DETERMINING THE POTENTIAL OF COMPENSATORY GROWTH OF NILE TILAPIA (*OREOCHROMIS NILOTICUS, LINNAEUS, 1758*) IN A RECIRCULATING AQUACULTURE SYSTEM

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Abstract

The effect of feed cycling on compensatory growth was examined in Nile tilapia (83 g), held individually at 28ºC. Fish were fasted for 2, 4, and 6 days and then refed the same period like they were fasting with the same daily quantity of food like the controls. In all the variants we had applied the same feed rate, 1.6% BW. The fed was administrated 2 times daily. After 25 days, fish fasted for 6 days at a time were not significantly smaller than controls, or fish experiencing 2 or 4 days of fasting. There were no significantly differences in visceral fat or hepatosomatic indices. Fish subjected to fasting displayed compensatory growth, and high growth rate during the recovery phase was achieved by hyperphagia, rather than improved feed conversion. There was a highly significant relationship between feed intake and weight gain, and feed conversion differ between fish subjected to the different treatments,with good result in the second treatment were the period of fasting was only for 2 days. The results indicate that Nile tilapia can be subjected to short periods of fasting without significant effects on growth, and for a good improvement in feed utilization during the refeeding period.

Key words: compensatory growth, Nile tilapia, refeeding period

INTRODUCTION

Compensatory growth in fish has aroused interest because of its potential application as a management in comercial fish production [20].

The use of compensatory growth in production strategies for fish species with partial compensatory capacity should be treated with circumspection.

Tilapia are omnivourous warm water fish of major comercial importance. Although compensatory growth has demonstrated in mozambique tilapia (Oreochromis mossambicus) reared in fresh water (Christensen and Mclean, 1998) and hybrid tilapia O.mossambicus x O.niloticus reared in seawater (Wang et al.,2000)[20]. Hybrid tilapia reared in seawater showed potential growth compensation resulting from increased food intake (F.I) but without improved food efficiency (F.E) (Wang et al., 2000)[20].

Compensatory growth refers to rapid weight/lenght gain following a period of reduced or deficient nutrient intake.

Hyperphagia abnormally increased appetite for and comsumption of food, is the common phemomenon used to explain compensatory growth of fish (Rueda et al., 1998; Gaylord and Gatlin ,2000; Wang et al.,2000; Tiar and Qin, 2004; Cho, 2005, Cho et al.,2006; Cho,2011)[20].

Although determining the critical point of hyperphagia is not easy, in commercial fish farms, overcompensation of fish still attracts the attention.

The specific nutrient (lipid) in fish was primarily utilised for the energy source for maintenance of basal metabolism and suvival while fasted (Miglavs and Jobling, 1989; Rueda et al., 1998; Ali et al., 2003). Since body lipid of fish is generally affected by

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nutrient quality and quantity of the consumed feed, manipulationn of dietary nutrient composition can also affect compensatory growth of fish.

In the present experiment we evaluate the compensatory growth, feed utilisation and body composition of Nile tilapia (*Oreochromis niloticus, Linnaeus, 1758*), with a view to reducing feed costs in culture.

MATERIAL AND METHOD

The experiment was carried out between 14th May and 7 June 2012 at the pilot recirculating system located in a laboratory of “Aquaculture, Environmental Science and Cadastre” Department, University “ Dunarea de Jos ” of Galati. The system provided with 4 rearing units with a total volume of 0.336 m^3 (0.35x0.80x0.120 m) each. Water quality maintenance units represented by water filtration unit, water sterilization unit (represented by a UV lamp) and water oxygenation unit (represented by two compressors)[2].

Experimental design. Nile tilapia (*Oreochromis niloticus, Linnaeus, 1758*) used in the present study were obtain from Centrului de Cercetare si Dezvoltare pentru Piscicultura, N u c e t. The average weight of the fish was 83±1 g/fish and they were stocked in almost equal biomass. The fish were distributed in homogenous groups with similar class frequencies and exemplar number (Table 1). Statistical tests confirmed normal distribution of the groups.

We have experienced 3 types of treatments regarding the feeding/starving period:

-Control, feed every day twice per day;

-V1 (2/2) - 2 days were fed/2 days were starved.

-V2 (4/4) - 4 days fed/4 days starved;

-V3 (6/6) - 6 days fed/6 days starved;

In all the treatments we had applied the same feeding frequency, 1.6%BW. The feed was administrated 2 times per day (at 10:00 and 15:00 h). The fish were fed with extruded pellets with 32% protein content (feed composition is presented in Table 2).

Table 1 Initial biometric and statistical data of the experimented fish treatments

Biometrical data	Control	V1(2/2)	V2(4/4)	V3(6/6)
	B1	B2	B3	B4
Number of exemplars	45	45	45	45
Total biomass (g)	3777	3773	3774	3776
Mean individual w eight (g)	83,93	83,84	83,86	83,91
Std. Deviation	18,53	17,12	20,12	16,95

Table 2. Biochemical composition of SOPROFISH PROFI 32/10

Parameters	*Quantity*
Crude protein (%)	32,0 %
Crude fats and oils (%)	10 %
Crude ash (%)	6,0 %
Crude fiber (%)	3,5%
Water (%)	9,0 %
Active urea, ∆pH	0,3
Calcium (%)	1,2 %
Phosphorus (%)	0,8 %
Vitamin A (UI/Kg)	10000 UI/Kg
Vitamin D_3 (UI/Kg)	1800 UI/Kg
Vitamin E (mg/Kg)	60 mg/Kg
Vitamin C	150
Lysine	1,9
Methionine + Cysteine (%)	1,0 %

Growth parameters. The following parameters for growth performance were determined and feed utilization was calculated as follows:

- Weight gain (W) = $W_2 – W_1$ (g);
- Specific Growth Rate (SGR) = 100 ($\ln W_2 – \ln W_1$)/T (%BW/day); were:

-W_1 and W_2 are initial and final fish weight, respectively, and T is the number of days in the feeding period;

- Feed Conversion Ratio (FCR) = diet intake / weight (g/g) gain;
- Protein Efficiency Ratio (PER) = Total weight gain (W) / amount of protein fed (g);
- Protein Retention Efficiency (PRE;%) = 100 × (protein retained in fish body / protein intake);
- Relative Growth Rate (RGR) = (W_2 – W_1)/t/BW) (g/kg/day);

Liver-somatic Index and Condition Factor

Liver-somatic index (LSI) and Fulton condition factor (FQ) were determined as follows:

- LSI = 100 (liver weight/fish weight);

➢ FQ = 100 (fish weight / fish length (cm)^3).

The data of growth parameters, feed utilization, and chemical composition were statistic analyzed with t-student test

RESULTS AND DISCUSSIONS

The water parameters (Mean ± SD) including water temperature (21.70±1°C), dissolved oxygen (7.00±1.3 mg L^{-1}), pH (7.90±0.06), ammonium, nitrate and nitrite were fairly constant during the experiment (Chart 1). Regarding the dynamics of water quality parameters we didn't observed major modification during the experiment.

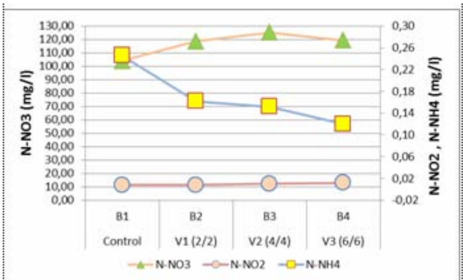


Chart no. 1. Mean values for nitrite, nitrate and ammonium during the experiment

The initial mean weight of the groups were not significantly different (p>0.05). In the experiment we didn't had any mortalities, which proved that environmental and dietary condition were at optimum limits. The data on growth and technological performance during the trial is summarized in table 3.

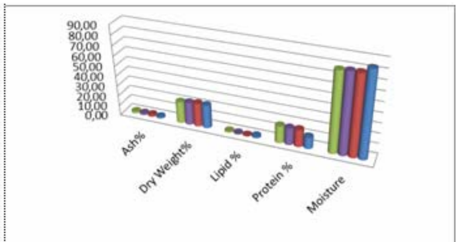
Table 3 indicate that the final fish weight decreased with increased of the fasting period except the fish group fasted for 2 days, in which the fish grew better.

SGR was decreased when the fasting period was increased, indicating that the fish can't recover if the period is too long. On the other hand we can observe that FCR values were higher for the first group feed/starved for 2 days (0.91) and for the second group 4/4 (1.10), moreover the values for FCR in the third group were almost the same like in the control (1.26 and 1.23).

Table 3 Biometrical parameters and technological indices of the fish sampled at the end of the experiment

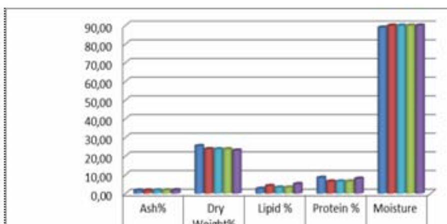
Biometrical data	Control	V1(2/2)	V2(4/4)	V3(6/6)
	B1	B2	B3	B4
Total feed/growth unit(g)	1312,00	624,00	624,00	648,00
Total final biomass (g)	4846,00	4457,00	4339,00	4290,00
Mean final weight (g/ex)	107,69	99,04	96,42	95,33
Weight gain (W) (g)	1069,00	684,00	565,00	514,00
Specific Growth Rate (SGR) (%BW/day)	1,00	0,67	0,56	0,51
Feed Conversion Ratio (FCR) (g feed/g E	1,23	0,91	1,10	1,26
Protein Efficiency Ratio (PER)	2,14	2,88	2,38	2,09
Protein Retention Efficiency (PRE;%)	22,34	17,1	17,15	21,02
Relative Growth Rate (RGR)(g/kg/day)	1,37	0,68	0,68	0,71

Chemical composition of Nile tilapia fasted and reefed for different periods are showed in Chart no.2 and 3.



	Ash%	Dry Weight%	Lipid %	Protein %	Moisture
V2 (4/4) B3 initial	2,10	21,58	1,36	16,98	78,94
V3 (6/6) B4 initial	1,97	22,57	1,09	16,63	79,62
V1 (2/2) B2 initial	2,18	23,40	0,63	16,93	79,73
Control B1 initial	1,70	23,26	1,91	11,45	84,81

Chart no.2. Mean values for biochemical composition of Nile tilapia at the begin of the experiment



	Ash%	Dry Weight%	Lipid %	Protein %	Moisture
Control B1 final	1,70	25,47	2,61	8,49	88,92
V1 (2/2) B2 final	1,70	23,85	4,12	6,50	91,54
V2 (4/4) B3 final	1,76	23,78	3,26	6,52	91,55
V2 (4/4) B3 final	1,76	23,78	3,26	6,52	91,55
V3 (6/6) B4 final	1,87	23,08	5,15	7,99	90,07

Chart no.3. Mean values for biochemical composition of Nile tilapia fasted and reefed for different period at the end of the experiment

Moisture content did not differ significantly differ at the end of the experiment (p>0.05). Crude protein increased with increase the fasting periods (p>0.05) in V3 is almost like in the control. However the total lipid increased with increasing the fasting period, the ash content was not significantly different between control and the other groups.

Regarding the nutrients deposition in fish body, we can observe that the fish lost protein to maintain normal life process, and they gain lipids (Chart no.3) depositing body reserves, V3 had made the bigger reserves (5.15) than control (2.61).

PER values increased in V1(2/2) and V2(4/4) (2.88 and 2.38), and is approximately the same (p>0.05) between the control and V4(6/6) (2.14 and 2.09).

Changes between FQ and LSI at the beginning of the experiment at the final are shown in Chart no.4 and 5.[1]

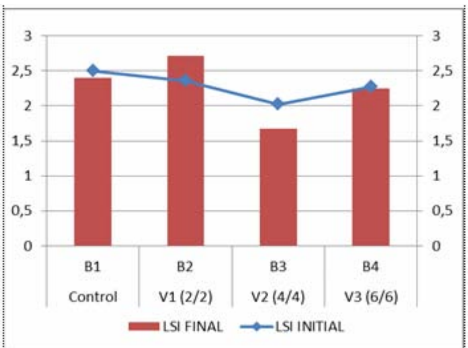


Chart no.4 Mean values of Nile tilapia Liver-somatic index at the begin and the end of the experiment

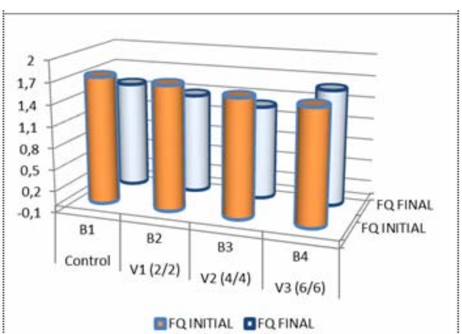


Chart no.5 Mean values of Nile tilapia Fulton condition factor at the begin and at the end of the experiment

Inducing compensatory growth in aquaculture is considerable interest with possible advantages included increased growth rate and diet utilization, decreased waste production, and more flexible feeding schedules. A period of diet deprivation had been commonly used to elicit a compensatory growth response in fish. Fish of many species have the ability to grow unusually fast after a period of diet deprivation or restricted feeding (Wang et al. 2005, Mohsen Abdel - Tawwab et al. 2006)[1].

The degree of compensation is related to the severity of diet deprivation and the previous feeding status (Mohsen Abdel – Tawwab et al. 2006)[1]. During the experiment the full –fed control, exhibited higher weight gain than the other groups, that were fed only with a half of the feed that the control were fed, so we can say that V1 (2/2) had a degree of compensation if we compare the FCR and SGR.

Fasting of Nile tilapia caused a cessation of body and skeletal growth and a reduction in FQ and LSI. FQ and LSI of fish from V1 increased compared with full-fed control. The relative changes in condition factor and liver weight are major indicators of physiological conditions and body loss caused by feed deprivation (Wang et al. 2005, Mohsen Abdel - Tawwab et al. 2006) [1].

CONCLUSIONS

The results of this study concluded that fish fasting should not exceed 4 days where fish could compensate their growth. The individual weight gain in V1 was not significantly different from the full-fed control (99.04 and 107).

The main conclusion of the experiment is represented by the fact that using a half of feed for the groups in the experiment, in the second group (2/2) we had a good biotechnological indicators results that showed compensation.

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