Egyptian Journal of Aquatic Research (2016) 42, 357–363

HOSTED BY

ELSEVIER

National Institute of Oceanography and Fisheries

Egyptian Journal of Aquatic Research

http://ees.elsevier.com/ejar
www.sciencedirect.com

FULL LENGTH ARTICLE

Effects of weekly feeding frequency and previous ration restriction on the compensatory growth and body composition of Nile tilapia fingerlings

Tamer El Sayed Ali [a], Silvia Martínez-Llorens [b], A.V. Moñino [b], Miguel Jover Cerdá [b], Ana Tomás-Vidal [b,*]

[a] *Oceanography Department, Faculty of Science, Alexandria University, Alexandria, Egypt*
[b] *Research Group of Aquaculture and Biodiversity, Institute of Animal Science and Technology, Universitat Politècnica de València, Camino de Vera, 14, 46071 Valencia, Spain*

Received 21 April 2016; revised 16 June 2016; accepted 26 June 2016
Available online 25 August 2016

KEYWORDS

Oreochromis niloticus;
Compensatory growth;
Feeding frequency

Abstract The effect of different weekly feeding frequencies on Nile tilapia fingerlings of 2.02 g, was determined during 12 weeks. This was done by feeding the fish 7 days/week, 6 days/week or 5 days/week. After this restriction feeding period, all fish were fed as the control group (7 days/week) during 26 days to study the capability of the fish to compensate the growth during this re-feeding period. At the end of the feeding restriction period, there were significant differences in weights among the different treatments, although the significance was detected only at 7 days/week level, which presented the highest final body weight compared with the other 2 treatments. The daily feed intake and the feed conversion and protein efficiency ratios did not present significant differences. Crude protein efficiency (CPE) and gross energy efficiency (GEE) were affected by the feeding frequency, presenting high values in fish fed 7 days/week. Growth results obtained during this re-feeding period indicate that weight gain (WG) and specific growth rate (SGR) presented a linear increase from 7 to 5 days/week, i.e. with increasing feed deprivation period the fish could compensate the growth effectively, trying to reach to the weight as those of the control group.

Introduction

Feed is generally the highest variable costs at aquaculture facilities. Understanding nutrient requirements and implementing appropriate feeding strategies can reduce waste and increase profits. Feed efficiency is vital in livestock farming in general and of course, in the case of aquaculture. From a management standpoint frequent feeding (number feeding per day) of fish may not be economical due to increased labour costs (Riche et al., 2004). So, one of the problems in fish production is to obtain a good balance between fish growth and food consumption. Therefore, equally important it is to know the growth and nutritional needs of fish, as knowing the best feeding strategies

* Corresponding author at: Polytechnic University of Valencia, Camino de Vera, 14, 46071 Valencia, Spain. Fax: +34 96 3877439.
E-mail address: atomasv@dca.upv.es (A. Tomás-Vidal).
Peer review under responsibility of National Institute of Oceanography and Fisheries.

http://dx.doi.org/10.1016/j.ejar.2016.06.004
1687-4285

for a species (Jobling, 1993; Goddard, 1996; Jørgensen et al., 1996; Gokcek et al., 2008).

There is a positive relation between growth and feeding frequency (Riche et al., 2004; Riche, 2008). However, Crampton (1991) demonstrated that it may not be necessary to feed daily in order to obtain maximum growth rates. Also De Silva and Anderson (1995) observed that beyond a certain level, excessive feeding has no influence on growth and result in poor growth. Excess intake causes a worse FCR, above what the fish really needs.

Hyperphagy contributed to the restoration of an energy deficit caused by the starvation period. In fact, compensatory growth is a clear response to hyperphagia (Ali and Wootton, 2003). Hyperphagia should allow an animal that has suffered a food restriction regain the weight it would have if fish had eaten without restriction. Compensatory growth is higher when greater has been the period of restriction that has been subjected the animal (Jobling and Koskela, 1997; Nikki et al., 2004; Tian and Qin, 2003, 2004).

Most studies of compensatory growth have focused on the duration of complete feed deprivation (Wieser et al., 1992; Jobling and Koskela, 1996; Zhu et al., 2001; Tian and Qin, 2003, 2004; Azodi et al., 2016) and mostly were carried out on cold water species and reports on warm water species are few (Schwarz et al., 1985; Kim and Lovell, 1995; Hayward et al., 1997). Hybrid tilapia *Oreochromis mossambicus* × *Oreochromis niloticus*, exhibited compensatory responses after feed deprivation (Wang et al., 2000, 2004, 2005, 2009; Gao et al., 2015; Ye et al., 2016), but fish that were kept on restricted feeding regimes failed to completely recover in the great majority of cases.

Despite the great potential of tilapia production, information regarding the effects of feeding strategies and management practices on fish performance is limited.

Along with carps and salmonids tilapia is considered the most produced worldwide species (El-Sayed, 1999). Although until recently are raised in ponds without artificial feeding, consequence of its recent intensification is necessary to increase the nutritional knowledge of this species.

For these reasons, the present study aimed to investigate the effect of different feeding regimes (frequency of feeding per week) by feed deprivation for days (week end was selected for later commercial application) on the growth parameters, nutrients retention and body composition of the fish during different life stages and the influence of previously mentioned restriction feeding (feeding frequency) and subsequent return to all-week feeding on compensatory growth responses of Nile tilapia.

Materials and methods

Experimental fish and culture system

Nile tilapia (*O. niloticus*) fingerlings that weighed 2.02 g (n = 360) came from a local commercial fish farm, Valenciana de Acuicultura S.L., Valencia, Spain. Fish were randomly stocked in 3 fibreglass tanks with 750 l capacity (40 fishes per tank), for facilities limitation 3 cages of 120 l capacity were put in each tank to obtain 3 replicates for each treatment.They were fed ad libitum with a commercial diet (45% CP and 20% CL) for a week before the experiment began.

The duration of the trial was 110 d. The facilities consist in a recirculating marine water system (65 m^3 capacity). The average water parameters measured during the experiment was: temperature was 28.3 ± 1.7 °C (mean ± SD) and dissolved oxygen was 6.04 ± 0.7 mg L^{-1} (both parameters were measured with an OxyGuard, Handy Polaris V 1.26).

All tanks have aeration and photoperiod was natural.

Experimental diets and feeding regime

Two experimental diets previously tested and recommended in preliminary feeding trial were tested (40% CP, 15% EE and 21.37 kJ g^{-1} for young fish till 40 g body weight and then the diet used was 35% CP, 15% EE and 21.20 kJ g^{-1} for the fish till the end of the experiment, Table 1).

Some ingredients, like wheat and extracted soybean were milled in a hammer mill (Technochufa, Valencia, Spain). Diets were prepared by extrusion cooking with a semi-industrial twin-screw extruder (Clextral BC-45, St. Etienne, France, 100 rpm screw speed, 110 °C temperature, 30 atm–40 atm pressure and 2 mm–3 mm diameter pellets).

The first period lasted for 84 days and tested a restricted feeding regime. During this period, fish were fed 3 times/day (9:00 a.m, 1:00 p.m and 5:00 p.m) to apparent satiation at different feeding frequencies as follow: T1, feeding 7 days/week, T2, feeding 6 days/week and T3, feeding 5 days/week, i.e. fasting one day or 2 days at weekends is the meaning of T2 and T3, respectively. Every four weeks, fish were weighed and counted (previously anaesthetisation with 30 mg/L of clove oil (Guinama, Valencia, Spain) containing 87% Eugenol).

After this restricted feeding period, fish were fed all the week days to satiation twice a day (9:00 a.m and 5:00 p.m). This was the second period, with duration of 26-days and with the objective studding the compensatory growth in tilapia.

Body composition analyses

Five fish per tank at the beginning and the end of the first period were randomly sampled and dissected to determine biometric parameters and body composition.

Ingredients, diets and the whole fish were analysed according to the following steps (AOAC, 1990): dry matter (105 °C to constant weight); ash (incinerated at 550 °C to constant weight); CP (N x 6.25) by the Kjeldahl method after acid digestion (Kjeltec 2300 Auto Analyser, Tecator, Höganas, Sweden); CL extraction with methyl ether (Soxtec 1043 extraction unit;

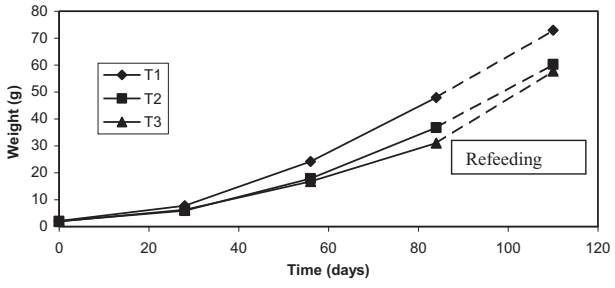

Figure 1 Evolution of average body weight of tilapia during the two periods of the experiment.