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Effect of Broodfish Sex Ratio on Seed Production of Red Tilapia in Suspended Hapa

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ABSTRACT

The purpose of the study was to investigate the effect of broodfish sex ratio on seed production of red tilapia, *Oreochromis* sp. using hapa nets suspended in an earthen pond. Sex ratios used in the experiment were 1:1 and 1:3 (male: female) with three replicates per treatment. Eight broodfish were placed in the hapa, each with a combination of either 4 male: 4 female or 2 male: 6 female to maintain the treatment sex ratios. Tilapia seeds (free swimming fry, sac-fry and eggs) were harvested every 21-day post-stocking. The broodfish were fed 3% of their body weight with a diet that contained 28% crude protein and 4% crude fat. Seed production of both sex ratio treatments were analyzed using the t-test. There were no significant differences ($p>0.05$) in seed production and female broodfish performance between the two sex ratios tested.

Key words: *Oreochromis* sp., sex ratio, hapa

INTRODUCTION

Red tilapia or *Oreochromis mossambicus/O. niloticus* hybrids is popularly cultured because it grows fast and command good market prices. In addition, red tilapia has an attractive color. Landau (1992) stated that after carps, tilapia is the most popular fish cultured in Africa, Europe, Pacific, Japan, China, Israel and the Caribbean. Its resemblance to the sea bream and red snapper makes the red tilapia popular among culturist (Fitzgerald, 1979; Liao and Chen, 1983; Fassler, 1984; Stickney, 1986).

Usually, tilapia is cultured in ponds, net cages (hapas) and concrete tanks (Bautista *et al*., 1988). Hapas are commonly used for breeding tilapia in the Philippines and Thailand (Little *et al*., 1997). Productions of fry and fingerlings in hapas have several advantages. They are design to allow the fish to be collected at one end so that the female can be removed with minimum disturbance to examine eggs or sac fry. Thus, the eggs can be harvested as frequently as every 5 to 10 days. Hapas are easy to construct for handling broodfish and harvesting eggs and fry. They are also cheaper and more flexible than tanks.

Low production of tilapia seeds could be attributed to very low density of broodfish, lack of spawning techniques, poor broodfish nutrition, high fry mortality and inappropriate sex ratio (Salama, 1996). Earlier studies (Mires, 1982; M'Hango and Brummett, 1998; Siddiqui and

Al-Harbi, 1997; Nour *et al.*, 2008; Khalfalla *et al.*, 2008) have indicated that choosing the appropriate sex ratio of broodfish could help to improve fry production, reduce wasting of resources and reduce cost of production.

Hence, the aim of the present work was to investigate the effect of different broodfish sex ratio on seed production of red tilapia reared in suspended hapas.

MATERIALS AND METHODS

Location and duration of study: Hapas for breeding studies were installed in a 1 ha experimental pond at the Aquaculture Research Station, Universiti Putra Malaysia, Puchong, Selangor. Collected seeds (eggs, sac-fry and swim up fry) were either placed in artificial incubators or in aquaria. The water temperature ranged from 27-30°C. The experiment was completed in three months.

Hapa installation: Hapa nets with a mesh size of 1.5 mm and surface area dimension of 2×1 m were prepared and suspended in the experimental pond to maintain a water depth of 0.6 m inside the hapa. Sex ratios of 1:1 and 1:3 male to female were tested in three replicates. Altogether, six hapas were utilized.

Experimental fish: Red tilapia broodfish were collected from Koperasi Serbaguna Batangkali Bhd. at Kampung Menyuruk, Ulu Selangor. Healthy broodfish varying in size from 250-350 g were selected. Larger-sized male broodfish were avoided to prevent injury to female broodfish during spawning.

Clove oil and ice were used to sedate the fish and minimize stress during transportation. Broodfish were quarantined in 5 ppm methylene blue bath for a week and were not fed for three days. The fish were then conditioned in 40 m^3 tanks with recirculated water and fed with a commercial tilapia diet at 3% body weight daily. In this study, 18 male and 30 female broodfish were used for spawning. Broodfish maturity and sex were determined before they were stocked in the breeding hapas.

Sex ratio: Sex ratios of broodfish used were 1:1 and 1:3 male to female. Eight broodfish were placed in each spawning hapa. Each hapa would consist of 4 male to 4 female of the 1:1 sex ratio and 2 male to 6 female of the 1:3 sex ratio.

Broodfish diet: Broodfish were fed with a commercial pelleted diet at 3% body weight daily. The fish pellets were sourced from CP-2 Bintang and contained 28% crude protein and 4% crude fat.

Collection of seeds: Swim-up fry first appeared after 14 days of pairing. The seeds (eggs, sac-fry and swim-up fry) were collected and counted every 21 days after stocking up to day 63. The complete set of seeds collected from each hapa was referred to as a clutch.

Water quality: Water quality parameters such as Dissolved Oxygen (DO), temperature, pH, ammonia (NH_3-N) and turbidity in the hapas were monitored weekly.

Statistical analysis: Seed production performance was analyzed using t-test in SPSS 17.0.1. statistical package.

RESULTS AND DISCUSSION

Effect of sex ratio on seed production: Table 1 shows the effect of broodstock sex ratios on seed production of red tilapia throughout the breeding period. The t-test analysis indicated that there was no significant difference ($p>0.05$) in seed production between the sex ratios in the 1st and 3rd clutches. However, in the 2nd clutch, seed production from 1:3 sex ratio was significantly higher ($p<0.05$) than the 1:1 sex ratio. Overall however, sex ratio of 1:3 male to female produced higher mean seed production than the sex ratio of 1:1 even though they were statistically indifferent.

Siddiqui and Al-Harbi (1997) studied four sex ratios of 1:2, 1:3, 1:4 and 1:5 male to female in hybrid tilapia reared in concrete tanks. They stated that there were no significant differences in seed production between all treatments. However, they found better performance of females stocked at lower sex ratios (1:2 and 1:3) than those stocked at higher 1:4 and 1:5 sex ratios. Similarly, Bautista *et al.* (1988) found that seed production in *O. niloticus* was not significantly different ($p>0.05$) using sex ratios of 1:4, 1:7 and 1:10 male to female.

Ridha and Cruz (1998) used male to female sex ratio of 1:3, 1:4 and 1:5 with water temperature and photoperiod under controlled conditions. Their result showed that seed production was not influenced by sex ratio. Nevertheless, M'Hango and Brummett (1998) found that fry production was significantly higher in 1:1 male to female (111 fry/ female) compared to 1:3 sex ratio (66 fry/ female) for *O. shiranus*. Khater (2002) reported that sex ratio of 1:3 male to female was better economically for fry production.

Some unfertilized eggs were observed in the 1st clutch of 1:1 sex ratio treatment. This could have been due to competition between males during spawning activity that caused some eggs to remain unfertilized. Grant *et al.* (1995) stated that higher male density led to increase aggression and male-male competition which could reduce the opportunity for female to spawn. This statement is supported by Mills and Reynolds (2003) who concluded that there was low competition between males and higher spawning frequency with females occurred when fewer males were encountered during spawning activity.

In the present study, for the 1:1 sex ratio, it was observed that seeds harvested in the 1st and 3rd clutches were mostly at the swim-up fry stage. The 2nd clutch, however, consisted mostly of eggs and sac-fry. In comparison, seeds harvest from the 1:3 sex ratio were mostly in the swim-up fry stage in the 1st and 2nd clutches while the 3rd clutch consisted mostly of eggs and sac-fry. The increase in spawning frequency of females in the 1:3 sex ratio could have contributed to the observation of more swim-up fry in the 1st and 2nd clutches.

Effect of sex ratio on female broodfish performance: Table 2 summarizes red tilapia broodfish performance. Mean total seed, seed female^{-1} day^{-1} and seed m^{-3} day^{-1} were not significantly different between the sex ratios used, even though the 1:3 male to female sex ratio recorded higher value compared to the 1:1 sex ratio. Similarly, Khalfalla *et al.* (2008) reported that seed output of

Table 1: Effect of broodfish sex ratio on seed production of red tilapia (Mean±SE)

Treatment/Sex ratio	Clutch 1 (days 21)	Clutch 2 (days 42)	Clutch 3 (days 63)	Mean seed production
1:1 (4M:4F)	485±303.22^{a}	801±45.76^{a}	210±73.22^{a}	499±124.75^{a}
1:3 (2M:6F)	676±436.00^{a}	1096±333.64^{b}	372±132.21^{a}	719±186.37^{a}

Means in the same column having the same superscript letter are not significantly different ($p<0.05$), as determined by t-test

Table 2: Red tilapia broodfish performance (Mean±SE)

Treatment	1:1 (4M:4F)	1:3 (2M:6F)
Mean total seed	499±124.75[a]	720±186.37[a]
Seed female^{-1} day^{-1}	6±1.67[a]	6±1.67[a]
Seed m^{-3} day^{-1}	12±4.06[a]	17±4.10[a]

Means in the same row having the same superscript letter are not significantly different ($p<0.05$), as determined by t-test

Table 3: Water quality ranges recorded in the broodfish hapa nets during the experimental period

Parameters	Value
pH	6.89-8.63
Dissolve oxygen (ppm)	3.47-4.67
Temperature (°C)	29.8-32.6
Ammonia (ppm)	0.03-0.04
Turbidity (cm)	32.8-40.2

blue tilapia broodfish using sex ratios of 1:1, 1:2 and 1:3 male to female were not significantly different among the ratios.

Water quality parameters in hapa: Result of water quality parameters measured in the suspended hapa throughout the experimental period is summarized in Table 3. The pH values ranged from 6.89 to 8.63. Water temperatures ranged between 29.8 to 32.6°C. Ammonia levels remained stable throughout the experiment and it ranged from 0.03 to 0.04 ppm. Secchi disk turbidity values ranged from 32.8 to 40.2 cm. Dissolved Oxygen (DO) reading, however, was quite low, ranging from 3.47 to 4.67 ppm. Under these conditions, broodfish were able to spawn naturally and were not stressed.

CONCLUSION

Seed production of red tilapia in hapas was not affected by the ratio of males to females, as tested in this study. Similarly, female broodfish performed equally well in hapas, using either the 1:1 or 1:3 male to female sex ratios.

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