±: SD)

*P<0.05, **P< 0.01, ***P< 0.001, NS – Non Significant

3. DISCUSSION

Nutrition is one of the important factors influencing the ability of cultured fish to exhibit its genetic potential for growth and reproduction. Conversion efficiencies, specific growth rate and food conversion are the major variables for the commercial aquaculture enterprises. An understanding of the relationships between these is fundamental in optimizing feeding the fish. Unfortunately, the maximum growth and the lowest feed conversion ratios do not coincide at the same feeding rate. The lowest feed conversion occurs at feeding rates below those at which maximum growth occurs (De Silva and Anderson, 1995; Goddard, 1996). Growth and feed conversion are two critical variables determining the success in fish culture. They are also greatly influenced by factors such as behavior of fish, quality of feed, daily ratio size, feed intake or water temperature. Since the feed cost accounts approximately 40-60% of the operating costs in intensive culture systems (Anderson *et al.*, 1997), the economic viability of the culture operation depends on the feed and feeding frequency. It means that nutritionally well-balanced diets and their adequate feeding are the main requirements for successful culture operations. Commercialized feed presented to cultured species is not only nutritionally well-balanced, but also readily ingested with minimum waste production and digested and converted to live weight in a predictable manner (Okumuş, 2000; Hasan, 2001).The FCR values of various feed ingredients have been estimated for *Cirrhinus mrigala* using single feed ingredient by Seema *et al*. (2002); Shabbir *et al*. (2003) and Jabeen *et al*. (2004). The feed conversion ratio values of various feed ingredients for carps under controlled conditions have been estimated by many workers (Jhingran, 1991; Shabbir *et al*., 2003; Jabeen *et al*., 2004; Ali and Salim, 2004; Saeed *et al*., 2005; Inayat and Salim, 2005; Chang *et al*, 1983; Jhingran , 1991 Gull *et al*., 2007). Jhingran (1991) has reported that no reliable data have been obtained on the rate of conversion of feed into fish flesh. Taking under consideration the importance of FCR, there is a need to evaluate the locally available feed ingredients for obtaining reliable data on rate of conversion of feed into the fish flesh. In the present study, FCR value was comparatively lower than the value observed by Ali and Salim (2004). Similar findings were also observed by Shabbir *et al*. (2003). The FCR value on cotton seed meal (1.55) reported by Jabeen *et al*. (2004) was somewhat close to value of FCR observed in the present study.

PER is used as indicator of protein quantity and quality in the fish diet and amino acids balance. So, this parameter is used to assess protein utilization and turnover, where they are related to dietary protein intake and its conversion into fish gain and protein gain. In this study, PER was significantly affected by protein level and reflects that protein utilization decreased by increasing dietary protein levels.

Lack of readily available nutritive fish feed ingredients have continued to be a major constraint to the survival of aquaculture in the competitive global food production system (F.A.O., 2006; Ogunji *et al;* 2005). Consequently, fish nutrition experts world over have considered the recruitment of alternative protein feed ingredients necessary for inclusion in fish diet. The poor conversion may be attributed to the feeding management, culture system, experimental condition, water management, improper balance of amino acids, high carbohydrates and decrease in palatability or reduction in pellet quality. The poor conversion may also be attributed to the low lysine. Although methionine and lysine are low in groundnut cake the incorporation of methionine through the premixes may have made up for the low level while lysine remains low.

In aquaculture, several models applicable to the concave portion of the growth curve have been used. The model most widely used is Specific Growth Rate (SGR) based on natural logarithm of body weight. It is widely recognized that SGR decreases with size of the fish and length of the time interval used in the calculation. This indicates that the natural logarithm does not correspond to the pattern of growth curve of most fish species reared under optimal conditions. SGR is dependent on fish weight and this result in meaningless comparisons of growth rates among different groups unless live weights are similar.

From overall observations it was concluded that, the fishes fed on combinations of formulated feed group were having adequate growth performance as compared to conventional group. As far as, nutritional efficiency indices were concerned in both the fishes all the parameters were high in *Labeo rohita* as compared to *Cirrhinus mrigala.*

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