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EFFECT OF HYDROPONIC BARLEY ON SOME GROWTH TRAITS, APPARENT DIGESTIBLE COEFFICIENT, AND APPARENT PROTEIN DIGESTIBLE OF COMMON CARP (*CYPRINUS CARPIO* L.) DIETS

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Abstract

This study was carried out in Fish Laboratory/ Department of Animal Production College of Agriculture, University of Baghdad, for 74 days from 18/10/2017to3/1/2018 to study the effect of Hydroponic Barley in some Growth traits and fish Apparent Digestible Coefficient and Apparent Protein Digestible of Common Carp *Cyprinus carpio* L. Diets. diets by the nutritional value of Grain Barley (GB) by germination it in Hydroponics system of two water sources, which is Fresh water (HBF) and Waste water fish (HBW). The experiment was conducted to elucidate potential differences between treatments of barley, as: T1: %5 (GB); T2: % 10 (GB); T3: % 15(GB) ; T4:%5 (HBF), T5: % 10 (HBF), T6:% 15 (HBF), T7: %5 (HBW), T8: %10 (HBW), T9: %15 (HBW). The results showed significant differences ($P<0.05$)in the Final Weight, Weight Gain, Relative Growth Rate, Specific Growth Rate and Feed Conversion Rate for T8, (%10 HBW) were recorded 92.65g/fish, 49.01 g/fish, 1.34% g/day, 112.29%, 1.49 respectively, The results showed no significant differences between T5, T6 (HBF) and T7, T8 and T9 (HBW) in ADC% which were 74.90, 75.88, 75.98, 69.22 and 70.93% respectively also T4, T5 and T6 (FBH) and T7 (WBH) didn't differed significantly in ADP% which were 83.09, 81.38, 84.93 and 84.64% respectively. These results indicated that the use of germination barley improved Growth criteria through improvement microflora in fish intestine leading to improve the ADC & APD instead of Grain Barley (GB). There by, it is recommended to add 5% and 10% FBH or WBH in fish diets instead of grains barley.

Key words: Common carp, germinated barley , waste water fish

Introduction

Fish culture is a major food production sector and is now a major global industry as total annual production exceeds 167.2 million tone's (FAO, 2014). Recently statistics for the year 2017 in Iraq for fresh water fish reaches 39582.35 thousand tons and marine fish 7905 thousand tons (Ministry of Agriculture, Directorate of Animal Resource). Fish culture requires fresh water which now is scarce. On the other hand waste water discharge from fish culture activities, which contains organic matter, ammonia, nitrate, phosphate and other material, could be release into water bodies and cause environmental pollution. Untreated waste water from fish culture activities not only pollute rivers but can spread diseases to fish ponds when they receive polluted water. (Thein *et al.*, 2007). Organic matter in fish pond waste when discharged into the water bodies reduces dissolved oxygen levels, contributes to the accumulation of sediment and stimulates the production of phytoplankton, which reduces water quality (Joyner, 1992). Removal of organic matter from waste water is necessary to keep cultured fish protected receiving water from nutrient saturation and re-use (Endut *et al.*, 2009). Organic materials derived from fish production systems can be utilized and effectively converted as nutrients to plant growth, Cereals are usually incorporated into fish feed as a source of carbohydrate and starch. As well as, grains of barley, wheat, yellow and white maize traditionally used as a source of carbohydrates in fish diets (Gaylord *et al.*, 2009). But there are some anti-nutritional factors that have made the use of these grains limited. These factors may reduce digestibility and absorption of nutrients because of their ability to bind protein and digestible enzymes and make them sediments or conglomerate (Overturf *et al.*, 2003). Of these agricultural plants, barley

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annual production in Iraq is 499100 thousand tons according to statistics of the Ministry of Agriculture / 2016. The combination of aquaculture and hydroponics can achieve the dual purpose of reducing pollution from aquaculture and reducing the demand for commercial fertilizers, thereby helping to reduce pollution and maintain the quality of water in rivers and water bodies. The main objective of this study was to evaluate efficiency of using hydroponics barley of two categories of germination on fish diets, which is importance to produce some productive parameters, apparent digestibility coefficients (ADC) for diet and protein.

Materials and methods

The experiment was conducted in the fish laboratory of Animal Production Department, College of Agricultural/University of Baghdad. Barley grain was germinated according to method of Al-Karaki&Al-Hashimi, (2011) for 8 days The diets content were brought to the fish laboratory and mixed for each treatment. (GB) was added to T1and T2 and T3 , hydroponics barley on fresh water (HBF) were added to T4 and T5 and T6 , Hydroponics barley on Waste water fish (HBW) were added to T7 and T8 and T9 barley was added in the ratios of 5, 10 and 15%, respectively (table 1). Chrome Oxide Cr_2O_3 was added at 1% to the ingredients and manufactured as to pellets (Furnkawa and Tsukahara, 1966).The feces of fish were collected every day, for 14 days, them dried (5g)and storage for analyzed.

Experimental fish

Common carp fish with mean weight of 43.43 gm were distributed in 18 aquariums at rate 7 fish per aquarium and two replicates for each treatment. Each glass aquarium was supplied with air pump to keep continuous aeration. Fish were fed twice daily at a fixed feeding rate of 3% body weight per day for 60 days.

Chemical analyses and data collection

Samples of Barley diets were analyzed including protein % for (GB), (HBF) and (HBW) (table 2), fecal for (ADC and APD), and all chemical composition for experimental diets samples including, moisture, crude protein, ether extract, crude fiber and ash were analyzed and determined according to the Official Methods of Analysis A.O.A.C. (1980). Metabolic Energy (kcal) was estimated by IKA CALORIMETER C7000. Water quality parameters (O_2, pH, NH_3 and water temperature) were monitored following the methods outlined (Hepher, 1988 ; Wang *et al.*, 1997; Boyd and Tucker, 1998).

Studied Parameters

Weight Grain (WG)g/Fish

$$= E^{Final\ Weight\ EFWF}\ E\frac{g}{Fish}F^{Initial\ Weight\ EIWF}\ E\frac{g}{Fish}EF$$

(RGR) Relative Growth Rate

$$= E^{Final\ Weight}\ \frac{EFWF_{EF} - Initial\ Weight\ EIWF_{E\cdots F_F}}{Initial\ Weight\ EIWF_{E\cdots F}}$$

Utne (1978)

(SGR) Specific Growth Rate

=[(LN Final Weight (FW)g fish]-LN Initial weight (IW)g Fish] / No. fo days (Jobling & Koskela,1996)

[(FCR) Feed Conversion Rate

$$= \left(\frac{Weight\ Gain_{E\cdots F}}{Food\ Intake_{E\cdots F}}\right)(Utne,1978)$$

Apparent Digestible Coefficient (APC)

$$= E\frac{CrO\ in\ food}{CrO\ in\ Feces}\times 100_F - 100 \text{ (Bolin,1952)}$$

Apparent Protein Digestible (APD)

$$= \frac{CrO\ in\ food \times Protein\ ratio\ in\ feces}{CrO\ in\ Feces \times Protein\ ratio\ in\ feces}$$

(Mayanard & Loosli, 1969)

Results and Discussion

The results of the statistical analysis showed that there was significant differences ($p<0.05$) between experimental parameters(table3), which is: final weight, growth rate, specific growth rate, relative growth rate and best food conversion For treatment T8 (10% HBW) as it was 92.65 g/fish, 49.01 g/fish, 1.34% g/day, 112.29% and 1.49, respectively, followed by T7 and T4 (%5 HBW and HBF respectively (table3), than T5 (%10 HBF) at last T9 (%15 HBW) no Significant differences between them, followed by treatment T6 (%15 HBF). The results of (GB) treatments recorded the lowest growth parameters When it compared with other treatments. These results were attributed to the improvement in the value of barley through the germination in Hydroponics system in two sources for water (HBW) and (HBF), which led to decrease the concentration of phytic acid (Kumar *et al.*, 2012) which increase formation of complexes protein and incourages the mineral bindings (EL-Haroun, 2006),while the Improvement and change in the essential and non-essential amino acids in Hydroponic Barley, as well its work as a Prebiotic to the intestinal flora (microflora) which improve the nutritional value of fish feed (Weremko *et al.*, 1997; Herre *et al.*, 2004). The statistical analysis of apparent digestion for

diets (ADC)% showed a significant highest ADC (table 4) for treatments T6, T7 75.88% and 75.98% respectively; which did not differ significantly, but exceeded other treatment especially when compared with the ratios 5, 10 and 15% (BG). Then followed by treatments T5 and T9 (74.90%, 70.93%) (10 and15% HBF and HBW) When compared with the ratios 5, 10 and 15%(BG). At the last the treatments T8; 69.22% (10% HBW) when compared with the ratios 5, 10 and 15% (GB).The results of the statistical analysis of apparent protein digestible (APD) % showed a significant differences ($p<0.05$) between treatments (table 4). Treatments (T6 and T7 84.93, 84.64%); 15 and 5% HBF and HBW) which were no differences between them and exceeded other treatments when compared with the ratios 5, 10 and 15% (BG). Then followed by treatments T4and T5 (83.09,81.38% 5and10% HBF) when compared with the ratios 5, 10 and 15%(GB). The results of this study demonstrated that the suitability use of germination barley on hydroponics system in two water sources of waste fish water (HBW) and fresh water (HBF) in common carp diets. The results exhibited lowest ADC% and APD% for T1, T2 and T3 compared with the other treatments which is used germination barley. The results of the present study also indicated that germination improves the nutritive value of (GB) (Snow *et al.*, 2008), because of 3-11% ß-glucan in barley (Bhatty, 1992) which acts as a Prebiotic which improves intestinal flora (Williams,

Table 1: The components of experimental diets

Material	(GB)			(HBF)			(HBW)		
	T1 5%	T2 10%	T3 15%	T4 5%	T5 10%	T6 15%	T7 5%	T8 10%	T9 15%
Fish protein	11	11	11	11	11	11	11	11	11
Animal Protein concentration	12	12	12	12	12	12	12	12	12
Soy bean meal	32	31	30	32	31	30	32	31	30
Maize	11	10	9	11	10	9	11	10	9
Wheat	7	5	3	7	5	3	7	5	3
Barley	5	10	15	5	10	15	5	10	15
Sesamum meal	12	12	12	12	12	12	12	12	12
Panicum	5	4	3	5	4	3	5	4	3
Wheat bran	3	3	3	3	3	3	3	3	3
Oil fish	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Vit&minera	1	1	1	1	1	1	1	1	1
Salt	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5

Table 2: Chemical composition for experimental diets

Treatments	Crude Protein	Fiber	Ether Extract	NFE	Ash	Mois-ture	Dry matter	*Metabolic Energy kcal
T1-5% GB	27	5.7	4.9	44.71	13	4.69	95.31	3214.41
T2-10% GB	26.8	5.8	5.6	43.51	13.5	4.79	95.21	3267.04
T3-15% GB	27.3	5.3	4.2	45.32	12.5	5.38	94.62	3244.41
T4-5% HBF	27	5.6	6.2	43.16	13	5.04	94.96	3154.02
T5-10 HBF	27.2	5.7	5.3	42.67	14.5	4.63	95.37	3239.7
T6-15% HBF	27.8	5.8	6.4	42.11	13.5	4.39	95.61	3353.1
T7-5% HBW	27	5.8	6.6	41.55	14.5	4.55	95.45	3204.94
T8-10% HBW	27	5.7	6.7	40.55	15.5	4.55	95.45	3245.33
T9-15% HBW	27.3	5.9	6.8	42.07	13.5	4.43	95.57	3315.08

* Metabolic Energy(kcal) was estimated by device IKA CALORIMETER C7000

Table 3: Effect of addition of germination barley (HBF)and(HBW) compared with dry barley grains(GB) in some Growth criteria for common carp (Mean±s.e.m)

Treatments	IW	FW	WG	SGR	RGR	FCR
T1-5% GB	43.50±0.74a	65.43±7.03c	21.93±7.03c	0.72±0.19b	50.48±16.43c	3.72±1.21a
T2-10% GB	43.50±0.42a	65.78±2.04c	22.28±2.04c	0.74±0.05b	51.21±4.78c	3.50±0.31ab
T3-15% GB	43.43±0.46a	64.30±0.64c	20.87±0.64c	0.70±0.02b	48.07±1.63c	3.50±0.58a
T4-5% GB	43.57±0.28a	84.30±2.44ab	40.73±2.44ab	1.18±0.05a	93.50±5.91ab	1.80±0.11c
T5-10 HBF	43.57±0.17a	82.78±2.11ab	39.21±2.11ab	1.15±0.04a	90.00±5.15ab	1.87±0.10bc
T6-15 HBF	43.50±0.02a	80.30±0.63b	36.80±0.25	1.10±0.01ab	84.60±1.30b	1.99±0.03bc
T7-5% HBW	42.93±0.91a	87.40±4.61ab	44.48±0.62ab	1.27±0.07a	103.45±8.86ab	1.64±0.14 c
T8-10% HBW	43.64±0.47a	92.65±0.58a	49.01±0.58a	1.34±0.01a	112.29±1.14a	1.49±0.01c
T9-15% HBW	43.29±1.15 a	82.13±0.16ab	38.84±0.16ab	1.14±0.01a	89.74±0.96ab	1.87±0.02bc

The means which have similar letter in the same column no significant different between at probability level ($P<0.05$) (Mean± standard deviation).

Table 4: Effect of addition of germinated barley by (HBF) and (HBW) compared to dry barley grains (GB)(Mean±s.e.m)

Treatments	ADC%	ADP%
T1-5% GB	68.21±3.00 bcd	77.19±0.90 c
T2-10% GB	68.00±1.92 bcd	79.85±1.43 bc
T3-15% GB	63.63±1.24 d	77.82±2.01 c
T4-5% HBF	67.81±1.72 dc	83.09±0.79 ab
T5-10 HBF	74.90±1.38 ab	81.38±2.16 abc
T6-15% HBF	75.88±3.69 a	84.93±1.08 a
T7-5% HBW	75.98±1.04 a	84.64±0.56 a
T8-10% HBW	69.22±1.00 abcd	78.40±0.86 bc
T9-15% HBW	70.93±0.95 abc	79.39±1.52 bc

The means which have different letter litter in the same column indicated significant differences at (P>0.05) .

1995). Several previous biology studies had been shown beneficial effect on growth performance, microbiology in the digestive tract and resistance to diseases (Ganguly *et al.*, 2013 ; Ringo *et al.*, 2014 ; Song *et al.*, 2014 ; Torrecilas *et al.*, 2014). The Prebiotict derived from polysaccharides and other dietary fiber can be used in the diets of aquaculture to stimulate the health of the gastrointestinal tract by increasing the number of beneficial bacteria while reduce the number of harmful bacteria and other pathogens As well enhance the immunity of the host while provide conditions for absorption of minerals (Sayar *et al.*, 2007; Sweetman *et al.*, 2008). These results indicated that the use of germination barley improved Growth criteria through improvement microflora in fish intestine leading to improve the ADC & APD. It is therefore recommended to add 5% and 10% FBH or WBH in fish diets instead of grains barley.

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