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EFFECT OF STOCKING DENSITY, PROTEIN LEVEL AND FREQUENCY OF FEEDING ON SURVIVAL, GROWTH AND PRODUCTION OF TILAPIA MONOSEX IN PONDS

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SUMMARY

Survival, growth and production of tilapia monosex (mean wt. 20.0±5g) were evaluated when reared in twenty four earthen ponds (1500 m^2) provided with continuos water current with increasing exchange volume and night aeration at three different stocking densities (5, 10 and 15 fish / m^3) and fed with two levels of protein (25 or 32% CP) under two feeding frequencies (3 or 6 times/day). The experiment duration was 232 days.

The results indicated that the survival (%) was significantly (P>0.05) decreased with increasing density or protein level while it increased with increasing feeding frequency.

Growth performance (final body weight, total weight gain, average daily gain and specific growth rate %) were significantly (P>0.05) decreased with increasing stocking density while increased with increasing protein level and frequency of feeding.

Production (Ton/acre) increased significantly (P>0.05) with increasing stoking density, protein level and feeding frequency.

It was concluded that stocking density 5 fish/m^3, 32% CP level and 6 times of feeding frequency were the optimum treatments for production of tilapia monosex in ponds.

Keywords: Tilapia (monosex), stocking density, protein level, feeding frequency, survival %, growth performance, production

INTRODUCTION

Tilapia (*Oreochromis niloticus*) are widely cultured in the tropical and subtropical regions. (FAO, 1980). The choice of breeds for aquaculture is particularly important for tilapia since a number of genera, species, isolates and hybrids are potential candidates (Wolfarth and Hulate, 1983). Sex reversal in tilapia species to produce monosex is considered one of the successful methods for overcoming the problem of overpopulation caused by the uncontrolled reproduction in culture ponds. Also, hormonal sex reversal produce fast-growing all male population, so that the desired marketable size can be attained in a shorter time and obtain a more uniformed fish yield after growth in ponds. Numerous studies on the relation of stocking density, food, yield and growth of tilapia in ponds have been carried out (Hickling 1962; Van der Lingen 1967; Shell 1968). Zoneveld and Fadholi (1991) studied the effect of different stocking densities on (phenotypically *Oreochromis niloticus*) reared in ponds. Their results showed that growth performance and nutrients utilization were decreased by increasing the stocking density, however total production increased with increasing stocking density within certain limits.

For maximum growth of fish, an optimum protein content in feed is necessary. But the optimum level of dietary protein does not necessarily lead to the most economical production of fish due to the high cost of the protein component of the diet. Thus, in Egypt, fish diets contain 17% protein and this is considered the least requirement of tilapia. The optimum protein requirement for tilapia has been determined by several investigators and the results are not consistent. For instance, estimates of 30% (Wang *et al.*, 1985), 30-35% (Mazid *et al.*, 1979), 40% (Jauncey, 1982) and 32% (Shiau *et al.*, 1987) has been reported.

Tilapias, like many other cultured warm water fish species, benefit from multiple daily feeding meals. Kubaryk (1980) found that Nile tilapia grew faster when fed four times daily than when fed two times, but did not grew faster when fed eight times.

The present study aims at investigating the effect of protein level, stocking density and feeding frequency on survival, growth performance and production of tilapia mono sex reared in earthen ponds.

MATERIALS AND METHODS

The experiment was conducted in a randomized complete block design in twenty-four earthen ponds with an average area of 1500m^2.

The experiment consisted of three treatments, the first (three stocking densities: 5, 10, 15 fish/m^3) the second treatment (two levels of protein: 25 and 32% CP) and the third treatment (two frequencies of feeding 3 and 6 times/day). Two duplicates were made for each sub-treatment. The treatments were assigned to the experimental units completely at random. Twenty percent of water volume in all earthen ponds were partially replaced daily and each pond was continuously supplied all night with paddle wheel air.

Fish were weighed at the beginning of the experiment and every month then after during the experimental period (232 days).

Composition of the experimental diets containing 25 and 32% crude protein is shown in Table 1. Fish samples were taken at the beginning and at the end of the experiment. The fish flesh of the frozen samples were obtained and based through a meat grinder into one composite homogenate per group. Content of homogenized fish were analyzed for protein, lipid, moisture and ash according to the procedure of the AOAC (1984).

Table 1. Formulation and proximate chemical analysis of two diets containing different levels of dietary protein and energy

Items	Diets	
	A	B
Ingredient (%)		
Fish meal	10	10
Meat meal	10	20
Soybean meal	16	24
Wheat bran	20	20
Yellow corn meal	38	20
Corn oil	3	3
Vitamin and mineral premix*	2	2
Bone meal	1	1
Proximate analysis (%)**		
Dry matter	0	0
Crude protein	25.12	32.2
Crude fat	5.9	7.6
Ash	7.41	9.5
Crude fiber	5.40	4.21
NFE	56.17	46.49
Gross energy Kcal / kg	427.98	444.36

* Premix supplied the following vitamins and minerals (mg or IU) / kg of diet, vit. A, 8000 I.U., vit. D3, 4000 I.U., vit. E 50 I.U., vit. K3, 19 I. U., vit B2, 25 mg, vit. B3, 69 mg, Nicotinic acid, 125 mg, Thiamin, 10 mg, folic acid, 7 mg, Biotin, 7 mg, vit. B12, 75 mg, Cholin, 400 mg, vit. C, 200 mg, Manganese, 350 mg, Zinc, 325 mg, Iron, 30 mg, Iodne, 0.4 mg, Cobalt 2 mg, Copper, 7 mg, and Selenium, 0.7 mg.

** Values represent the mean of three sample replicates.

*** Protein = 5.65 Kcal / g, Fat = 9.45 Kcal / g and Carbohydrate = 4.1 Kcal / g according to (Brett, 1973).

During the 232 feeding trial, water quality parameters were: water temperature 27.4 $\pm$ 0.8C°, dissolved oxygen 7.6 $\pm$ 0.5 mg/L, total ammonia, 0.16 $\pm$ 0.14 mg/L, nitrite, 0.05 $\pm$ 0.03 mg/L, total alkalinity, 180 $\pm$ 28 mg/L, pH8.2 $\pm$ 0.16.

Mean of growth performance and feed utilization parameters were calculated as indicated by Zein-El Dain and Meyers (1973). Gross energy was calculated according to Brett (1973).

Data were analyzed by analysis of variance (ANOVA) using the SAS ANOVA procedure (statistical analysis system. 1988). Means were compared according to Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Final mean weight was inversely proportional to stocking density, which was particularly evident when average weight of fish held at the lowest and highest densities were compared. However, the

average weight of fish reared at the lowest stocking density was significantly different from weight of fish reared at the higher densities. In the present study, mean individual fish weights at harvest were significantly higher ($P<0.05$) for fish stocked at 5 fish m^{-2} (average 324.84) than those stocked at 10 or 15 fish m^{-2} (average 238.68 g and 228.29 g respectively), (Table 2). Similar results were obtained by Cruz and Ridh (1991) who showed that the final mean weight was heaviest at low density when tilapia hyprid reared at different densities. On the other hand the growth performance in terms of gain, average dialy gain (ADG) and specific growth rate (SGR%) were affected significantly by stocking density while no significant effect on protein level and feeding frequency on growth performance was detected (Table 2).

Table 2. Means of final weight, growth gain, average daily gain and specific growth rate of mono sex Tilapia reared in ponds

Main effect	Final weight (g)	Growth performance		
		Gain (g)	ADG (g/d)	SGR (%)
Stocking Density:				
5	324.84^{a}	304.84^{a}	1.34^{a}	1.21^{a}
10	238.73^{b}	218.73^{b}	0.94^{b}	1.07^{b}
15	228.29^{b}	208.29^{b}	0.89^{b}	1.05^{b}
Dietary protein:				
25	248.82^{b}	228.82^{b}	0.99^{b}	1.08^{a}
32	279.09^{a}	259.09^{a}	1.13^{a}	1.14^{a}
Feeding frequency:				
3	254.60^{b}	234.60^{a}	1.01^{a}	1.09^{a}
6	273.31^{a}	253.31^{a}	1.11^{a}	1.13^{a}

* Initial mean weight 20 ± 5 g.

^{a,b,c}: means with different supersctipts differ significantly ($P<0.05$)

The present study showed that the final weight, gain and average daily gain were significantly affected by increasing protein levels from 25% CP to 32% CP, while the 32% CP was the best for tilapia monosex reared in the pond. These results agreed with those found by Shaiu *et al.*, 1987 in hybrid tilapia. For instance, estimates of 30% (Wang *et al.*, 1985), 30-35% (Maized *et al.*, 1979) were reported. Kono and Nose (1971) showed that frequency of feeding is apparently related, among other parameters, to stomach size, since species with smaller stomachs require more frequent feeding for maximum growth. The feeding frequency in the present study showed that 6 times a day produced better growth than 3 times of day. Similar results were obtained by Kubryk (1980) who found that tilapia grew faster when fed four times daily than when fed two times, however, fish did not grow faster when fed eight times. There was a strong trend for both production and final harvests to increase with increasing stocking density. The results (Table 3) showed that the higher production was observed at 15 fish/ m^{-2} (average 10554.73 kg / feddan) than for fish stocked at 5 or 10 fish/ m^{-2} (average 5640.65 and 7785.37 kg / feddan respectively). These results agreed with those found by Cruze and Ridh (1991), when reared tilapia hybrid at different densities. Also, Bjonsson (1994) found that total production increased with increasing stocking density within certain limits due to the fixed carrying capacity of the ecosystem under certain conditions.

Table 3. Main effects on final production and survival of mono sex tilapia reared in ponds

Main effect	Production Kg/feddan	Survival rate %
Stocking density		
5	5640.65^{c}	82.71^{a}
10	7785.37^{b}	79.29^{b}
15	10554.37^{a}	72.62^{c}
Dietary protein		
25	7794.22^{b}	81.79^{a}
32	8192.95^{a}	74.62^{b}
Frequency of feeding		
3	7083.08^{b}	72.96^{a}
6	9154.09^{a}	83.45^{b}

^{a,b,c}: Means with different supersctipts differ significantly ($P<0.05$)

On the other hand, effect of different protein levels on production was observed since total production was significantly increased by increasing protein levels. Also, the effect of different frequency of feeding differed significantly. Survival rates were related to stocking density as might be expected. The results of the present study showed that survival was significantly affected by stocking density (average 82.71, 79.29 and 72.92% for 5, 10 and 15 fish m^{-3}, respectively).

Daungswasdi *et al.* (1986) reported that the survival rate of Nile tilapia raised in cage was not dependent upon stocking density. However, Haylor (1991) found that survival rate in African cat fish fry were directly related to stocking density.

On the other hand, protein levels and feeding frequency affected significantly survival, while increasing protein level or feeding frequency (32% CP or 6 time/day) were better than the low protein level or feeding frequency. (25% and 3 time/day).

In conclusion the present study showed that the 5 fish m^{-3} and 32% CP and 6 time / day feeding frequency were better for tilapia monosex reared in ponds under the present experimental conditions.

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