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Fortified feed for fresh water fish culture: A pilot study

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Abstract

A 31 day experimental study was conducted to access the growth performance of koi carp (*Cyprinus carpio*) fingerlings with average initial body weight of (1.20±0.06g) and the average length of (2.4±0.3cm). In experiment, three practical diets were designed. Diet-A (spirulina) contains 67% of crude protein, Diet-B (Azolla) contains 75% of crude protein and Diet-C (control) contains 86% of crude protein. A total of 60 fingerlings were stocked at 10 fish per plastic container of 20 liters capacity. Six experimental groups were made and the experimental diets were fed to three replicate groups of the fingerlings. Three days once the biomass for each group was established before the first feeding. Fish were fed four times daily in equal portions. After the experiment was completed, Average Length (TL), Average Body Weight (BW), Specific Growth Rate (SGR), Feed Conversion Ratio (FCR) and Survival rate were determined. In these 31 days study the highest weight gain recorded as 8.02±2.12g in D2 fishes respectively. The percentage weight gain recorded as 502.5±166.99%, 568.33±177.31% and 564.16±176.29% and the percentage length gain recorded as 145.83±47.41%, 170.83±57.04% and 158.33±53.82% in D1, D2 and D3 respectively from initial weight. The results suggest that the growth is better in D2 which contains Azolla. The Feed Conversion Ratio (FCR) ranged between 0.043-0.049. The survival was recorded in D1, D2 and D3 as 50%, 80% and 70% respectively. It is inferred that the Diet-B (Azolla) is more effective, than the Diet-A (spirulina) and Diet-C (control).

Keywords: Fish feed, *Cyprinus carpio*, Azolla, spirulina, performance

1. Introduction

Fish is rich in nutrition especially as a good source of animal proteins. Aquaculture remains one of the fastest-growing animal food-producing sectors, accounting for almost half of total food fish and substitutes for wild fish and plants. So to achieve improvements in fisheries and to gain maximum yields from resources of fresh water, it is necessary to provide nutritive feed, by which fish grows rapidly and attains maximum size in shortest possible time.

According to [1], increased use of plant protein supplements in fish feed can reduce the cost of fish meal. The research has focused on utilizing less expensive and readily available resources to replace fish meal, without reducing the nutritional quality of feed [2].

The success of culturing fish depends heavily on maximizing cost effective approaches in the production process. An important approaches to reducing feed costs in commercial aquaculture is to develop proper feed and feeding management and husbandry strategies, which promote growth, reduces feed input cost and at the same time reduce the quality of waste products released in the water [12]

The development of fish in culture conditions depends upon the availability of essential nutrients in the diet, feed stability in water, digestibility and feed conversion ratio (FCR). These parameters are considered as the basis for growth for the fish [11]

2. Materials and methods

2.1 Collection of Ingredients

The ingredients such as Groundnut oil cake, Rice bran, Corn flour, Spirulina, Azolla and Gelatin were collected from feed stores, grocery stores, pharmacies, and specialty stores such as natural food stores, as well as from various companies that may be found through the internet.

2.2 Experimental Fish

Koi carp (*cyprinus carpio*) fingerlings of 1.20±0.06g average weight and 2.4±0.3cm average length were obtained from Darsini Aquarium, a private aquarium, Kannadapalayam, Avadi and were acclimatized in 20L plastic containers for 7 days. All fishes were weighed individually at the beginning and end of the experiment using electric balance (NSAW, Estd. MH200) of 200g capacity. A total of 60 fishes were used for the experiment.

2.3 Tank preparation

Six plastic containers of 20 L capacity and circular in shape were used for the experiment. The plastic containers were set with electrically aerated pumps. Uniform water level was maintained to compensate for water loss due to evaporation and the water was obtained from the local municipality. The mosquito net was used to avoid the unwanted things such as hair, dust, mosquito eggs, etc.

1	Mean weight gain (g) = Mean final weight – Mean initial weight
2	Percent weight gain (%) = [(Mean final weight – Mean initial weight)/Mean initial weight]×100%
3	Mean length gain (cm) = Mean final length – Mean initial length
4	Percent length gain (%) = [(Mean final length – Mean initial length)/Mean initial length]×100%
5	Specific growth rate (%/day) = [Ln(Final weight) – Ln(Initial weight)/Experimental periods in days]×100
6	Food conversion ratio (FCR) = Feed fed (dry weight) / Body weight gain (Wet weight)
7	Survival (%) = (Total number of fingerling harvested / Total number of fingerling stocked)×100

The growth performance evaluation was determined by find outing the mean weight gain, percent weight gain, mean length gain, percent length gain, specific growth rate, feed conversion ratio, and survival. The following parameters considered:

2.4 Measurements of Growth Development

To determine the growth rate of the fish, the initial length and eight were measured. Later, in two days interval of time the length and weight of the fishes in six experimental groups were measured. This process was repeated for 31 days to find out the growth rate of the Koi carp and to determine the efficiency of the three diets. It is very important in Fish culture to establish the optimal minimum feeding rate level for the each species, age and growth rate. The amount of feed to fish can be different even between the species within one family [2]. To measure the length and weight of the Koi carp, an electronic weighing balance of 200g capacity was used and for the length measurement regular tape was used.

3. Result and discussion

3.1 Water Quality Monitoring

It is better to monitor the water quality parameters such as temperature, dissolved oxygen, pH, alkalinity, ammonia and nitrate regularly. Temperature during study period remained almost constant [8]. Temperature is measured with mercury-in-glass thermometer calibrated in degree centigrade (°C), dissolved oxygen (DO) is determined using Winkler’s method, Alkalinity (mg/L) is determined by using titration method and pH is determined using a pH meter [5]. The mean values of

water quality parameters like temperature (°C), DO (mg/L), pH, Alkalinity (mg/L) recorded during the fingerling rearing period are presented in Table: 1.

3.2 Determination of Growth parameters

Measurements of weight and length were carried out in the time interval of two days to determine increase in growth. The data obtained was also used to determine the following parameters mean weight gain (MWG), mean length gain (MLG), specific growth rate (SGR %), feed conversion ratio And survival percentage [3] (Table 2).

Studies conducted on other fish species have shown that feed consumption and growth generally increased with nutritional feeding. Diet-B gave the best result in terms of feed conversion ratio (FCR) and other growth indices. This indicates that both growth and feed utilization were most efficient at this feeding. All the structured designs and data were analyzed using MS-Excel oneway ANOVA. This was followed by

Duncan’s new multiple range test (Duncan 1995) to identify the level of significant of variance (P < 0.05) among the treatment means. Standard deviations (±SD) of treatment means were also calculated [10]. The growth indices of the fingerling are presented in and denoted graphically in Fig. 1, Fig. 2, Fig. 3, Fig. 4, and Fig. 5 respectively for mean length gain, mean weight gain, Specific growth rate, Food Conversion ratio, and Survival.

Table 1: Range and average values of different water quality parameters of three diets

Weeks	Diets	Water temperature (°C)	DO (mg/l)	pH	Alkalinity (mg/l)
Week 1	A	27.0-28.08(27.54)	4.6-5.0(4.8)	6.4-8.0(7.2)	51.4-96.6(74)
	B	26.28-28.52(27.4)	4.8-5.6(5.2)	6.8-7.8(7.3)	61.6-92.0(76.8)
	C	27.72-29.84(28.78)	4.0-5.2(4.6)	6.6-7.7(7.15)	72.3-110.6(91.45)
Week 2	A	28.28-29.96(29.12)	4.8-5.9(5.35)	6.2-7.9(7.05)	53.3-86.2(69.75)
	B	29.72-29.4(29.56)	5.1-5.5(5.3)	6.4-8.0(7.2)	64.2-140.6(102.4)
	C	26.84-29.08(27.96)	4.9-6.0(5.45)	6.8-7.6(7.2)	78.5-109.6(94.05)
Week 3	A	28.4-27.08(27.74)	4.4-5.8(5.1)	6.1-7.5(6.8)	95.7-160.2(127.95)
	B	29.28-26.52(27.9)	5.6-5.0(5.3)	6.5-8.0(7.25)	86.2-110.5(98.35)
	C	26.84-27.4(27.12)	4.8-5.2(5)	6.8-7.9(7.35)	78.5-150.2(114.35)
Week 4	A	26.96-28.08(27.52)	4.6-5.9(5.25)	6.2-7.3(6.75)	85.6-96.7(91.15)
	B	27.28-29.52(28.4)	4.1-5.7(4.9)	6.0-7.9(6.95)	96.3-120.6(108.45)
	C	29.84-28.96(29.4)	5.5-6.0(5.75)	6.9-8.0(7.45)	84.7-135.0(109.85)

Table 2: Average values of growth parameters under different diets throughout the study period (31 days)

Parameters	Diet-A	Diet-B	Diet-C
Mean initial weight (g)	1.20±0.06	1.20±0.06	1.20±0.06
Mean final weight (g)	7.23±2.00	8.02±2.12	7.97±2.42
Mean weight gain (g)	6.03±4.26	6.82±4.82	6.77±4.78
Percentage Weight gain (%)	502.5±166.99	568.33±177.1	564.16±176.29
Mean initial length (cm)	2.4±0.3	2.4±0.3	2.4±0.3
Mean final length (cm)	5.9±1.04	6.5±1.21	6.2±1.15
Mean length gain (cm)	3.5±2.47	4.1±2.89	3.8±2.68
Percentage Length gain (%)	145.83±47.41	170.83±57.04	158.33±53.82
Specific Growth rate (SGR %)	5.986	6.332	6.311
Feed Conversion ratio (FCR)	0.049	0.043	0.044
Survival (%)	50	80	60

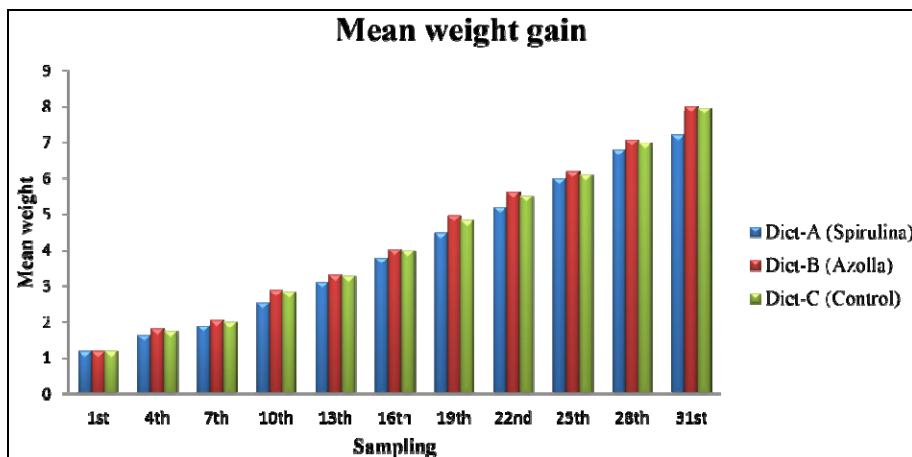


Fig 1: Comparison of the mean weight gain (g) of koi carp Fingerlings in different diets over 31 days

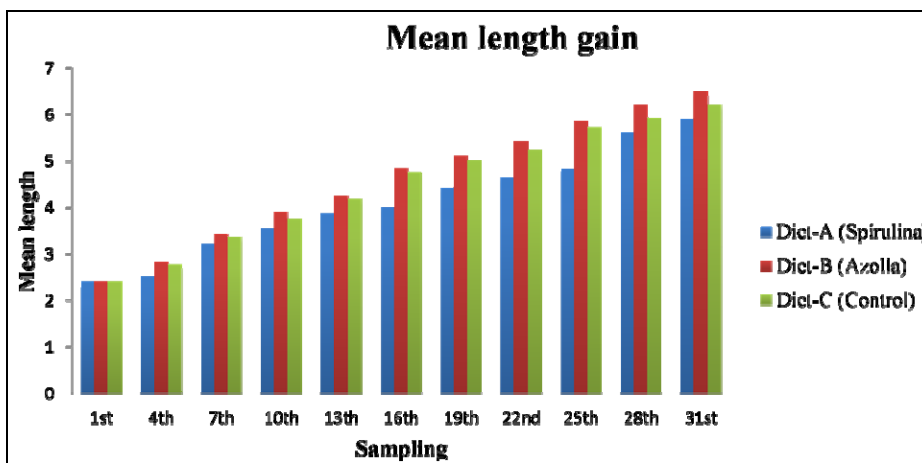


Fig 2: Comparison of the mean length gain (cm) koi carp fingerlings in different diets over 31 days

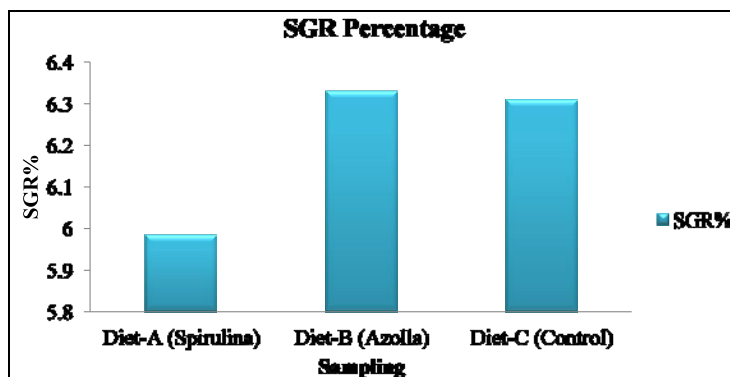


Fig 3: Comparison of the specific growth rate (%) of koi carp Fingerlings in different diets over 31 days

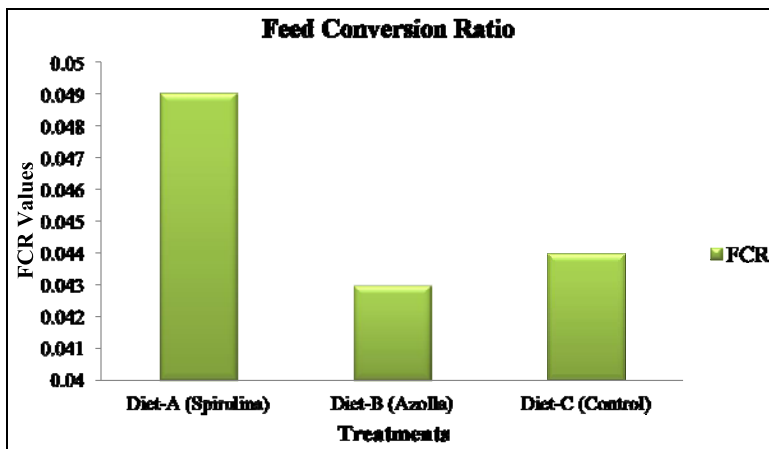


Fig 4: Comparison of the feed conversion ratio of koi carp Fingerlings in different diets over 31 days

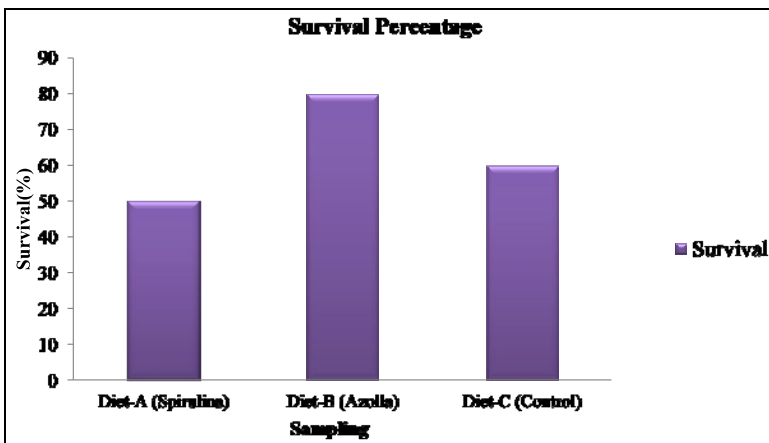


Fig 5: Comparison of the survival (%) of koi caep finger lings in Different diets over 31 days

The present study showed that the diet prepared with Azolla was more effective than the Spirulina and Control (Ground nut oil cake, Rice bran and Corn flour). The diets were well accepted by the Koi carp but Azolla gave the best growth performance comparing to other diets [7], reported that the FCR was significantly different in experimental diets groups and the best FCR's were obtained from 50% Hazelnut meals and 50% Soya bean meals diet groups, respectively. In the present study the Azolla incorporated diet gives better results. [4] Determined that the present experiment conducted under heap systems with the contribution of commercial feed, suggested that a higher feeding frequency (3 meals /day) may be advantageous over feeding twice as well as feeding once. In the present study higher feeding frequency recorded as 4 meals /day.

[6] found that the present study has shown that common carp grow equally well on diets of 26% and 31% protein content under field conditions, as opposed to 35 - 40% suggested by various authors under laboratory conditions. In the present study better growth can be seen in Azolla with 75% of protein content.

[11] Reported that the results of the present study demonstrate that the highest growth was obtained in fish fed corn gluten 60%. [13] Determined that the higher growth and better (lower) feed conversion ratio for fish feed on wheat bran supported the inclusion of this ingredient in the diet of hybrids. In the present study Azolla gave the highest growth and better FCR values. [12] reported that the results indicate that the soya bean incorporated feed was much acceptable than alternative plant

protein source for the fish however, the potential for including mustard oil cake protein in the feeds of fish need more evaluation. In the present study the three diets were well accepted by the Koi fish but Azolla was better in comparison to other diets.

4. Conclusion

The results indicate that Azolla incorporated feed was much acceptable than Spirulina and other plant protein source for Koi carp (*cyprinus carpio*). The maximum weight of (8.02±2.12g), length of (6.5±1.21cm) was recorded in Diet-B and the minimum weight of (7.23±2.00), length of (5.9±1.04) was recorded in Diet-A. The highest percentage of Weight gain (568.33±177.31), Length gain (170.83±57.04), Specific Growth Rate (SGR) of 6.332% and Survival (80%) was also recorded in Diet-B. The better (lowest) Feed Conversion Ratio (FCR) of 0.043 was recorded in Diet-B. Diet-B gave the best result in terms of Feed Conversion Ratio (FCR) and other growth indices. This indicates that both growth and feed utilization were most efficient at this feeding.

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