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Effect of Dietary α-Cellulose Levels on the Growth Parameters of Nile Tilapia *Oreochromis niloticus* Fingerlings

Keri Alhadi Ighwela, Aziz Bin Ahmad, A. B. Abol-Munafi

***Abstract*—**Three purified diets were formulated using fish meal, soya bean, wheat flour, palm oil, minerals and maltose. The carbohydrate in the diets was increased from 5 to 15% by changing the cellulose content to study the effect of dietary carbohydrate level on the growth parameters of Nile tilapia *Oreochromis niloticus.* The protein and the lipid contents were kept constant in all the diets. The results showed that, weight gain, protein efficiency ratio, net protein utilisation and hepatosomatic index of fish fed the diet containing 15% cellulose were the lowest among all groups. Addition, the fish fed the diet containing 5% cellulose had the best specific growth rate, and food conversion ratio. While, there was no effect of the dietary cellulose levels on condition factor and survival rate. These results indicate that Nile tilapia fingerlings are able to utilize dietary cellulose does not exceed 10% in their feed for optimum growth.

***Keywords*—**Dietary cellulose, growth parameters, Nile Tilapia *Oreochromis niloticus*, purified diets.

I. Introduction

FEEDING Fish feed is the largest expenditure in fish farming and this is due to the inclusion of high cost of some essential nutrients such as protein and this constitutes 50% or more of the operating cost of production in intensified culture systems [1], [2]. Carbohydrate is the least expensive nutrient in the diet of animals, including fish feeds, and also can be used to reduce catabolism of protein for energy and for synthesis of glucose, which reduces protein maintenance and increases the nitrogen release to the environment [3], [4]. The ability of fish to utilize different types and levels of carbohydrate sources differs among species [5]. In general, the nutritional value of carbohydrates varies among fish: warm water herbivorous or omnivorous fish species such as tilapia utilize much higher levels of carbohydrate than coldwater marine carnivorous fish species such as Atlantic salmon [6], due to their digestive tract, liver and metabolic systems, being adapted to the different aquatic environments and dietary carbohydrate level and complexity.

In addition, one factor having a major effect on carbohydrate utilization is the degree of polymerisation: monosaccharides are absorbed completely whereas the digestibility of polysaccharides such as starch, dextrin and cellulose are very low. Moreover, the weight gain and feed efficiency generally increased with decreasing carbohydrate complexity in the diet of sunshine bass; whereas, striped bass weight gain was highest when dextrin was included in the diet [7]. Cellulose is polysaccharides consisting of several hundred of monosaccharide units, which use of fish feed formulation [7], [8] and also which can help in reducing the cost of feed production [9]. Fish generally do not utilize cellulose as well as aquatic animals and utilization varies among fish species and levels in their diets [7], [8]. The maximum dietary level of cellulose which does not depress fish growth was studied by researchers, 8% for Lake Trout and Rainbow Trout [10], 16% for Rohu (*Labeo rohita*), [11], and 25% for *Penaeus Indicus* [12]. On the other hand, information on the effects of dietary cellulose on the growth of tilapia is scarce, reported by only a few workers [13], [14]. Therefore, the aim of the current study was to assess the optimum cellulose level leading to optimum growth of Nile tilapia, *Oreochromis niloticus*.

II. Material and Methods

A. Experimental Diets

Three diets were prepared with ingredients usually used. To all three diets, α-cellulose was added in different levels (5%, 10% and 15%) which extracted from barley husk [9]. All ingredients were individually finely ground and then mixed in an appropriate ratio to achieve required protein and lipid levels (33% and 4%) respectively. Homogenously mixed feed ingredients were moistened with water and pelleted using meat mincer machine and then dried in oven at 55 ^{0}C to constant weight and after that stored in plastic bags in refrigerator at 4 ^{0}C until analyzed

B. Chemical Analysis of Diets

All chemical analyses were done in triplicate and made on dry weight basis by AOAC [15]. Crude Protein (N × 6.25) was determined by Kjeldahl Nitrogen, Crude Lipid was extracted by ether in a Soxhlet fat extraction apparatus. Total Ash was determined by incineration in Muffle Furnace. Crude Fiber was determined by filter bag. Carbohydrate and gross energy by:

Carbohydrate by % NFE % = 100 – (% protein + % lipid + % fiber + % ash + moisture), gross Energy (GE) = (% NFE x 4.11) + (% protein x 5.64) + (% lipid x 9.44).

Keri Alhadi Ighwela is with the faculty of Marine Resources,, Al Asmarya University, Zliten Libya (e-mail: Keri_gwallah@yahoo.com).

Aziz Bin Ahmad is with the Faculty of science and Technology, Universiti Malaysia Terengganu, Kuala Terengganu , Terengganu, Malaysia.

A.B. Abol-Munafi is with the Faculty of Fisheries and Aqua-Industry, Universiti Malaysia Terengganu, Kuala Terengganu, Terengganu, Malaysia.

The formulations and proximate analysis of experimental diets are presented in Table I.

C. Experimental Animals

After acclimatization, the healthy of Nile tilapia, *Oreochromis niloticus* fingerlings were weighed (the initial weight ranged from 1.52±0.19 to 1.76±0.16 g), and after that randomly distributed into 9 fiberglass tanks at a density of 30 fishes per tank. The fish were fed on the three test diets for three months.

D. Growth Performance of Fish

Growth parameters of this experiment were measured at the end of experiments according to the following equations:

1. Weight gain = (Mean final weight–Mean initial weight) / Mean initial weight
2. Specific growth rate (SGR) = (In final weight - In initial weight) x l00 / number of days)
3. Feed conversion ratio (FCR) = Total feed intake (g) / Total wet weight gain (g)
4. Protein efficiency ratio (PER) = PER = Wet weight gain (g) / protein fed (g)
5. Net protein utilisation (NPU %) = Weight gain / Protein Intake
6. Hepatosomatic index (HSI %) = 100 x (liver weight [g] / whole fish weight [g]).
7. Survival rate (%) = (Final number of fish/Initial number of fish) × 100
8. The condition factor was determined by using [16]:

$$K = 100W/ L^b$$

where by K = condition factor, W = the weight of the fish in gram (g), L = the total length of the fish in centimetres (cm), b = the value obtained from the length-weight equation.

E. Statistical Analysis

The data obtained from the study were analysed using analysis of variance (ANOVA). Ducan's multiple test [17] was used to verify significance of the mean differences among treatments

TABLE I
COMPOSITION AND PROXIMATE ANALYSIS OF EXPERIMENTAL DIETS (G/KG ON AS FED BASIS)

Feed Ingredients (G KG-1)	D A (5% Cellulose)	D B (10% Cellulose)	D C (15% Cellulose)
Fish Meal	12	12	12
Soya Bean	38	38	38
Wheat Flour	10	10	10
Maltose	30	25	20
Cellulose	5	10	15
Palm Oil	3	3	3
Mineral Premix	0.5	0.5	0.5
Vitamin Premix	0.5	0.5	0.5
Vitamin C	0.4	0.4	0.4
Binder (CMC)	0.5	0.5	0.5
Chromic Oxide	0.1	0.1	0.1
Total (%)	100	100	100
Proximate Composition % on Dry Basis			
Moisture	9.82 ±1.12a	9.22 ±0.52a	8.39 ±1.44a
Protein	33.56 ±1.83a	33.85±0.50a	33.70±0.44a
Lipid	4.83 ±0.29a	4.68 ±0.14a	4.83 ±0.10a
Ash	4.94 ±0.17a	4.81 ±0.03a	4.77 ±0.03a
Fibre	8.71 ±0.35cd	8.93 ±0.36c	11.2 ±0.17b
NFE*	38.14±1.06b	38.51 ±0.87ab	37.08 ±0.99b
Energy (KJ G^{-1})	19.67 ±0.85ab	19.17 ±0.34bc	18.66 ±0.23cd

III. RESULTS AND DISCUSSION

Water quality parameters remained within appropriate ranges during the course of experiment.

All diets were well accepted as fish actively fed on them at each feeding time. The survival ratio for all experimental fish was 100% (Table II). The average value of weight gain obtained from fish fed on diet at 5 % cellulose was similar to that of the group fed diets at 10% cellulose. While the fish group fed on diets at 15% cellulose was significantly lower value than from among all groups (Figs. 1 and 2). These results are slightly different with those obtained by [11] for Rohu *(Labeo Rohita)* fingerlings using 12% cellulose in diet.

Situation was highly different in other studies, [14], [18] observed growth depression and decrease in tilapia when fed on diet containing 10% cellulose.

In addition, the result of current study was lower than those found in European sea bass using diet containing 20% cellulose [19]. Generally, weight gain increased with decreasing cellulose in the diet of Nile tilapia (Figs. 1 and 2). As other growth parameters like, protein efficiency ratio, and net protein utilisation are tagged with gain in weight, therefore they followed the same trend as it was observed in weight increment. The increase in the growth of fish with increasing dietary carbohydrate is due to supplied energy.

The hepatosomatic indexes observed in this study (ranging from 0.47 to 0.55) are in agreement with the [20]. On other hands, the fish fed the diet containing 5% cellulose had the best specific growth rate (1.38), and food conversion ratio (1.16) than other groups. These results in the present study are in agreement with the range described by [19] for Seabass fed with 10% cellulose (1.23 and 1.54 for SGR and FCR respectively). The mean of condition factor (CF) of Nile tilapia fed the experimental diets were all normal with no observable irregularity during the experiment. The result of this study was in agreement with the values reported for Nile tilapia [21]; these indices are considered good health condition for experimental fish.

TABLE II
DATA ON THE FEEDING EXPERIMENT WITH FEEDS D A TO C ON *OREOCHROMIS NILOTICUS* FOR THREE MONTHS

Diets	D A (5% cellulose)	D B (10% cellulose)	D C (15% cellulose)
Initial weight(g)	1.76±0.16a	1.74±0.06a	1.52±0.19a
Final weight(g)	24.09±1.49a	24.25±2.30a	22.08±0.79b
Weight gain(g)	22.33±1.44a	22.51±2.26a	20.55±0.72b
SGR	1.38±0.04a	1.33±0.03b	1.34±0.05b
FCR	1.16±0.04 b	1.16±0.06 b	1.26±0.03 a
PER(3)	0.67±0.05a	0.66±0.06a	0.61±0.02b
NPU(4)	66.58±1.67a	66.57±4.46a	60.98±1.0b
HSI(5)	0.55±0.046a	0.49±0.056b	0.47±0.077b
CF(6)	1.77±0.095	1.71±0.065	1.68±0.05
Survival rate (%)	100	100	100

1- SGR = Specific growth rate, 2- FCR= Feed conversion ratio, 3- PER= Protein efficiency ratio, 4- NPU= Net protein utilisation, 5- HSI= Hepatosomatic index, 6- CF= condition factor

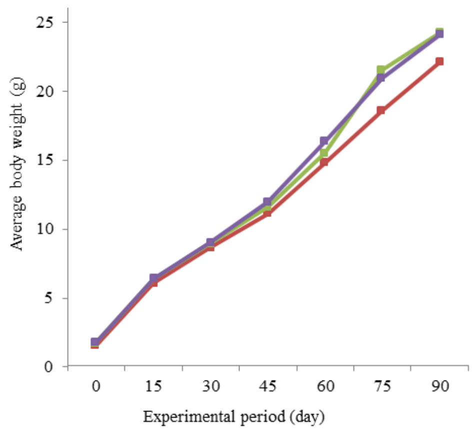

Fig. 1 Average body weight (g) of Nile tilapia fingerlings fed with diets containing of cellulose after 90 days

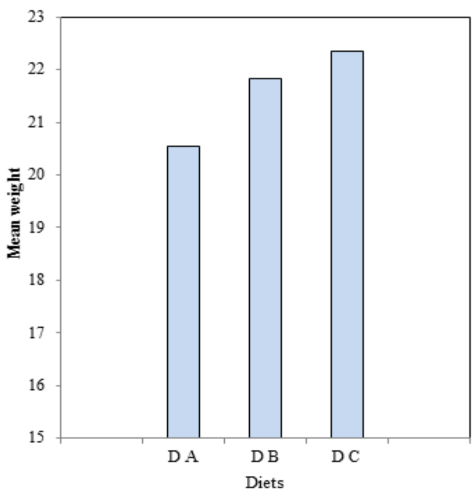

Fig. 2 Weight gain percent of Nile tilapia fingerlings fed with diets containing of cellulose

IV. CONCLUSION

In conclusion, results of the present investigation show that the maximum levels of cellulose that can be used in the diets without affecting the growth parameters do not exceed 10% in their feed. Furthermore this study can be extended to needs further investigation for digestibility and chemical parameters in this fish and other fish.

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