Effect of Three Photoperiods on the Growth of Tilapian Fish *Oreochromos aureus* Reared in Glass Tanks

Abdullah A. Al Jerian & Elsayed M. Younis

Zoology Department, College of Science,
King Saud University, P.O. Box 2455,
Riyadh 11451, Saudi Arabia.

Abstract. Fishes (*Oreochromis aureus*), with an initial weight of 17.14-18.57 g, were reared in laboratory glass tanks for 135 days to investigate growth under three photoperiodic regimes: LD 6:6, 12:12 and 24:0. The fishes were stocked at a density of 100 fish/m^3, and fed once daily. Every week, fishes were removed and weighted and water was changed using new dechlorinated water. Photoperiod did not affect ($P \leq 0.05$) the mean body weight, but the mean growth rates under LD 6:6 and LD 12:12 were higher than under LD 24:0, whereas the mean specific growth rate under LD 6:6 was lower than under the other two light periods. However, during the first two months the body weight, growth rate (GR) and the specific growth rate (SGR) were the highest under LD 24:0, but then declined. Body weight, GR and SGR became the highest under LD 12:12 after the first two months until the end of the experiment. The LD 6:6 resulted in the lowest values.

Key Words: fish, growth rate, light regime, *Oreochromis* specific growth rate,.

Introduction

The tilapians are fast becoming important culture species in several parts of the world. Tilapians raising has been introduced in several developing countries that concentrated on oreschromis culture, because it is a relatively less expensive protein source and easy to breed.

Many studies investigated the factors affecting the growth of fish. Feeding, ratio, quality of feed, water quality, cage design, size of fish at stocking and stocking density were reported by Trzebiatowski *et al.* (1981) as the major factors to affect the growth of fish cultured in cages. Saunders and Henderson (1970), Komourdijian *et al.* (1976), Lundqvist (1980), Brauer (1982) and Saunders *et al.* (1985) concluded that artificially-increased day light length applied during appropriate season and during certain developmental stages may be used to enhance growth rate of fishes.

Little is known on the effect of light on the growth and development of *Oreochromis* spp. The aim of this study was to determine the effect of light on the growth rate and specific growth rate of *O. aureus* (Steindachner 1864) at three different artificial photoperiods.

Materials and Methods

Fishes were collected from the fish hatchery of King Abdulaziz City for Science and Technology (KACST) in Riyadh. The average initial weight of the fish fingerlings was 17.14-18.57 g at the beginning of the experiment.

The experiment started in 5 Dec. 1993 and terminated 135 days later. The fishes were reared in nine laboratory glass tanks (100X30X35 cm), each holding 90 L of water. The stocking density was 100 $fish/m^3$ in each tank. Fingerlings were fed on a dry crumbs food (34% protein) with an amount equivalent to 2% of the fresh body weight. The fishes were fed once daily, six days per week; on the seventh day no food was offered. The fish feed is widely used by local fish growers. in Saudi Arabia and was obtained from the Grain Silos and Flour Mills Organization in Riyadh, and its composition is as follow:

Material	Ratio
1- Crude protein	345
2- Crude fat	4.0%
3- Crude fibber	3.05
4- Ash	10%
5- Calcium	1.8%
6- Phosphorus	15
7- Salt	0.3%
8- Vitamin A	20.0 Iu/g
9- Vitamin D	6.0 Iu/g
10- Vitamin E	25.0 Iu/g

Trace elements added included: Cobalt, Copper, Iodine, Iron, Manganese and Since.

The tanks were divided into three equal groups, and three light intensities were used. The first group was lighted 24 hours per day (LD 24:0). The second group was lighted for only 12 hours per day (LD 12:12), while the third group was lighted 6 hours per day (LD 6/6). The glass tanks were illuminated using a pair of 20W daylight fluorescent lamps suspended 25 cm above the water surface. Photoperiod was controlled by electric timers; light lamps were switched on and off without simulated dawn and dusk periods. The tanks were provided with biological filters. Each tank was equipped with thermoregulated immersion heater, and the temperature was maintained at 25 $^0C\pm1$. Water in the tanks was changed every two weeks using dechlorinated water. At the same time fishes were removed, weighed and the tanks were cleaned.

Since weight could be measured more accurately than length, growth was determined in terms of the change in fish weight (Allen and Wooton, 1982). The growth rate (GR) and the specific growth rate (SGR) were calculated according to the following equations (Degani *et al.*, 1989):

1) $GR = \frac{dw}{dt}$

Where dw is the change in fish weight, and dt is the change in time

2) $SGR = [({}^{Ln}wt - {}^{Ln}wo) / days] X 100$

Where wo is the weight of fish at time o "initial weight", and wt is the weight of fish at time t.

All data were subjected to analysis of variance (two-way ANOVA) using the Statistical Analysis System (SAS).

Results and Discussion

Photoperiod did not significantly affect the mean body weight at the end of the experiment (Table 1). However, the growth rates at LD 6:6 and LD 12:12 were higher ($P \leq 0.05$) than at LD 24:0, but the specific growth rate at LD 6:6 was lower than at the two other light periods (Table 1).

During the first two months, fishes which were reared under continuous light (LD 24:0) achieved the highest body weight (Table 2), growth rate (Table 3) and specific growth rate (Table 4). The growth rate and specific growth rate under LD 12:12 were the highest after the first two months until end of the experiment. The lowest values of growth rate and specific growth rate were at LD 6:6.

Our results support the findings of Saunders and Henderson (1970), Komourdjian *et al.* (1976), Lundqvist (1980), Kristinsson *et al.* (1985) and Saunders *et al.* (1985) who concluded that growth rate of Atlantic salmon juveniles that were exposed to increasing day length were high in comparison with those under simulated natural photoperiod. Our results are also in general agreement with those obtained by Saunders and Henderson (1988) who reported that growth rates of Atlantic salmon, which were reared for 6 months, were highest in the LD 24:0 group during the first 3 months. However; under the LD 16:8 fishes grew faster than all others during the last three months.

Table 1. Effect o three light regimes on mean body weight, growth rate and specific growth rate of *Oreochromis aureus* reared in cages for 135 days.

Light regime	Body weight (g)	Growth rate (GR)	Specific growth rate (SGR0
LD 6 : 6	31.75 a	0.2254 a	0.6957 a
LD 12 : 12	32.04 a	0.2553 a	0.8173 b
LD 24 : 0	32.45 a	0.2010 b	0.8923 b

Means, in a column, followed by the same letter are not significantly different at $P \leq 0.05$.

Table 2. Body weight (g) of *Oreochromis aureus* reared for 135 days at three light regimes.

Days of rearing	Light regime		
	LD 6:6	LD 12:12	LD 24:0
0	18.57	17.14	17.86
15	20.24	19.14	20.80
30	22.40	21.57	24.60
45	25.20	24.66	28.60
60	28.50	28.33	33.00
75	32.25	32.50	34.40
90	36.25	37.00	37.40
105	40.43	41.80	40.20
120	44.66	44.66	42.64
135	49.00	51.60	45.00
Mean ± SD	31.75±10.578	32.04±11.938	32.45±9.280

Table 3. Growth rate (GR) of *Oreochromis aureus* reared for 135 days at three light regimes.

Days of rearing	Light regime		
	LD 6:6	LD 12:12	LD 24:0
15	0.1113	0.1333	0.1960
30	0.1440	0.1620	0.2533
45	0.1867	0.2060	0.2667
60	0.2200	0.2447	0.2933
75	0.2500	0.2780	0.0933
90	0.2667	0.3000	0.2000
105	0.2787	0.3200	0.1867
120	0.2820	0.3240	0.1627
135	0.2893	0.3293	0.1573
Mean ± SD	0.2254±0.0648	0.2553±0.0733	0.2010±0.0620

Table 4. Specific growth rate (SGR) of *Oreochromis aureus* reared for 135 days at three light regimes.

Days of rearing	Light regime		
	LD 6:6	LD 12:12	LD 24:0
15	0.57409	0.73577	1.01593
30	0.62505	0.76630	1.06728
45	0.67844	0.80837	1.04632
60	0.71393	0.83751	1.02324
75	0.73596	0.85310	0.87399
90	0.74321	0.85500	0.82123
105	0.74098	0.84903	0.77267
120	0.73128	0.83456	0.72519
135	0.71872	0.81638	0.68452
Mean ± SD	0.69574±0.0593	0.81734±0.0414	0.89226±0.1490

Villareal *et al.* (1988) suggested that the photophase acts as a synchronizer of endogenous of appetite and growth. Rottiers (1992) reported that growth of yearling Atlantic salmon was greatest under the influence of a longer photoperiod (LD 16:8), and he concluded that increased growth with increased day length was probably due to increased appetite and food conversion.

In our investigation, a possible explanation is that the growth rate of *O. aureus* which increased with increased day length in the first two months may be due to the increased of fish appetite and food conversion; but declined late due to the stress of long photoperiod. The stress could cause the animals to spend energy for homeostatic processes (Schreck, 1982). In this situation, the long photoperiod is a kind of stress so that not all the food will be utilized for growth. Therefore, the growth rate declined at 24 h group after two months. Finally it could be concluded that the photoperiod 12 h is the suitable for these fishes. However, different species of tilapia may have different responses to photoperiod regimes.

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تأثير ثلاثة أنظمة للإضاءة اليومية على نمو أحد أنواع سمك البلطي *Oreochromis aureus* المرباة في أحواض زجاجية

عبد الله عبد الرحمن الجريان و السيد محمد يونس

قسم علم الحيوان ، كلية العلوم ، جامعة الملك سعود
ص.ب ٢٤٥٥ الرياض ١١٤٥١ — المملكة العربية السعودية

ملخص : في هذا البحث ربيت أسماك البلطي *O. aureus* ذات الأوزان المبدئية التي تراوحت بين ١٤ر١٧ – ٥٧ر١٨ جرام في أحواض زجاجية لمدة ١٣٥ يوماً ، وذلك بهدف دراسة نمو هذه الأسماك عند ثلاثة أنظمة للإضاءة (٦ ساعات إضاءة و ٦ ساعات إظلام) ، (١٢ ساعة إضاءة و ١٢ ساعة إظلام) وأيضا (إضاءة مستمرة ٢٤ ساعة) . كانت كثافة التربية المستخدمة ١٠٠ سمكة/م^{٣} وتمت تغذية الأسماك مرة واحدة يومياً . وعند كل اسبوعين كان يتم أخذ الأسماك من الأحواض وتحديد وزنها ومن ثم استبدال ماء الأحواض بآخر جديد خال الكلور . دلت نتائج هذا البحث على أن نظام الإضاءة لم يؤثر على متوسط أوزان الأسماك ، ولكن متوسط معدل النمو عند نظامي الإضاءة (٦:٦) و (١٢:١٢) كان أكبر منه عند نظام الإضاءة (٢٤:صفر)، في حين كان متوسط معدل النمو النوعي عند نظام الإضاءة (٦:٦) اقل منه عند نظامي الإضاءة الآخرين . على الرغم من أنه خلال الشهرين الأولين من التجربة كان متوسط الأسماك ومعدل النمو وأيضاً معدل النمو النوعي عند نظام الإضاءة (٢٤:صفر) هو الأعلى إلا أنه انخفض بعد ذلك . بعد مضي الشهرين الأولين وحتى نهاية التجربة اصبح متوسط وزن الأسماك ومعدل النمو وأيضاً معدل النمو النوعي عند نظام الإضاءة (١٢:١٢) هو الأعلى على الإطلاق ، في حين كان الأقل دائما عند نظام الإضاءة (٦:٦) .