INFLUENCE OF STOCKING DENSITY ON SOME WATER QUALITY PARAMETERS AND GROWTH TRAITS IN ANGEL FISH (*Pterophyllum skalare*)

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Abstract

The trial was conducted in aquaria tanks with Angel fish (Pterophyllum skalare) for period of 60 days, to examine the effect of three stocking density on hydro chemical parameters and growth performances. The fish were stocked in three densities 40 (SD1), 80 (SD2) and 100 fish (SD3) per tank in tree replication. They were fed with a food containing 45% protein and food ratio of 3% of its body weight per day. Water quality parameters (T, pH, DO, NO3 and BOD) were recorded on a daily basis. Stock densities had a significant impact on dissolved oxygen (DO), biological oxygen demand (BOD). Changes in pH and nitrates concentrations were insignificant (P>0.05). During the study period, measured values of the hydro chemical parameters were within the effluent limits for ornamental fish. Finally, the body weight was insignificantly affected by water quality and stocking density.

Key words: Angel fish, *Pterophyllum skalare*, ornamental fish, stocking density, growth parameters, water parameters

INTRODUCTION

Angelfish are quite popular around the world among aquarium hobbyist [7]. These are gregarious cichlids fish that naturally live in tropical rivers and lakes with good instantaneous oxygen regime [14]. This species is one of the first fish which were transported from South America to the rest of the world, they were brought to Europe around 1820 and they were bred in captivity for the first time in 1930 in the United States [6].

The determination of adequate stocking density has received special attention in the creation of cultivation fish, to affect survival [10, 16], growth [3, 9] these animals. The use of small quantities of animals leads to underutilization of the available space for the creation, and very high densities, can also be harmful, because of the greater amount of food used and its consequent degradation, and increased excretion of nitrogenous waste by fish, with losses in water quality [5].

Based on the above, the purpose of this study was to evaluate the effect of three different stocking densities on growth of angelfish produced in a glass aquarium.

MATERIAL AND METHODS

The experiment was performed in the Experimental Aquaculture Base, Trakia University–Stara Zagora in accordance with the Law on Veterinary and Medical Activities and the Animal Welfare Act.

Fish were stocked at densities of 40, 80 and 120 per tank. The stocking density trails were conducted in glass tanks with dimension of 80x48x30 cm filled with 100 L dechlorinated bore water. Adequate level of oxygen in each tank was maintained through artificial aeration. The experimental fish were fed with diet containing crude protein 42% (Table 1). The daily ration was 3% of the body weight and was split into 3 equal portions, given manually during the light part of the day.

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Table 1 Nutrient content in the feed

Crude protein, %	42.00
Crude fat, %	16.00
Crude fibre, %	2.50
Moisture, %	7.62
Lysine, %	1.68
Methionine + cysteine, %	2.84
Ca, %	1.40
P, %	1.44
ME, MJ/kg	18.20

* 1 kg feed contains: vit. A – 10000 IE; vit. D3 – 1500 IE; vit. E – 200 mg; vit. K – 3 mg; vit. B1 – 10 mg; vit. B2 – 15 mg; vit. B6 – 8 mg; vit. B12 – 0.02 mg; nicotinic acid – 40 mg; folic acid – 3 mg; biotin – 0.3 mg; Fe – 145 mg; Mn – 67 mg; Cu – 16 mg; Zn – 68 mg; I – 1.5 mg; Co – 0.5 mg; Se – 0.6 mg.

The study lasted for 60 days after which 20 fish from each group were collected and measurement for standard length and weight. Fine mesh nets were used for catching and after induction the fish were placed on a non-abrasive surface, such as waterproof drape to prevent damage to delicate piscine cuticle. Out of water, fish handling and measured by wearing latex gloves to minimize damage to the skin and mucus covering [1]. They were analyzed under stereomicroscope Leica MZ 16 with Leica CLS150XE white light source and were photographed with the camera Leica EC3 connected to the microscope (Picture 1). Individual fish weight and length were used to calculate condition factor (K). For evaluation of K, standard body weight (g) of a fish is proportional to the cube of its length [2, 18].

$$K = g \times 100 / length^3$$

Water temperature (digital thermometer; ^0C), dissolved oxygen (WTW-oxi330; $mg.L^{-1}$), nitrate (HANNA HI 98312; $mg.L^{-1}$) and pH (REDOX Zac plus) were daily measured. The samples for analysis of biological oxygen demand for 24 h and 5 days (BOD Sensor System) were obtained weekly prior to feeding of fish. There were no dead fish during the study.

The results were processed with software Statistica v.6.1 (StatSoft Inc., 2002). All results are presented as mean and standard error of the mean (Mean ± SEM). The statistical significance of parameters was determined in the LSD test at $P < 0.05$.

RESULTS AND DISCUSSIONS

Hydro chemical characteristics monitored during the study period are shown in Table 2.

Table 2 Hydro chemical parameters in the different stocking densities

Parameters	SD1 (40)	SD2 (80)	SD3 (120)
Temperature, (°C)	25.2±0.10	24.9±0.10	25.6±0.21
pH	7.2±0.24	7.15±0.21	6.87±0.29
Dissolved oxygen, ($mg.L^{-1}$)	5.75±0.62*	4.83±0.85	4.12±0.85*
Nitrate, ($mg.L^{-1}$)	0.1±0.00	0.1± 0.00	0.3±±0.001
Biological oxygen demand 24 h, ($mg.L^{-1}$)	1.21±0.2*	1.48±0.4	2.14±0.4*
Biological oxygen demand 5 days, ($mg.L^{-1}$)	3.81±0.8	4.12±0.7	4.27±0.7

* ($P < 0.05$) indicate significant differences between groups

The water temperature during the period of study was maintained between 24.9-25.6° C. The pH values varied between 6.8 and 7.2 and decreased with increasing of stock density. The nitrate values were not affected by treatment (P>0.05) in compare with values of dissolved oxygen and biological oxygen demand (P<0.05).

Angel fish are quite popular around the world among aquarium hobbyist [7]. These are gregarious cichlids fish that naturally live in tropical rivers and lakes with good instantaneous oxygen regime [14]. Since Angel fish do not produce lots of excrements and pollute water their tank does not need heavy maintenance. The use of small quantities of animals leads to underutilization of the available space for the creation, and very high densities, can also be harmful, because of the greater amount of food used and its consequent degradation, and increased excretion of nitrogenous waste by fish, with losses in water quality [5]. Despite its origin in acidic waters the Amazon River, the commercial varieties Angelfish, currently exploited, present tolerance to wide pH range. The optimal pH and temperature of Angel fish has been reported as 5.5-7.5 [13] and 25°C [8], which are similar of those obtained in the present study.

The dissolved oxygen and biological oxygen demand depend on many biotic and abiotic factors. As stocking density increased, the levels of dissolved oxygen also changed. According to similar studies [18], [11], [12] high stocking densities strongly influence in the level of respiration and oxygen consumption as change the metabolism of fish, especially intensity of glycolysis. The reduction in dissolved oxygen levels, from 5.75 to 4.12 mg.L^{-1} for the lowest and the highest density, respectively, remained adequate for the fish.

BOD is the measurement of how much oxygen is needed to break down the waste created. The higher the BOD value, the worse the quality of the water. An acceptable BOD value is at about 1-2 mg.L^{-1} [4]. Nitrates contribute to high BOD levels, since this generally indicates a high break down rate of waste.

Despite the higher nitrate concentrations for the SD2 and SD3, this had no apparent influence on animal growth and survival. An increase in the concentration of nitrates with increased stocking density has been observed for ornamental fishes and indicating the need for better water quality care with increasing stocking densities [15]. The lower nitrate and BOD levels were result of the cleaned daily from residues and 20% of the water was replaced twice weekly.

The determination of adequate stocking density has received special attention in the creation of cultivation fish, to affect survival [10, 16], growth [3, 9] of these animals. The changes in mean body weight and length of Angel fish during the period of study are shown in Table 3.

Table 3 Mean growth parameters in the different stocking densities

Parameters	SD1 (40)	SD2 (80)	SD3 (120)
Initial body weight, (g)	0.8±0.03	0.8±0.03	0.8±0.03
Final body weight, (g)	2.33±0.3	2.12±0.6	2.04±0.1
Final body length, (mm)	19.26±1.1	19.18±0.9	18.52±1.0
Condition factor, (K)	1.7	1.4	1.3

The cultivation of Angel fish at stocking densities SD1 – 40 fish; SD2 – 80 fish and SD3 – 120 fish, showed that fish stocked at SD1 attained the highest body weight (Table 3). In this experimental variant fish grew most intensively and attained final live weight of 2.33±0.3 g. In the comparison of the body length there were no significant differences (P>0.05) between experimental groups at the beginning of the study and no significant differences were found between replicates of the groups over the study.

Changes in Angel fish morphology were observed in relation to the water quality (Picture 1). The condition Factor allows to compare quantitatively the condition of individual fish within a population or from different populations. K may also be used as an index of the productivity of water (Barnham and Baxter, 1998). As stocking density increased, the fattening coefficients went down. In the SD3 group, condition factor was stable around 1.2-1.3 and in the SD2 and SD1 group it progressively increased from 1.4–1.5 to 1.7. The average fattening coefficient of fish from the all groups were statistically insignificantly (P>0.05).

Picture 1 Measurement of freshwater angelfish by stereo microscope

CONCLUSIONS

To conclude, this study provides information on the effects of hydro chemical parameters and stocking density on growth of Angel fish that may be useful to ornamental fish farming keepers. The higher stocking density influences the hydro chemical parameters, but they remained within optimal reference ranges of the species. There was a trend for higher body weight of fish from SD1 (2.33±0.3), compared that of SD2 group (2.12±0.6) and SD3 group (2.04±0.1) respectively. This tendency was preserved also for other body dimensions of SD1 fish. It can be concluded that, the best desirable stocking density was SD3 and 20% water exchange rate.

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