BARLEY GRASS POWDER ADDITION TO A PLANT-BASED FEED IMPROVED GROWTH AND FLESH QUALITY OF INDIAN MAJOR CARP CATLA CATLA (HAMILTON, 1822)

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ABSTRACT

The present investigation aimed to evaluate the effects of barely grass added plant based feed on growth and flesh quality of Indian major carp Catla catla (Hamilton, 1822). The growth performance of fish showed increased total length, total weight, specific growth rate, body weight index, relative growth rate increases and health condition factor with increased in barley grass level. The improved survival rate was also observed in groups fed with high level of barley grass added plant based feed. The flesh quality analysis showed that moisture, crude lipid and ash content do not represent any significant change except the crude protein level was observed to be improved with increased barley grass content in plant based diets. In considering the overall performance, barley grass supplementation (10%) in plant based diet is recommended for successful aquaculture of this important fish species

Keywords:*Barley grass, Catla catla, carp, fish feed, flesh quality, growth.*

Introduction

The fresh water fish culture is one of the most important fish production systems. It refers to the commercial cultivation and rearing of the fish in freshwater system such as tank, ponds and other enclosure as the food production. Fish is a highly nutritive and rich source of animal proteins. For the improvement of fisheries and to achieve maximum yields from resources of fresh water, it is necessary to provide an artificial feed, by which fish grow rapidly and attain maximum weight in shortest possible time. One approach is to include new substances into fish diets to improve feed conversion efficiency or elevate general conditions for fish growth and maintenance (Bhosale *et al.*, 2010; Shrivastava *et al.*, 2012; Joshi *et al.*, 2015).

Fish feeding is one of the most important factors in commercial fish farming because feeding regime may have consequences on both, growth performance and feed wastage (Azzaydi *et al.*, 2000). Hence nutrient composition of feed, such as protein, carbohydrate, lipid, vitamins, and minerals are the most important factors affecting the health and growth of fish; hence, properly balanced supplemental feeds with a reliable feeding rate can be helpful to enhance survival and growth (Ammar, 2008; Alina *et al.*, 2013; Lee *et al.*, 2016; Shabana *et al.*, 2019). In recent years, plant products (leaf, root, stem, bark, etc.) have been used as a natural growth promoters and immunostimulant instead of antibiotics in aquaculture feed formulations. It is due to their eco-friendly and cost-effective properties compared to synthetic drugs.

Barley grass (*Hordeum vulgare*) refers to young grass of the common barley plant, which belongs to Poaceae family. This is one of the most commonly found herb in India which is freshly juiced or dried into powder for animal and human consumption. According to Yawen *et al.* (2018), barley grass powder is the best functional food that provides nutrition and eliminates toxins from cells in human beings; however, its functional ingredients have played an important role as health benefit. Barley grass is rich in active phytochemicals with variety of pharmacological properties. The recent studies supported that barley grass may be one of the best functional foods and the best raw material of modern diet structure. It will help in promoting the development of large health industry as barley grass have preventive and therapeutic role for chronic diseases (Panthi*et al.*, 2020). These potential varieties of barley grass suggested the effective utility in fresh water fish culture.

In this concern, present study aims to evaluate the dietary barley grass induced growth

performance and flesh quality of Indian major carp *Catla catla* (Hamilton, 1822).

Materials and Methods

Experimental diets

For the experiment, barley grass from conventional organic farm was used. A crop of mature barley grass (8 inches) trimmed to 1/2-inch above the soil. It took 6 to 9 days for barley grass to be mature. The harvested grass blades lay on a clean baking sheet. The oven temperature was set to 150^{O} F and inserted the baking sheet. The blades were allowed to dry out in oven. After two hours onward, the blades were dried and brittle. The barley grass grinded in a clean grinder once the blades of grass were dry and brittle. The developed powder was stored in dry airtight container for experimental use. For the diet preparation, ingredients were sun dried, weighed, mixed and then grinded in food processor. At first, control feed mixture was prepared. The experimental feed mixtures were prepared by combining the required proportion of control feed mixture and barley grass powder. The grinded mixtures were pelleted with size of 2.5 mm die. After pelleting, the feeds were air dried and put in an air-tight container. The composition of experimental diet is given in Table 1.

Table 1: Composition of barley grass powder added plant- based fish feed

	Control	**Experimental**				
Ingredients (%)	**BG0**	**BG 1**	**BG 2**	**BG 3**	**BG 4**	**BG 5**
Sunflower meal	20	Control feed				
Wheat	20					
Barley	15	98	96	94	92	90
Soybean	10					
Peas	10					
Oats	10					
Corn	10					
Rapeseed	05					
Barley grass powder	---	02	04	06	08	10

Fish farm and stocking of fish

The culture experiment of *Catla catla* was carried out at the fish farm. The farm has three tanks in premises, a nursery pond (9mx5mx2m), a stocking pond (18Mx9mX2m) and a plankton culture pond (5mX3Mx1m). Water requirement of all these ponds is fulfilled from the rain water harvesting project of the college. About six nylon net happa of size 4X2X3 ft were installed in a water tank for stocking the fingerlings (Jayakumar *et al.*, 2014). The Indian major carp *Catla catla* of average weight 32.68±3.10 and length 11.11±0.74 grams were stocked in the happas at the density of 40 fishes.

Maintenance and feeding

The Indian major carp *Catla catla* were obtained from the Government Fish Seed Farm at Mahan for the experiment. The fingerling of about 8-10 cm in size was selected. They were transported in large plastic bags containing pond water in which oxygen pumped prior to transport. The fingerling brought to the laboratory for observation for any pathological symptoms. The collected fishes were disinfected with 1% $KMNO_4$ solution to avoid fungal infection. Then fingerlings were rinsed in water and acclimatized for one week. Tanks were aerated by air pump for supply of oxygen to individuals. The drain settled in tanks is collected by filtration net. Water quality was maintained during the feeding trials. The specimens were fed on control diet during acclimatization. The experiment was performed for 60 days. During the acclimatization, fish were fed the control diet to satiation twice a day at 09:00 and 15:00 hours. During experiment, the fishes were fed on experimental diet to satiation thrice a day at 08:00, 12:00 and 16:00 hours.

Water quality standards

Water quality was maintained during the feeding trial with light: dark cycle of 12:12 h during study. The water analysis is performed according to APHA (2000). The water composition and characteristics were maintained within the effective range (Bhatnagar and Devi, 2013). During the experimental period, water temperature was

28.5±2.5^{O}C; pH 8.1±0.5; total dissolved solids 240.5±19.5 mg/L; dissolved oxygen 4.42±0.24 mg/L; biological oxygen demand 1.70±0.20 mg/L; free CO_2 13.4±1.3 mg/L; alkalinity 65.3±5.0 mg/L; hardness 123.20±16.76 mg/L; ammonia 0.55±0.01 mg/L; nitrate 0.136±0.28 mg/L; nitrite 11.39±0.37 mg/L; salinity 0.3±0.1 ppt in the experimental tanks.

Growth performance analysis

The growth performances of experimental fishes were carried out at the end of 60 days. The total lengths of randomly sampled fish were measured with considering that the total length is the length from the tip of snout of fish to the end of caudal fin. Similarly, total weight of fish was measured by using electronic balance. Records were analyzed by using the formulae suggested by Altorre-Jacome *et al.*, (2012) with some modification. Results were recorded as Mean ± Standard Deviation of triplicate.

a) Total Length Increase (TLI) = Final Length – Initial length
b) Total Weight Increase (TWI) = Final Weight – Initial Weight
c) Specific growth rate (SGR) = $[(\ln W_t - \ln W_0) / T] \times 100$
d) Relative Growth Rate (RGR)= Weight gain (g) / Time (Days)
e) Body Weight Index (BWI)= Weight (g) / Length^3(cm)
f) Health Condition Factor (HCF)= BWI × 100
g) Average Survival Rate (ASR)= [No. of fishes survived / No. of fishes stocked] × 100

Flesh quality analysis

Flesh quality analyses were performed according to AOAC (1995) procedures. Water content was determined by drying samples at 105±2 °C until a constant weight was obtained. Dried samples were used for determination of crude protein, lipid and ash contents (Bake *et al.*, 2016). Results were recorded as Mean ± Standard Deviation of triplicate.

Result and Discussion

Table 2 shows the growth performance of Indian major carp *Catla catla* fed on control and barley grass added plant based formulated fish feed. It shows that the total length of fish increases from 2.11±0.16 to 7.06±0.58 cm; total weight increased from 43.47±3.02 to 96.09±2.74 g; specific growth rate increased from 0.658±0.037 to 0.908±0.097; body weight index increases from 0.021±0.008 to 0.035±0.013; relative growth rate increases from 0.725±0.14 to 1.602±0.09; health condition factor improved from 2.100±0.229 to 3.500±0.296 and average survival rate increased from 75.0±2.65 to 92.5±1.53 %.

Table 2: Growth performance of *Catla catla* fed on barley grass added feed

Parameter		BG0	BG1	BG2	BG3	BG4	BG5
Total Length Increase (cm)	Mean	2.110	3.200	3.330	3.700	5.880	7.060
	±SD	0.160	0.130	0.210	0.400	0.320	0.580
Total Weight Increase (g)	Mean	43.47	44.70	51.27	59.47	94.90	96.09
	±SD	3.020	3.710	4.980	5.730	4.630	2.740
Specific Growth Rate	Mean	0.658	0.617	0.713	0.776	0.97	0.908
	±SD	0.037	0.037	0.077	0.057	0.047	0.097
Body Weight Index	Mean	0.021	0.022	0.026	0.031	0.034	0.035
	±SD	0.008	0.012	0.014	0.011	0.016	0.013
Relative Growth Rate	Mean	0.725	0.745	0.855	0.991	1.582	1.602
	±SD	0.140	0.110	0.110	0.100	0.160	0.090
Health Condition Factor	Mean	2.100	2.200	2.600	3.100	3.400	3.500
	±SD	0.229	0.177	0.201	0.178	0.180	0.296
Average Survival Rate (%)	Mean	75.0	77.5	80.00	85.0	90.0	92.5
	±SD	2.65	2.52	1.53	1.53	1.53	1.53

Kumar *et al.* (2004) and Cho and Cho (2009) reported that formulated feed is more recommendable than a readily available feed for the growth performance in aquaculture. It is well documented that formulated feed pellets have superior water stability, better floating properties, and higher energy content among the ordinary pelleted diets (Ammar, 2008). Aqua feed technology is moving in tandem with the aquaculture growth with the usage of formulation procedures for the improvement of digestibility (Umar *et al.*, 2013). Chang and Wang (1999) stated the advantages of feed formulation for aquaculture feed production including improved feed conversion ratio,

control of pellet density, feed stability, production efficiency and versatility (Kannadhason *et al.*, 2011; Hazem *et al.*, 2017; Mishre *et al.*, 2018).

The use of plant based feedadditives are beneficial in increasing fish production. The nutritional values of feeds are influenced not only by their nutrient content, but also by many other factors. These include the feed presentation, hygiene, digestibility, and effect on intestinal health (Diatin *et al.*, 2021). The present experiment clearly demonstrated the beneficial effects of barley grass added plant based pellet quality on the growth performance of fish. Interestingly, a lower growth performance was observed in control group than experimental group. The barley grass contained several bioactive compounds. It is also a rich source of protein. Protein rich diet is responsible of improvement of growth performance of fish (Nath *et al.*, 2014; Islam *et al.*, 2017; Uraiwan *et al.*, 2019; Abdus *et al.*, 2020; Daniela *et al.*, 2020; Rana *et al.*, 2020). These findings are also in well agreement with Nabela *et al.* (2011) on effects of barley grass powder (*Horidium Vulgare*) on Behavioral and Histological alterations of Nile Tilapia.

The use of feedadditives is beneficial in increasing fish production. A feedadditive are also the supplements for farm animals that cannot get enough nutrients from regular meals that the farmers provide and include vitamins, amino acids, fatty acids, and minerals. In some cases if an animal does not have some specific nutrition in its diet it may not grow properly. The nutritional values of animal feeds are influenced not only by their nutrient content, but also by many other factors. These include feed presentation, hygiene, digestibility, and effect on intestinal health. Even with all of the benefits of higher quality feed, most of a farm animal's diet still consists of maize, wheat and soybean meal because of the higher costs of quality feed. Hence feed and feeding are among the most important factors influencing growth, feed utilization and tissue composition of the fish in aquaculture. In the present study, quality of barley grass powder added feed increased the average feed intake and feed efficiency while reduced the feed conversion ration. It was one of the reasons for increased growth performance and survival of the fish. These results are in well agreements with Nath *et al.* (2014), Islam *et al.* (2017), Uraiwan *et al.* (2019), Abdus *et al.* (2020), Daniela *et al.* (2020), Rana *et al.* (2020) and Pradhan *et al.* (2021).

Table 3: Flesh quality of *Catla catla* fed on barley grass added feed

Parameter		BG0	BG1	BG2	BG3	BG4	BG5
Moisture (%)	Mean	83.35	84.08	83.85	82.02	82.29	82.16
	±SD	1.08	0.54	0.68	0.20	0.30	0.31
Crude Proteins (%)	Mean	10.15	10.40	11.05	11.07	11.19	11.36
	±SD	0.46	0.38	0.39	0.17	0.19	0.22
Crude Lipids (%)	Mean	3.96	2.95	3.48	3.21	3.94	3.01
	±SD	0.38	0.26	0.36	0.19	0.12	0.29
Ash (%)	Mean	2.54	2.58	2.50	2.70	2.58	2.47
	±SD	0.13	0.08	0.18	0.08	0.02	0.04

Table 3 shows the carcasses composition of *Catla catla* fed on control and barley grass powder added plant based formulated fish feed. It shows that the moisture content ranges between 82.02±0.20 and 84.08±0.54 %; crude protein contents increased from 10.15±0.46 to 11.36±0.22 %; crude lipid contents ranges between 2.95±0.26 to 3.96±0.38 %; ash content was ranges between 2.47±0.04 and 2.70±0.08 %. Among these all, only the crude protein contents of control and test feed groups were significantly different ($P<0.05$) from each other.

The flesh quality in control and all experimental groups were generally similar. Only the crude protein contents of control and test feed groups were significantly different. The parameters, such as moisture, crude protein, crude lipid and ash are the qualitative physiological indicators of fish health, and the nutritive value of fish depends upon their biochemical constituents. In the present study, the significant improvement in muscle biochemical composition suggested that the synthesis and the storage of the biochemical compositions in fish were promoted due to supplementation of barley grass in the diet. Similar results have also been reported in previous studies of Acar *et al.* (2015) and Xiaohong *et al.* (2017). However, changes in the body composition are probably affected by

various factors such as age, feed quality, feeding frequency, water quality etc. (Karun *et al.*, 2017; Shabana *et al.*, 2019; Marian *et al.*, 2022).

Conclusion

An experimental study was carried out to evaluate the effect of barely grass added plant based feed on growth and flesh quality of Indian major carp *Catla catla* (Hamilton, 1822). The results indicated that the increased level of barley grass in diet improved the growth and advanced the survival rate. The flesh quality analysis showed the enriched crude protein level. In considering the overall performance, barley grass addition in plant based diet is recommended for successful aquaculture of this important fish species.

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