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BIOENERGETICS OF *CYPRINUS CARPIO*, LARVAE FED WITH α-AMYLASE SUPPLEMENTED DIET

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ABSTRACT:

The evaluation study was conducted to assess the bioenergetics parameters for the Cyprinus carpio, larvae fed with α-amylase supplemented diet. The experimental diets namely T_0, T_1, T_2, T_3 and T_4 were prepared by supplementing enzyme α-amylaseat the rate of 0.0, 0.1, 0.2, 0.3 and 0.4 % in a diet containing 40 % protein.The feeding experiment was conducted for ten days in duplicate.

Better FCR (1.48 ± 0.005), Maximum protein efficiency ratio (1.638 ± 0.005), gross growth efficiency (67.59 ± 0.21 %), net growth efficiency (82.59 ± 0.92 %), conversion rate (0.068 ± 0.0002) and protein digestibility coefficient (61.352 ± 0.606) were observed in larvae fed with T_4diet and it were significantly different ($P< 0.05$) fromT_0 diet but not significantly different ($P> 0.05$) from T_1, T_2 and T_3 diets. Maximum lipid digestibility coefficient (25.039 ± 0.773) was recorded in T4 diets but it was not significantly different ($P>$ 0.05) from other experimental diets.

Maximum consumption / unit weight / day (0. 016 ± 0.001) was recorded in larvae fed with T_3 diet while maximum metabolism (0.019 ± 0.002) was recorded in larvae fed with T_1diet but there was no significant difference ($P> 0.05$)among the diets for Maximum consumption / unit weight / day and for metabolism. Maximum assimilation (0.090 ± 0.002)as well asmaximum relative growth rate (0.011 ± 0.001) were recorded in the larvae fed with T_3diet and showed significant difference ($P< 0.05$) from T_0 diet but not significantly different ($P>0.05$) from other experimental diets (T_1, T_2 and T_4).Maximum assimilation efficiency (84.84 ± 2.70 %) was recorded in larvae fed with T_2diet and one way ANOVA showed significant difference ($P< 0.05$) from T_0 diet but not significantly different ($P> 0.05$) from other experimental diets.

Thus the result of this study concluded that 0.1 % supplementation of α-amylase was most suitable for the better growth and feed ingredients utilization in rearing of common carp, C. carpio larvae.

KEYWORDS: *Aquaculture, Fish Nutrition, Bioenergetic Study, Cyprinus carpio, α-amylase.*

INTRODUCTION

Aquaculture is only mean to meet the growing demand for fin and shell fish all over the world by enhancing the aquaculture production. Annual growth rate of aquaculture food producing sector is over 6% during the last two decade and possesses higher growth rates than other food producing sectors. Among the cultured animals Indian Major Carpsandexoticcarpsaremajor aquaculture species which contributing about 97 % of total freshwater aquaculture production in tropical countries (Jhingran 1991).*Cyprinus carpio* is third most commercially cultured and produced fish species from aquaculture throughout the world(FAO 2018).

The expansion of global aquaculture production is increasing the demand for aquaculture feed. Fish feed is a major constituent of variable cost representing up to 60 % of the total fish production cost in commercial semi-intensive and intensive fish and shellfish farming (Akiyama et al. 1992, Mohanty 2001, Stankovic Dulic and Markovic 2011).Therefore, it is necessary to develop nutritionally adequate and cost effective feed for carp farming.

Now a days exogenous dietary enzyme supplements are successfully used in the pig and poultry industries to enhance the better growth and feed ingredient utilization. The supplementation of exogenous carbohydrase to aquaculture diets have been assessedto enhance the proper utilization in of unavailable dietary carbohydrates and other nutrientsfor Atlantic salmon (*Salmo salar*), larval gilthead seabream (*Sparus aurata*), tiger prawns (*Penaeus monodon*) and freshwater prawn (*Macrobrachium rosenbergii*) (Kolkovski et al. 1993, Carter et. al. 1994, Buchanan et al. 1997, Patil and Singh 2014). However; there is very less scientific study on the use of enzyme in the diet of *C. carpio* larvae. Hence, the present study was designed to study the effect of α-amylase supplemented diet on feed utilization of *C. carpio* larvae.

MATERIAL AND METHODS:

Test animal:

Larvae of *C. carpio*were obtained from local carp seed supplier and acclimatized to the laboratory conditions for a week in a circular tank on a control diet (T_0). The ration was given once a day at the rate of 05 % of body weight. Faeces and remaining feed were removed from the culture tank daily and aeration was provided throughout acclimatization period to avoid stress.

Diets:

Experimental diets namely T_0, T_1, T_2, T_3 and T_4 were prepared by supplementing enzyme α-amylase (LOBA CHEMIE PVT LTD, Mumbai) at the rate of 0.0, 0.1, 0.2, 0.3 and 0.4 % in a diet. Diet containing 40 % crude protein was prepared by using fishmeal and groundnut oil cake as dietary protein source while rice bran and wheat flour as basal sources on the basis of nutritional information available with regards to *C. carpio*.Dietwas prepared in the form of 2 to 3 mm flake and stored in air tight plastic container for further use after sun drying.

Ingredients and proximate composition:

The diets were analyzed for moisture, carbohydrate, crude fat, ash, nitrogen and crude protein as per the AOAC (1990). Gross energy of each diet was computed by using conversion factors viz. carbohydrate by 4.2, ether extract by 9.5 and protein by 5.65. Ingredients, proximate composition and gross energy of experimental diets are given in table 1.

Table 1. Ingredients and proximate composition (% dry weight basis) of the experimental diets fed to larvae of *C. carpio* for 10 days.

Sr. No.	Ingredients and proximate composition	Experimental diets				
		T_0	T_1	T_2	T_3	T_4
	Ingredients (g)					
01	Fish meal	37.50	37.50	37.50	37.50	37.50
02	Groundnut oil cake	37.50	37.50	37.50	37.50	37.50
03	Wheat flour	12.50	12.50	12.50	12.50	12.50
04	Rice bran	12.50	12.50	12.50	12.50	12.50
05	A-amylase	0	0.1	0.2	0.3	0.4
	Proximate composition					
01	Moisture(%)	12.61	10.48	12.35	11.87	11.62
02	Crude protein(%)	39.46	39.72	40.32	41.69	41.27
03	Crude lipid(%)	6.86	7.04	7.48	7.91	6.47
04	Ash(%)	6.29	6.43	6.61	7.15	7.08
05	Carbohydrate(%)	34.78	36.33	33.24	31.38	33.56

06	Gross energy (kcal/100 g)	434.20	443.88	438.48	442.49	435.59
07	Protein / energy ratio (mgprotein / kcal)	90.88	89.48	91.95	94.22	94.74

Experimental Procedure:

Larvae of *C. Carpio* were randomly stocked in circular plastictubs with 20 L of water at the rate of 10 larvae per tub after recording initial weight and length. The larvae were fed once a day at 0800 h with different experimental diets at the rate of 5 % of body weight.The feeding experiment of was conducted in duplicate. After 2 hthe unconsumed feed was removed. Faeces were collected daily by filtering water through bolting silk. Unconsumed feed and faeces were dried at 60^{o}C in oven until constant weight was attained. Dried faeces and unconsumed feed were kept in airtight container at room temperature for subsequent analysis.

On termination of experiment the following observations were recorded and energy parameters were calculated as fallows,

1. Initial weight (W_1)
2. Final weight (W_2)
3. Mean weight (W) = (W_1 + W_2)/2
4. Production (P) = W_2 - W_1
5. Amount of feed given (a)
6. Remainder feed (b)
7. Consumption (C) = a - b
8. Fecal output (F)
9. Assimilation (A) = C - F
10. Metabolism (R) = A – P
11. Assimilation efficiency = A/C × 100
12. Gross growth efficiency (K_1) = P/C ×100
13. Net growth efficiency (K_2) = P/A ×100
14. Consumption/unit weight/number of experimental days = (C/W)/days
15. Conversion ratio = C/P
16. Conversion rate = (P/C)/days
17. Relative growth rate = (P/W)/days
18. Protein efficiency ratio = (Production / Dry protein consumed)
19. Protein digestibility coefficient = [(Feed protein–Faecal protein)/Feed protein] x 100.
20. Lipid digestibility coefficient = ((Feed protein–Faecal protein)/Feed protein) x 100.

Statistical Analysis

Data obtained in feeding experiments were analyzed by one-way ANOVA at 0.05 level of significance. Student Newman Keuls test was used for comparison of variation among mean values after revelation of significant variations in ANOVA (Snedecor and Cochran 1967, Zar 1974).

RESULT AND DISCUSSION

The measurements of average initial length and weight and bioenergetics parameters of *C. carpio* larvae fed with experimental diets for 10 days of rearing period are summarized in Table 2.

Table 2. Feed utilization and nutrient digestibility of larvae of *C. carpio* fed with experimental diets during bioenergetics study.

Bioenergetics parameters	Experimental diets				
	T_0	T_1	T_2	T_3	T_4
Initial Weight (g)	0.559 ± 0.0236 [a]	0.6911 ± 0.0297 [a]	0.6554±0.027 [a]	0.643 ± 0.0806 [a]	0.5851 ± 0.0357 [a]
Initial Length (cm)	3.83 ± 0.01 [a]	3.92 ± 0.06 [a]	3.88 ± 0.04 [a]	3.87 ± 0.09 [a]	3.90 ± 0.04 [a]

FCR	2.257 ± 0.106[a]	1.603 ± 0.076[b]	1.591 ± 0.098 [b]	1.52 ± 0.003 [b]	1.48 ± 0.005 [b]
PER	1.125 ± 0.053 [a]	1.574 ± 0.074 [b]	1.565 ± 0.097 [b]	1.578 ± 0.003 [b]	1.638 ± 0.005 [b]
Assimilation	0.046 ± 0.004 [a]	0.082 ± 0.001 [b]	0.071 ± 0.007 [b]	0.09 ± 0.002 [b]	0.077 ± 0.001 [b]
Metabolism	0.017 ± 0.002 [a]	0.019 ± 0.002 [a]	0.018 ± 0.004 [a]	0.019 ± 0.003 [a]	0.013 ± 0.001 [a]
Assimilation efficiency (%)	69.96 ± 2.99 [a]	82.01 ± 1.06 [b]	84.84 ± 2.7 [b]	83.56 ± 3.59 [b]	81.84 ± 0.65 [b]
Gross growth efficiency (%)	44.4 ± 2.08 [a]	62.53 ± 2.95 [b]	63.11 ± 3.9 [b]	65.79 ± 0.12 [b]	67.59 ± 0.21 [b]
Net growth efficiency (%)	63.45 ± 0.259 [a]	76.21 ± 2.608 [b]	74.32 ± 2.236 [b]	78.88 ± 3.255 [b]	82.59 ± 0.915 [b]
Relative growth rate	0.005 ± 0.001 [a]	0.009 ± 0 [b]	0.008 ± 0.001 [b]	0.011 ± 0.001 [b]	0.01 ± 0.001 [b]
Consumption/unit weight/day	0.012 ± 0.002 [a]	0.014 ± 0 [a]	0.012 ± 0.002 [a]	0.016 ± 0.001 [a]	0.015 ± 0.001 [a]
Conversion rate	0.044 ± 0.0021 [a]	0.063 ± 0.0029 [b]	0.063 ± 0.0039 [b]	0.066 ± 0.0001 [b]	0.068 ± 0.0002 [b]
Protein digestibility coefficient	54.891 ± 1.521 [a]	57.326 ± 0.378 [a b]	61.31 ± 1.24 [b]	60.902 ± 0.959 [b]	61.352 ± 0.606 [b]
Lipid digestibility coefficient	18.367 ± 1.458[a]	21.875 ± 1.42 [a]	23.128 ± 2.005 [a]	23.515 ± 1.896 [a]	25.039 ± 0.773 [a]

* Values are mean ± S. E.

** Values within same row with same superscript are not significantly different at 0.05 probability level.

Better FCR (1.48 ± 0.005), maximum protein efficiency ratio (1.638 ± 0.005), gross growth efficiency (67.59 ± 0.21 %), net growth efficiency (82.59 ± 0.92 %), Conversion rate (0.068 ± 0.0002) and protein digestibility coefficient (61.352 ± 0.606) were observed in larvae fed with diet $T_4$and it was significantly different ($P< 0.05$) from diet T_0 but not significantly different ($P> 0.05$) from the other experimental diets (Figure 1 and 2). Tagare (1992) also reported similar observation for FCR for common carp fry fed with diet containing papain and crude papain.Similarly best performance in terms of percent weight gain, SGR, FCR and PER were also reported in *Labeo rohita* fingerlings fed with diet supplemented with α-amylase (700 U) by Ghosh et al. (2001). Liu et al. (2018) also reported better FCR, PER improved the growth, feed efficiency, apparent digestibility of crude protein and crude lipid without affecting the health of juvenile Gibel carp (*Carassius auratus gibelio*) fed with the diet supplemented with protease.Similarly improved efficiency of feed utilization, protein efficiency ratio and growth rate are observed in tilapia fed with diet containing 2 % papaya leaf powder by (Norma Isnawati 2015).

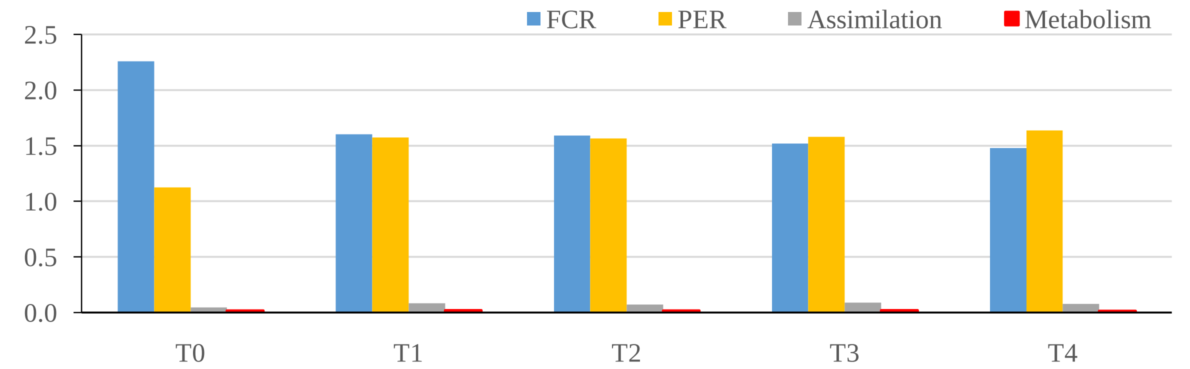

Fig 1. FCR, PER, Assimilation and Metabolism for larvae of *C. carpio* fed with experimental diet

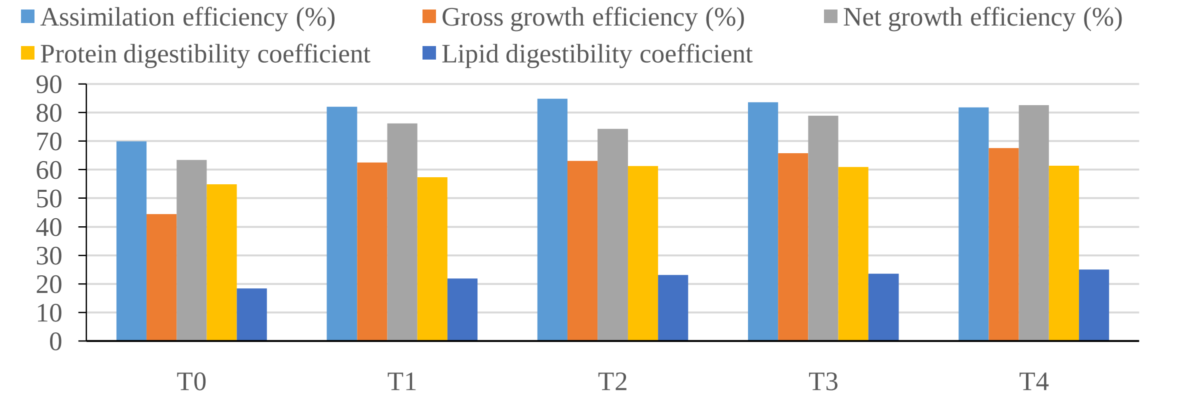

Fig 2. Assimilation efficiency, Gross growth efficiency, net growth efficiency along with protein and lipid diegestibility coefficients for larvae of *C. carpio* fed with experimental diet

Maximum assimilation (0.09 ± 0.002) and relative growth rate (0.011 ± 0.001) were recorded in larvae fed with T_3 diet and it was found significantly different (P< 0.05) from T_0diet but not significantly different (P> 0.05) from the other experimental diets (Figure 1).Maximum assimilation efficiency (84.84 ± 2.7 %) was observed for larvae fed with T_2 diet (Figure 2). However, diet T_2 was significantly different from T_0 but not significantly different from T_1, T_3 and T_4 for assimilation efficiency.Kolkovski et al. (1993) also recorded better growth and 30 % higher (P< 0.05) assimilation rate in larvae of gilthead seabream, *Sparus aurata* fed with microdiet supplemented with a commercial pancreatic enzyme than the control diet without enzyme. Similarly studies with post-larvae of *M. rosenbergii* revealed better FCR, PER, assimilation, assimilation efficiency, metabolism, gross growth efficiency, net growth efficiency and protein as well as lipid digestibility coefficient fed with diet supplemented with α-amylase (Patil and Singh 2006). However, it is very difficult to compare the results of present study with other study due to lack of information.

Maximum metabolism (0.019 ± 0.003) was recordedin larvae fed with diet T_3 while maximum consumption/unit weight/day (0.016 ± 0.001) was recorded in larvae fed with diet T_0(Figure 1). However, there was no significant difference among the diets for metabolism and as well as maximum consumption/unit weight/day. In present study maximum lipid digestibility coefficient (25..039 ± 0.773) was observed for larvae fed with T_4 diet and one way ANOVA showed no significant difference (P> 0.05)among the different experimental diets (Figure 2).

CONCLUSION

The result of this bioenergetic study concluded that low level (0.1%) supplementation of α-amylasewas most suitable for the better growth performance and nutrientutilization from the feed ingredients in rearing of common carp, *C. carpio* larvae.

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