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Effect of Natural and Hydroponic Barley Plant and Sprout on the Common Carp (*Cyprinus Carpio*) Growth Performances

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Abstract

This study was designed to investigate the effect of natural, sprout powder and hydroponic planting of Barley on some growth parameters of common carp *Cyprinus carpio L.* The trail was conducted for 56 days and for this purpose 175 fingerlings common carp, mean initial weight of 34.71 g were acclimated to laboratory conditions and fed with control pellets (30%crude protein) prior to the feeding trials for 21 days. Seven experimental diets were used and the control as 0% (T1), Natural planting 2.5 (T2) and 5 gm/kg diet (T3), Hydroponic Planting 2.5 (T4) and 5 gm/kg diet (T5), Barley sprout powder 2.5 (T6) and 5 gm/kg diet (T7). According to the results no significant differences observed in mean initial weight this was done in way to avoid differences attributed to fish initial weight, T4 (Barley sprout powder 2.5 g/kg diet) was significantly higher in each daily and relative growth rate, but the specific growth rate both T4 and T7 were significantly higher than other treatments. No significant differences observed in Food Conversion Ratio and Protein Efficiency Ratio but T4 (Barley sprout powder 2.5 g/kg diet), T6 (Natural planting 2.5 gm/kg diet) and T7 (Natural planting 5 gm/kg diet) differ significantly in Food Efficiency Ratio. As general conclusion the adding of germinated barley enhance common carp performance in any way of germination.

Keywords: Natural planting; Barley sprout powder; Hydroponic germination; Barley; Common carp; Growth performance

Introduction

World aquaculture has grown tremendously during the last years becoming an economically important industry. Today it is the fastest growing food-producing sector in the world with the greatest potential to meet the growing demand for aquatic food [1]. Globally, aquaculture is expanding into new directions, intensifying and diversifying. A persistent goal of global aquaculture is to maximize the efficiency of production to optimize profitability.

Barley is used for a wide range of traditional and novel end-uses. In most countries, the major portion of barley is fed to animals, particularly cattle and pigs. Human food uses of barley are more limited, although recent trends in the use of barley varieties, high in dietary fiber, have been identified. A significant high-value use is to produce malt as a raw material for the brewing industries, including beer and whiskey. An arabinoxylan-rich germinated barley product has been reported by Kanauchi [2] to induce the proliferation of bifidobacteria in the human intestine. However, as for all known and emerging prebiotics, convincing evidence of a consistent clinical benefit in the treatment of IBD remains to be demonstrated in large, randomised, double-blind, placebo-controlled studies [3,4].

Maltose is produced by hydrolysis of starch using the enzyme β-amylase. It occurs only rarely in nature and only in plants as a result of partial hydrolysis of starch. Maltose is produced during malting of grains, especially barley, and commercially by the specific enzyme catalyzed hydrolysis of starch using β-amylase from Bacillus species, although the β-amylases from barley seed, soybeans, and sweet potatoes may be used. Maltose is used sparingly as a mild sweetener for foods. Proteins of major cereals and legumes are often deficient in at least one of the essential amino acids. While proteins of cereals, such as rice, wheat, barley, and maize are very low in lysine and rich in methionine, those of legumes and oilseeds are deficient in methionine and rich or adequate in lysine. Oats, barley, and rye are examples of cereals that contain a relatively high percent (5%-25% of total carbohydrates) of non-starch polysaccharides in the flour. The pentosan fraction of cereals is a complex mixture of branched polysaccharides with an arabinoxylan backbone containing small amounts of glucose and ferulic acid [5].

So the objective of the study compare natural planting, Barley sprout powder and hydroponic germination of Barley of common carp growth performance in weight gain, Daily growth rate, Specific growth rate, Relative growth rate, Feed conversion ratio (FCR), Food efficiency ratio (FER) and Protein efficiency ratio (PER).

Materials and Methods

Experimental diet

Seven practical diets were formulated based on the proximate composition of the feed ingredients. Diet 1 (Control diet free of any barley), diets 2, 3, 4, 5, 6 and 7 contained 2.5 and 5 gm/kg diet of each of natural, Barley sprout powder and hydroponic planting respectively on an equivalent protein basis. Composition and proximate analysis of different experimental diet diets were shown in Table 1 and the chemical composition of the different diet by NRC et al. [6,7] explained in Table 2.

Chemical Composition	
Crude protein%	27.351
Crude fat%	2.584
Crude fiber%	6.155
Energy kgal/kg	2235.2
Ash%	87.61

Table 1: Chemical composition of fish diets used in the experiment.

Animal concentrate commercial Brocon-5 Special W 40% imported by Wafi. B.V. Holland.

Premix: vitamins: Vit A: 6000 UI; Vit D3: 1000 UI; Vit E: 60 UI; Vit K: 12 UI; Vit B1: 24 mg/kg: Vit B2: 24 mg/kg; Pantothenic acid: 60 mg/kg; Niacin: 120 mg/kg; Vit B6: 24 mg/kg; Biotin: 0.24 mg/kg; Folic acid: 6 mg/kg; Choline chloride: 540 mg/kg; Vit B12: 0.024 mg/kg. Minerals include (mg/kg): Fe: 50; Cu: 3; Mn: 20; Zn: 50; I: 0.1; Co: 0.01; Se: 0.1.

Ingredients	Crude Protein%	Crude Fat%	Dry Materials%	Crude Fiber%	Energy KG/kg	% in diet
Animal protein concentrate	40	5	92.9	2.2	2107	10
Yellow corn	8.5	3.6	89	2.2	3350	15
Soybean meal	44	1.1	89	7	2230	40
Barely	11	1.9	89	5.5	2640	15
Wheat bran	15.7	4	89	11	1300	18
Premix	---	---	---	---	---	2

Table 2: Chemical composition of the different diet by NRC et al. [5,6].

Fish and feeding regime

Common carp *Cyprinus carpio* fingerlings with an average weight 34.71 g were brought from local fish farm located in Daqoq/HaftaGar Middle of Iraq were randomly allocated on the aquaria (7/aquarium). Each treatment was represented in three aquariums (3 replicates). A feeding regime of 3% body weight per day was employed throughout the experiment. The amount of food was calculated and readjusted weekly according to change in the body weight and distributed in three equal portions for 56 days.

Experimental diets

The different feeding combinations (seven formulas of isoenergy diets, (Table 1) were prepared as follows:

The control as T1 with 0% barley, Natural planting as T2 with 2.5 gm/kg diet, T3 with 5 gm/kg diet, Hydroponic Planting as T4 with 2.5 gm/kg diet, T5 with 5 gm/kg diet 5), Barley sprout powder as T6 with 2.5 gm/kg diet, and T7 with and 5 gm/kg diet.

Experimental system

The experimental facility consisted of 21 Aquaria (60 litters each). Each aquarium was supplied with aerated and dechlorinated tap water, which was stored in tanks for 24 hours and aerated by air pump (Model-Rina 301) during the experimental period. The water level was maintained to a fixed level by the addition of new well-aerated fresh water.

Growth parameters

The individual body weight (g) and total body length (cm) for all fish per treatment were measured weekly. The feed consumption of each treatment was recorded and readjusted according to the obtained biomass at every treatment weekly. The average body weight gain (WG) as (g/fish) was estimated according to the following equation:

Body weight gain (g/fish)=Mean of weight (g) at the end of the experimental period-weight (g) at the beginning of the experimental period

Daily weight gain (DWG)=Gain/experimental period

Relative weight gain (RWG%)=Gain/initial weight × 100

Specific growth rate (SGR)=(In W1-In W0)/T) × 100

W1: final weight W0: initial weight T: time between W1 and W0

Feed conversion ratio (FCR)=Total feed fed (g/fish)/total wet weight gain (g/fish)

Protein efficiency ratio (PER)=Total wet weight gain (g/fish)/ amount of protein fed (g/fish).

Statistical Analysis of Data

Statistical analysis was performed using the Analysis of variance (ANOVA) two-way classification and Duncan's multiple Range Test, to determine differences between treatments means at significance rate of $P<0.05$. The standard errors of treatment means were also estimated. All statistics were carried out using Statistical Analysis System (SAS) program [8].

Results and Discussion

Common carp is fresh water fish that is distinct to the Northern Hemisphere. This species requires an optimal temperature range between (20°C to 28°C) according to [9]. The activity of the carps is affected by low water temperatures which minimize their moving and

feeding activities [10]. The temperature of water demonstrated in the present study was approximately 20°C throughout the entire experimental period. Over the entire period of the experiment, no mortalities among the fish have been observed. Wang et al. [11,12] obtained a similar survival rate with *C. carpio* over 56 days of a feeding trial. This result reflects healthiness of the experiment fish.

According to the results in Table (3) no significant differences observed in mean initial weight this was done in way to avoid differences attributed to fish initial weight, T4 (Barley sprout powder 2.5 g/kg diet) was significantly higher in each daily and relative growth rate, but the specific growth rate both T4 and T7 were significantly higher than other treatments.

Treatment	Mean initial weight (gm)	weight gain (gm)	Daily growth rate (gm/fish/day)	Specific growth rate (/day)	Relative growth rate (gm/day%)
T1 (control)	34.775 ± 0.025 a	10.870 ± 0.100 c	0.194 ± 0.002 c	0.002 ± 0.000 b	31.255 ± 0.265 c
T2 Hydroponic Planting 2.5 g/kg diet	34.675 ± 0.050 a	10.920 ± 0.760 c	0.195 ± 0.012 c	0.002 ± 0.000 ab	31.395 ± 2.455 c
T3 Hydroponic Planting 5 g/kg diet	34.640 ± 0.020 a	11.265 ± 0.065 c	0.203 ± 0.001 bc	0.002 ± 0.000 ab	32.745 ± 0.055 bc
T4 Barley sprout powder 2.5 g/kg diet	34.670 ± 0.005 a	13.175 ± 0.010 a	0.231 ± 0.001 a	0.002 ± 0.000 a	37.355 ± 0.020 a
T5 Barley sprout powder 5 g/kg diet	34.730 ± 0.030 a	11.185 ± 0.345 c	0.201 ± 0.010 bc	0.002 ± 0.000 b	32.160 ± 1.675 bc
T6 Natural planting 2.5 gm/kg diet	34.700 ± 0.060 a	11.760 ± 0.165 bc	0.212 ± 0.001 abc	0.002 ± 0.000 ab	33.675 ± 0.490 abc
T7 Natural planting 5 gm/kg diet	34.765 ± 0.075 a	12.460 ± 0.050 ab	0.223 ± 0.006 ab	0.002 ± 0.000 a	35.840 ± 0.495 ab

Table 3: Effect of Natural planting, Barley sprout powder and hydroponic germination of Barley in common carp growth parameters of common carp reared in indoor aquaria. Mean values with different superscripts within a column differ significantly ($P \leq 0.05$).

No significant differences observed in Food Conversion Ratio and Protein Efficiency Ratio as shown in table (4), T4 (Barley sprout powder 2.5 g/kg diet), T6 (Natural planting 2.5 gm/kg diet) and T7 (Natural planting 5 gm/kg diet) differ significantly in Food Efficiency Ratio.

Treatment	Food Conversion Ratio	Food Efficiency Ratio	Protein Efficiency Ratio
T1 (control)	3.085 ± 0.035 a	32.055 ± 0.005 b	1.180 ± 0.000 d
T2 (Hydroponic Planting 2.5 g/kg diet)	3.790 ± 0.510 a	32.700 ± 0.230 b	1.225 ± 0.000 c
T3 (Hydroponic Planting 5 g/kg diet)	3.530 ± 0.530 a	33.700 ± 0.020 b	1.230 ± 0.000 c
T4 (Barley sprout powder 2.5 g/kg diet)	2.595 ± 0.005 a	38.965 ± 0.030 a	1.410 ± 0.005 a
T5 (Barley sprout powder 5 g/kg diet)	3.025 ± 0.115 a	33.355 ± 1.535 b	1.240 ± 0.010 c
T6 (Natural planting 2.5 gm/kg diet)	2.590 ± 0.025 a	37.030 ± 0.345 a	1.340 ± 0.010 b
T7 (Natural planting 5 gm/kg diet)	2.695 ± 0.620 a	37.080 ± 0.100 a	1.355 ± 0.025 b

Table 4: Effect of Natural planting, Barley sprout powder and hydroponic germination of Barley in common carp feed utilization of common carp reared in indoor aquaria. Mean values with different superscripts within a column differ significantly ($P \leq 0.05$).

Little information is known about the impact of barley in different germination way on feed utilization parameters in common carp. The findings of the current study may help to explain the improved feed utilization performance in this species. The most notable outcome of prebiotic supplementation, in general, is changes brought about to the intestine, both morphologically and microbiologically. Changes to the morphology of the intestine may be attributed to the production of short-chain fatty acids through the microbial fermentation of prebiotic substances.

The characteristics of proteinase enzyme are consistent with its being the predominant proteinase synthesized during barley

germination. Such endoproteinases are important because they are responsible for transforming the grain endosperm storage proteins into soluble proteins, amino acids and peptides that can be metabolized and utilized by the growing plantlet. Commercially, this transformation is important because, during the malting of barley for brewing, the insoluble storage proteins must be reduced to low molecular mass nitrogenous compounds that can be utilized by brewing yeasts and this may be the reason of significant differences of the Barley sprout powder [13].

The entry of sugar from the endosperm is evidently very slow, at any rate during the greater part of this period, for it exercises very little influence on the carbohydrate metabolism. This is shown by a comparison between the changes which take place in embryos germinated on their endosperms and those which are excised and grown on sand moistened with a culture solution containing no carbohydrate The production of fresh cell wall material indicated by the increase in the insoluble fractions is as great in the excised embryos as in the germinating grains, both show a slight accumulation of maltose and in neither is there any marked accumulation of hexose. In both cases there is a rapid loss of sucrose and raffinose, which also contains a sucrose unit, and only here is there any clear indication of the entry of sugar derived from the reserves in the endosperm. Sucrose almost entirely disappears from the excised embryos, whereas those germinating on their endosperms still contain approximately 33% of the amount present after 2 hr. It will be seen that during the first 24 hr. the greater part of the sugar in the embryo has either been lost in respiration or used in the production of insoluble material [14].

Fish feed on 2.5 g (FOS) had better growth than those feed on 5 g (FOS) in the study of [15] Improved growth performance is likely to be brought about by elevated digestive enzyme activities, possible improvements of intestine morphology or via prebiotic fermentation by endogenous gut microbes to produce SCFAs as stated by Dimitroglou et al. [16]. The results of clearly demonstrate the association of improved growth and performance, gut health, immune status and resistance to disease in fish fed Bio-Mos.

As general conclusion the adding of germinated barley enhance common carp performance in any way of germination.

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