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Short Communication

Maternal age influences on reproductive rates in Nile tilapia (*Oreochromis niloticus*)

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ABSTRACT - In this study we examined the effects of the maternal age on the fecundity (absolute and relative), egg production, and fertilization rates of Nile tilapia (*Oreochromis niloticus*). Females were divided into three groups: Group 1 (6 years old), Group 2 (3 years old), and Group 3 (8 months old). Males of eight months were used in all groups. Twice a week, the females' mouths were examined, and if they had eggs, these were removed and transferred to 2-L incubators. No difference was observed in the absolute fecundity between the different maternal age groups. Relative fecundity and egg production was greater in Group 3 (8 months) and fertilization rates were lower in Group 1 (6 years). Younger tilapias are more viable for egg production, because they have better reproductive indexes.

Key Words: fertility, quality of gametes, reproduction traits

Introduction

Captive and wild fish populations are dependent on the production of good-quality eggs with low mortality at the time of fertilization, incubation, and at the beginning of exogenous feeding (Bromage et al., 1992). Recent studies have shown that the age of fish can influence the quality of gametes (Quintero et al., 2011; Targonska et al., 2012; Aliniya et al., 2013). Thus, to obtain good-quality offspring, the age of the breeders must be taken into account.

The Nile tilapia (*Oreochromis niloticus*) is one of the most important species in fish farming worldwide, and knowledge of factors that influence its reproductive performance is essential. Given the increasing interest of fish farmers and researchers in the optimal breeding age of females, this study aimed to analyze the effects of the maternal age on fecundity, egg production, and fertilization rates of *Oreochromis niloticus*.

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Material and Methods

The experiment was conducted in Jaboticabal, SP, Brazil. Female *O. niloticus* originating from UNESP - São Paulo State University, Aquaculture Center were kept in 7,000-L tanks and fed twice daily a commercial diet containing 32% crude protein. For the experiment, they were divided into three groups: Group 1 (6 years old), Group 2 (2 years old), and Group 3 (8 months old). Each group was placed into two separate 7,000-L tanks, in a recirculation system, at a stocking density of 20 fish per tank. Each tank had a gender ratio of 1.5 female for each male (12 females and eight males per tank). All the males were eight months-old. The fish were fed commercial pellets containing 32% crude protein, four times daily.

Eggs were collected twice weekly for 60 days for group 1 (6 years old) and 2 (3 years old). For group 3 (8 months old), eggs were collected in one week. Eggs were removed from the mouth and transferred to 2-L incubators individually for each female. The number of eggs counted in a 0.5-g sample was used to estimate the quantity of eggs obtained per spawn, based on the weight of the spawn (absolute fecundity). The relative fecundity rate was calculated by dividing the total number of eggs produced by the weight of the females (Vazzoler, 1996). The total number of eggs was determined as the sum of all eggs obtained for each female.

Twelve hours after fertilization, 0.5 g of eggs was randomly collected from each incubator to estimate the fertilization rate, which was calculated as the number of fertilized eggs (undergoing cell division).

The experimental design was completely randomized, with repeated observations in time. Data were analysed by ANOVA and Turkey's test with the SAS (Statistical Analysis System, version 9.2) software. Significance was considered at 5%.

Throughout the experiment the water temperature was 30.4±0.75 ºC; dissolved-oxygen was 5.5±1.26 mg/L with saturation of 71.5±14.0%; electric conductivity was 325.0±65 µS/cm; alkalinity was 134.2±52.5 mg/L; ammonia was present at 38.3±52.3 mg/L; and the pH was 7.6±0.2.

Results

At 60 days, six spawns were obtained from Group 1 (6 years old) and twelve from Group 2 (3 years old). For Group 3 (8 months old), twenty spawns were obtained in just one week. No significant difference was observed in the absolute fecundity between the different maternal ages groups (ANOVA, $P>0.05$). Relative fecundity was significantly greater in Group 3 (8 months old; ANOVA, $P<0.05$) and fertilization rates were significantly lower in Group 1 (6 years old; ANOVA, $P<0.05$). Young females also produced more eggs with a high percentage of spawns (Table 1).

Discussion

A positive correlation has often been reported between the increasing age of females and egg quality in fish (Brooks et al., 1997; Laine and Rajasilta, 1999; Berkeley et al., 2004). However, the difference in the intervals between spawning at distinct ages indicates that older fish have reduced reproductive activity and/or a greater inter-reproductive period. These results show a decrease in relative fecundity, egg production, and fertilization rates as age progresses.

Absolute fecundity often increases with the size and age of the fish (Bromage et al., 1992; Adamek et al., 2004). However, in this study the observed fecundity rates were similar for all age groups, even though younger fish had lower body weight than older fish. Tahoun et al. (2008) observed that the fecundity rate of 3-year-old tilapias were higher than those of 1-year-old females. A similar result was also obtained by Getinet (2008), who reported higher fecundity rates in older tilapias. This difference in results could be due to different handling managements, location, and feeding. Furthermore, these authors analyzed fish no older than 2 years, while the present study used fish of up to 6 years of age. Therefore, the effects of this age difference between studies on the obtained results cannot be ignored.

Relative fecundity was better for the young fish (Group 3; 8 months old); significantly greater in Group 3 (8 months old). These results are in agreement with those reported by Getinet (2008), indicating that young females have, proportionally to their weight, a greater capacity of egg production.

Fertilization rates were significantly lower in Group 1 (6 years old) as compared with the other groups (Table 1). Jerez et al. (2012) stated that age influence could be specific to each species, as great variation is reported in the literature. Similarly to the current study, Jerez et al. (2012) and Getinet et al. (2008) reported greater fertilization rates in young *Sparus aurata* and tilapia females, respectively. On the other hand, the opposite was observed in *Hippoglossus hippoglossus* (Evans et al., 1996) and *Ictalurus punctatus* (Quintero et al., 2011).

Table 1 - Standard length, absolute fecundity, relative fecundity (g of egg/g of female), and fertility rates of Nile tilapia (*Oreochromis niloticus*) females aged 6 years, 3 years and 8 months during 60 days of experiment

Evaluated parameter	Age			CV (%)
	6 years	3 years	8 months[1]	
Weight (g)	793.33±35.49b	993.80±34.88a	182.30±9.29c	14.50
Standard length (cm)	35.58±0.27a	37.04±0.33a	21.58±0.37b	4.90
Absolute fecundity (g)	902.70±220.75a	1174.60±114.79a	997.80±111.58a	45.84
Relative fecundity (g)	1.14±0.28b	1.12±0.13b	5.17±0.55a	55.97
Fertility rate (%)	89.43±4.38b	97.08±1.18a	98.40±0.69a	5.35
Number of spawns	6	12	20	-
Spawning females (%)	20.83%	50.00%	83.33%	-
Total number of eggs	5,416.16	14,094.78	19,9956.19	-

Different letters in columns indicate significant difference between observations by Turkey's test ($P<0.05$).
[1] Values obtained in one week.

Conclusions

Older tilapia females are less viable for egg production than the younger ones, which show better reproductive indices.

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