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# STUDIES ON OVER- WINTERING OF NILE TILAPIA (*Oreochromis niloticus*) FRY

BY

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## ABSTRACT

Mono and Mixed sex Nile tilapia, *Oreochromis niloticus* fry with an average weight of 1g. were evaluated for winter growth performance and survival rate in outdoor earthen and concrete ponds under Egyptian winter condition . Eight earthen ponds were used, each surrounded with siag of dried plants to protect them from the cold wind, and also eight concrete ponds which covered with polyethylene sheet where 25 % of the surface area were left uncovered to allow aeration.

Experimental period started at 15, September 2003 and lasted at 15, April 2004 . The fish were fed on pelted commercial feed containing 25% crude protein. Two culture methods (earthen ponds and concrete tanks) within each tilapia mono sex or mixed sex were tested using two different feeding regimes 5 to 1 % or 10 to 2 % of total biomass according to water temperature . Our results can be summaries as follows.

1- Maximum increase in body weight recorded for mixed sex fish in concrete pond (feeding rate10- 2 % of total fish biomass) and the minimum for mono sex fish in earthen pond (feeding rate 5- 1% of total fish biomass).
2- The highest survival rate and growth performance were recorded at feeding rate 10- 2% of body weight in concrete ponds with mixed sex tilapia, followed by group of mixed sex fish fed at feeding rate 10- 2% in earthen pond, group of mono sex fish fed at feeding rate 5- 1% in concrete pond and group of mono sex fish fed at feeding rate 5-1% in earthen pond, respectively.
3- Mono sex Nile tilapia produced with hormone treatment (17 α methyl testosterone)had low SGR records under Egyptian winter condition .

In conclusion, on the light of the present knowledge it could be maintain mono, mixed sex tilapia fry in outdoor concrete ponds which covered with polyethylene sheet (covered 75% only of the surface and completely cover the sides of the concrete ponds) at stocking rate 50 fry/m$^3$ and feeding rate 10- 2% of body weight daily by adjusting over-wintering feeding in Egypt.

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**Key words**: Winter, Nile tilapia, mono sex, mixed sex, growth, survival rate, earthen ponds, concrete ponds.

## INTRODUCTION

Reducing survival rates of Nile tilapia *O.niloticus* in winter season in Egypt are being increasing recognized as significant constraint to aquaculture production and are affecting the economic development of fish farm sector .Over wintering of Nile tilapia are now considered to be the most limiting factor in aquaculture specially with intensification (Abd- EL. Ghany 1996).

There are different approach to compact or control winter temperature in aquaculture one of them is through the use of supplementary feeding with special feeding regime and pond cover to reduce fish susceptibility to winter temperature (Nour 1996 and Diab *et al.* 2004)

The aim of this work is to evaluate the use feeding regime for mono and mixed sex of Nile tilapia in earthen and concrete ponds in order improve its growth performance, body chemical composition and to increase survival rate of the reared fry under Egyptian winter condition.

## MATERIALS AND METHODS

This study was carried out in eight earthen ponds (50 x 42 m) in diameters with the water depth of 1m and eight concrete ponds (2.5 x 25 m)in diameters which represented two culture methods (earthen ponds and concrete tanks)within each tilapia mono sex or mixed sex were tested using two different feeding regimes 5 to 1 % or 10 to 2 % of total biomass according to water temperature . Each treatment was represented in replicates . The experimental plan was as follows:

| Culture systems | Earthen ponds (EP) | | | | Concrete ponds (CP) | | | |
|---|---|---|---|---|---|---|---|---|
| Feeding regime | 5 to 1 % ($FR_1$) | | 10 to 2 % ($FR_2$) | | 5 to 1 % ($FR_1$) | | 10 to 2 % ($FR_2$) | |
| Sex | mono sex ($S_1$) | mixed sex ($S_2$) | mono sex ($S_1$) | mixed sex ($S_2$) | mono sex ($S_1$) | mixed sex ($S_2$) | mono sex ($S_1$) | mixed sex ($S_2$) |
| Treatment | EP x $FR_1$x $S_1$ | EP x $FR_1$x $S_2$ | EP x $FR_2$x $S_1$ | EP x $FR_2$x $S_2$ | CP x $FR_1$x $S_1$ | CP x $FR_1$x $S_2$ | CP x $FR_2$x $S_1$ | CP x $FR_2$x $S_2$ |

Nile tilapia *Oreochromis niloticus* fry were obtained from abbassa hatchery belonging to Arab Fisheries Company.

The experimental fish (1g . initial weight) were stocked in both rearing system at a density of 50 fry $m^3$ . Fish were feed on a sinking pelleted diet containing 25% crud protein of 6mm. The experimental study expanded 7 month during the period from 15 September 2003 to 15 April 2004 .

**Adjusting over-wintering of feeding as follows:**

1- In the first and second month feeding regime used was 5-10% for 6 days weekly. Experimental diets were offered at three equal parts daily at 9 a.m.; 1 p.m. and 4 p.m.
2- In the third month feeding regimes used were 2.5 – 5% for 6 days weekly. Experimental diets were offered at two equal parts daily at 9 a.m. and 1 p.m.
3- The last period was without any feeding regime except during the sun days we used feeding regime 1- 2% daily. Experimental diets were offered one times daily at 11 a.m.

The water level was maintained at approximately 1m in both of earthen and concrete ponds and loss of water due to drainage and evaporation was replaced whenever necessary.

Every four weeks throughout the experimental period fish sample of 150 fish every treatment were weighed to the nearest 0.1 g. and measured to the nearest 1 mm. for length. Food amount for the next month was determine according to the last weight.

Total gain was calculated according to Innes (1982) . Specific growth rate S.G.R was calculated according to the following equation (SGR) = Ln final weight – Ln initial weight X 100/period in days. Diets and whole body fish samples were analyzed according to methods of AOAC (1990). Tilapia mortalities were calculated as% of the initial fish number .

Water temperature dissolved oxygen and pH were measured daily at 6 a.m. and12 p.m using thermometer and dissolved oxygen was measure using oxygen meter (YSI model 57) water pH was determined using pH meter (model corning 345). Determinations of water quality parameters (phosphorus and ammonia were carried out every two weeks according to the methods of Boyd (1990).

At the experimental end, fish body were chemically analyzed for their proximate analysis. Six fish were taken randomly from each treatment for chemical analysis of the whole fish body according to the methods of A.O.A.C(1990). Also proximate analysis of the diet was performed according to A.O.A.C (1990) .

The data were analyzed for analysis of variance by using (SAS program, 1989) Duncan's multiple range test (Duncan, 1955) was used to test the significance of mean among treatments.

## RESULTS AND DISCUSSION

**Physico characteristics of experimental ponds water**

Averages water quality parameters of earthen ponds as affected by treatments are presented in Tables (2 & 3). Results revealed that Transparency (Siecki disk reading in cm) had ranged between 17.6 cm (EP x $FR_2$ x $S_1$) and 20 cm. (EP x $FR_1$ x $S_1$). These values are beneficial to tilapia fish cultivation. In this connection, El-Gendy (1998) and Abdel – Hakim and Moustafa (2000) reported that temperature degree influence Siecki disk reading.

Table (1): Composition and proximate chemical analysis of experimental diet

| Ingredients | (25% C.P) |
|---|---|
| Yellow corn | 40.4 |
| Fish meal (73.% C.P) | 25.0 |
| Rice | 25.6 |
| Fat | 4.0 |
| Vitamin premix* | 1 |
| Mineral mixture** | 1 |
| Cellulose | 2 |
| Carboxmethyl cellulose | 1 |
| Total | 100 |
| **Calculated diet compositions fed** | |
| Protein % | 25 |
| Gross energy K cal/100g*** | 299.0 |
| **Analyzed % on dry matter basis** | |
| Crude protein (C.P) | 24.6 |
| Ether extract (E.E) | 11.80 |
| Crude fibers % | 4.50 |
| Nitrogen free extract (NFE) | 55.5 |
| Ash% | 3.20 |

* Each gram of vitamin premix contains 20.00 iu vit A 200 iu vit.,De, 400 vit E, 20 mg Niacin 4.5 mg riboflavin, 3 mg pyridoxine, 0.013 mg vit B12, 100 mg chorine chloride and 2 mg vit. K.

** Each gram contains 0.83 Ca, 0.63 P. 078Na. 0.018 Mn, 0.011 Zn. And 0,001 CU. The Mixture was prepared by mixing 35 parts of dicalcium phosphate, 3 parts of mineral premix and 2 part of common salt

*** According to Jobling (1983)

Turbidity is one of the physical properties that are greatly affected by fish used it has been determined in FTU and ranged between 126.25 ($EP_x FR_1 {}_x S_1$) and 123.5 ($EPxFR_1xS_2$), which show a similar trend. The same trend was observed in water temperature, where the averages ranged between 14.62°C and 19.84°C (Tables 2 & 3) The higher different values of water temperature in earthen ponds in all treatments may attribute to the increase in organic matter contents of these ponds because of higher feeding rate that may lead to temperature increases. These results are in agreement with results of Mahmoud (1997) and Abdel – Hakim *et al.* (2000) who reported a slight increase in water temperature with increasing feeding level. Transparency, turbidity and temperature values are in the range recommended for the tilapia fish culture in all treatments.

Averages water quality parameters of concrete ponds as affected by treatments are presented in Tables (4 & 5). Results revealed that transparency (Siecki desk reading in cm) had ranged between 21 cm ($CPx FR_2 xS_1$) and 24.9 cm ($CPxFR_1x1S_1$) .These values are beneficial to tilapia fish cultivation. These results are in agreement with results of Abdel – Hakim and Moustafa (2000) and Abdel – Hakim *et al* (2004) who worked with Nile tilapia reared in concrete tanks and came to similar results

**Table (2) Averages water quality parameters of earthen ponds experiment (Treatments 1, 2 )**

| Treatments | Months | Day | Water depth cm | Siecki disk cm | Turbidity FTU | PH | | DO mg/L | | $P_2O_5$ mg/L | $NH_3$ mg/L | Temperature | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | $6^{00}$ | $12^{00}$ | $6^{00}$ | $12^{00}$ | | | $6^{00}$ | $12^{00}$ |
| $T_1$ ($EPx\ FR_1xS_1$) | 15 Sep. | - | | 23 | 135 | 8.5 | 8.9 | 7.1 | 8.3 | 1.4 | 0.13 | 18 | 25 |
| | 15 Oct. | 30 | | 23 | 135 | 8.9 | 9.1 | 7.2 | 8.3 | 1.3 | 0.13 | 17 | 24 |
| | 15 Nov. | 60 | | 18 | 120 | 8.5 | 8.8 | 7.3 | 8.6 | 1.3 | 0.20 | 16 | 23 |
| | 15 Dec. | 90 | | 16 | 120 | 9.0 | 8.5 | 7.0 | 7.8 | 1.3 | 0.20 | 12 | 20 |
| | 15 Jan. | 120 | | 16 | 122 | 9.0 | 9.2 | 7.0 | 7.5 | 1.2 | 0.19 | 10 | 16 |
| | 15 Feb. | 150 | | 18 | 118 | 8.9 | 9.0 | 7.5 | 5.6 | 1.3 | 0.13 | 10 | 16 |
| | 15 Mar. | 180 | | 23 | 125 | 8.9 | 8.5 | 7.0 | 7.9 | 1.2 | 0.12 | 12 | 26 |
| | 15 Apr. | 210 | | 23 | 135 | 9.0 | 9.1 | 6.0 | 7.2 | 1.2 | 0.18 | 23 | 28 |
| **Average** | | | **100** | **20** | **126.25** | **8.86** | | **7.5** | | **1.28** | **0.16** | **17.8** | |
| ($T_2$) ($EPx\ FR_1xS_2$) | 15 Sep. | - | | 22 | 112 | 8.7 | 9.1 | 8.4 | 9.0 | 1.3 | 0.12 | 19 | 26 |
| | 15 Oct. | 30 | | 22 | 113 | 9.1 | 9.3 | 7.6 | 8.7 | 1.4 | 0.13 | 19 | 25 |
| | 15 Nov. | 60 | | 19 | 125 | 8.7 | 9.0 | 7.7 | 9.0 | 1.3 | 0.13 | 19 | 25 |
| | 15 Dec. | 90 | | 12 | 130 | 9.2 | 8.7 | 7.4 | 8.2 | 1.2 | 0.18 | 16 | 25 |
| | 15 Jan. | 120 | | 15 | 120 | 9.2 | 9.4 | 7.4 | 8.9 | 1.2 | 0.21 | 11 | 15 |
| | 15 Feb. | 150 | | 15 | 120 | 9.1 | 9.2 | 6.9 | 8.9 | 1.2 | 0.21 | 11 | 16 |
| | 15 Mar. | 180 | | 22 | 133 | 9.1 | 8.7 | 7.4 | 7.3 | 1.2 | 0.19 | 13 | 24 |
| | 15 Apr. | 210 | | 22 | 135 | 9.2 | 9.3 | 6.5 | 7.4 | 1.3 | 0.19 | 24 | 26 |
| **Average** | | | **100** | **18.62** | **123.5** | **9.5** | | **7.96** | | **1.26** | **0.17** | **19.8** | |

**Table ( 3 ) Averages water quality parameters of earthen ponds experiment (Treatments 3, 4 ):**

| Treatments | Months | Day | Water depth cm | Siecki disk cm | Turbidity FTU | PH | | DO mg/L | | $P_2O_5$ mg/L | $NH_3$ mg/L | Temperature | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | $6^{00}$ | $12^{00}$ | $6^{00}$ | $12^{00}$ | | | $6^{00}$ | $12^{00}$ |
| $T_3$ (EPX $FR_2xS_1$) | 15 Sep. | - | | 22 | 130 | 8.3 | 8.8 | 6.8 | 7.0 | 1.4 | 0.13 | 18 | 25 |
| | 15 Oct. | 30 | | 22 | 135 | 8.7 | 8.9 | 6.3 | 6.7 | 1.3 | 0.12 | 18 | 24 |
| | 15 Nov. | 60 | | 21 | 120 | 8.4 | 8.9 | 6.4 | 6.8 | 1.4 | 0.13 | 18 | 25 |
| | 15 Dec. | 90 | | 22 | 130 | 9.1 | 8.8 | 6.2 | 6.5 | 1.1 | 0.13 | 16 | 23 |
| | 15 Jan. | 120 | | 14 | 112 | 9.0 | 9.3 | 6.0 | 6.7 | 1.4 | 0.13 | 10 | 15 |
| | 15 Feb. | 150 | | 12 | 113 | 8.5 | 8.8 | 5.8 | 7.0 | 1.4 | 0.12 | 10 | 14 |
| | 15 Mar. | 180 | | 17 | 125 | 8.7 | 8.7 | 6.0 | 6.8 | 1.2 | 0.12 | 11 | 22 |
| | 15 Apr. | 210 | | 17 | 135 | 9.0 | 9.8 | 5.4 | 6.1 | 1.2 | 0.12 | 24 | 28 |
| **Average** | | | **100** | **19** | **125** | **8.5** | | **6.4** | | **1.3** | **0.125** | **18.8** | |
| $T_4$ (EPx $FR_2xS_2$) | 15 Sep. | - | | 21 | 135 | 8.6 | 8.8 | 6.2 | 7.0 | 1.4 | 0.11 | 22 | 25 |
| | 15 Oct. | 30 | | 21 | 133 | 8.9 | 9.0 | 6.5 | 7.0 | 1.4 | 0.11 | 22 | 25 |
| | 15 Nov. | 60 | | 18 | 125 | 8.5 | 8.7 | 6.5 | 6.8 | 1.3 | 0.12 | 18 | 24 |
| | 15 Dec. | 90 | | 11 | 125 | 9.0 | 9.2 | 6.0 | 6.5 | 1.2 | 0.12 | 20 | 24 |
| | 15 Jan. | 120 | | 14 | 120 | 9.0 | 9.2 | 6.0 | 6.5 | 1.3 | 0.12 | 10 | 17 |
| | 15 Feb. | 150 | | 14 | 120 | 8.4 | 8.7 | 5.7 | 6.3 | 1.3 | 0.11 | 10 | 16 |
| | 15 Mar. | 180 | | 21 | 123 | 8.8 | 8.9 | 5.0 | 5.5 | 1.1 | 0.18 | 22 | 26 |
| | 15 Apr. | 210 | | 21 | 135 | 8.5 | 9.0 | 6.1 | 6.6 | 1.2 | 0.11 | 24 | 26 |
| **Average** | | | **100** | **17.62** | **126.38** | **8.92** | | **6.26** | | **1.28** | **0.122** | **14.62** | |

Turbidity has been determined in FTU had ranged between 123.5 (CPx $FR_1$x $S_1$) and 126.3 (CPx $FR_2$ x $S_2$). The averages of water temperature were found to be 21.25°C and 22.13°C (Tables 4-5) these values are higher than that recorded in earthen ponds and indicate that water temperate showed a slightly increased in concrete ponds compared to earthen ponds.

**Chemical characteristics of water**

Averages of pH values of earthen ponds for treatments (EPx $FR_1$ x $S_1$) (EPx $FR_1$ x $S_2$), (EP x $FR_2$ x $S_1$) and(EP x $FR_2$ x $S_2$) were 8.86, 9.5, 8.5 and 8.9, respectively (Tables 2 & 3). The lower value of pH in ponds received higher feeding rate in all treatments may be attributed to the increase in organic matter contents of these ponds that may lead to pH decrease.

Averages of dissolved oxygen values (DO) ranged between 6.2 to 7.9 mg/L (Tables 2 & 3). These values are beneficial to tilapia fish cultivation and indicate that water dissolved oxygen slightly decreased in earthen ponds received higher feeding rate compared to the other ponds. This may attribute to the increase in organic matter contents of these ponds which may lead to DO decrease.

Averages of phosphorus had ranged between 1.2 and 1.3 mg/L., which represent the normal range of phosphorus in fish ponds. In this connection, Soltan *et al* (1999) and Abdel –Hakim *et al* (2000) showed that total phosphorus in the soil contributed only by about 0.8% of that in water.

Also the same tables show that averages of ammonia were 0.12 and 0.17 mg/L. These values had no effect on tilapia culture. Averages of water quality parameters of concrete ponds as affected by treatments are presented in Tables (4 & 5).Results revealed that PH values of concrete ponds for treatments (EPx $ER_1$x $S_1$); (EPx $FR_1$x $S_2$); (EPx $FR_2$ x $S_1$) and (EPx $FR_2$x $S_2$) were 8.75; 9.4; 8.6 and 8.6 respectively . The lower value of pH was defected in ponds received higher feeding rate in all treatments.

Averages of dissolved oxygen (DO) had ranged between 5.2 and 6.7 mg /L, which represent the normal rang for tilapia fish cultivation and indicate that water dissolved oxygen slightly decreased in earthen ponds received higher feeding rate. Values of dissolved oxygen (DO) in concrete ponds were lower than the other ponds which may attribute to increased aeration by wind in the large surface in the earthen ponds as compared with the concrete ponds.

Averages of phosphorus had ranged between 1.2 and 1.4 mg/L, which represent the normal range of phosphorus in fish ponds (Tables 4 & 5). Results of the same Table show also that Ammonia level recorded small variation. These results indicated that over wintering system of Nile tilapia had no effect on ammonia that averages between 0.14 and 0.19 mg/L, which seemed to have no effect on tilapia cultivation.

**Table (4) Averages water quality parameters of concrete ponds experiment (Treatments 1, 2):**

| Treatments | Months | Day | Water depth cm | Siecki disk cm | Turbidity FTU | PH | | DO mg/L | | $P_2O_5$ mg/L | $NH_3$ mg/L | Temperature | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | $6^{00}$ | $12^{00}$ | $6^{00}$ | $12^{00}$ | | | $6^{00}$ | $12^{00}$ |
| | 15 Sep. | - | | 28 | 128 | 8.5 | 8.8 | 6.2 | 6.6 | 1.3 | 0.12 | 24 | 25 |
| | 15 Oct. | 30 | | 28 | 130 | 8.6 | 8.7 | 6.5 | 6.5 | 1.3 | 0.12 | 23 | 25 |
| | 15 Nov. | 60 | | 25 | 125 | 8.3 | 8.5 | 6.5 | 6.8 | 1.1 | 0.20 | 20 | 24 |
| T1 | 15 Dec. | 90 | | 20 | 113 | 8.5 | 8.9 | 6.2 | 6.8 | 1.0 | 0.20 | 18 | 24 |
| (CPx $FR_1xS_1$) | 15 Jan. | 120 | | 21 | 110 | 9.0 | 9.1 | 6.3 | 6.7 | 1.3 | 0.20 | 12 | 16 |
| | 15 Feb. | 150 | | 21 | 110 | 8.8 | 9.0 | 6.7 | 6.8 | 1.4 | 0.20 | 13 | 16 |
| | 15 Mar. | 180 | | 28 | 110 | 8.5 | 9.0 | 6.2 | 6.7 | 1.2 | 0.18 | 20 | 25 |
| | 15 Apr. | 210 | | 28 | 110 | 8.9 | 9.0 | 5.3 | 6.4 | 1.3 | 0.15 | 25 | 30 |
| **Average** | | | **100** | **24.9** | **122** | **8.75** | | **6.4** | | **1.42** | **0.17** | **21.25** | |
| | 15 Sep. | - | | 26 | 130 | 8.3 | 8.9 | 7.0 | 8.1 | 1.2 | 0.21 | 24 | 26 |
| | 15 Oct. | 30 | | 26 | 130 | 8.4 | 8.6 | 6.7 | 7.5 | 1.3 | 0.21 | 24 | 26 |
| | 15 Nov. | 60 | | 24 | 120 | 8.0 | 8.4 | 6.7 | 7.3 | 1.1 | 0.20 | 22 | 26 |
| T2 | 15 Dec. | 90 | | 23 | 120 | 8.2 | 8.7 | 6.0 | 6.9 | 1.2 | 0.18 | 20 | 25 |
| (CPx $FR_1xS_2$) | 15 Jan. | 120 | | 19 | 113 | 8.7 | 9.0 | 6.2 | 6.8 | 1.2 | 0.20 | 13 | 15 |
| | 15 Feb. | 150 | | 21 | 113 | 8.5 | 9.0 | 6.2 | 6.8 | 1.3 | 0.20 | 13 | 16 |
| | 15 Mar. | 180 | | 29 | 135 | 8.0 | 8.4 | 6.2 | 7.0 | 1.1 | 0.18 | 22 | 29 |
| | 15 Apr. | 210 | | 29 | 130 | 8.5 | 8.9 | 5.5 | 6.8 | 1.3 | 0.18 | 25 | 28 |
| **Average** | | | **100** | **24.6** | **123.88** | **9.4** | | **6.7** | | **1.2** | **0.19** | **22.13** | |

**Table ( 5 ) Averages water quality parameters of concrete ponds experiment (Treatments 3 , 4 ):**

| Treatments | Months | Day | Water depth cm | Siecki disk cm | Turbidity FTU | PH | | DO mg/L | | $P_2O_5$ mg/L | $NH_3$ mg/L | Temperature | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | $6^{00}$ | $12^{00}$ | $6^{00}$ | $12^{00}$ | | | $6^{00}$ | $12^{00}$ |
| T3 ($CPx\ FR_2xS_1$) | 15 Sep. | - | | 23 | 130 | 8.3 | 8.6 | 5.0 | 6.0 | 1.3 | 0.16 | 25 | 28 |
| | 15 Oct. | 30 | | 26 | 130 | 8.7 | 8.0 | 5.7 | 6.0 | 1.3 | 0.17 | 24 | 26 |
| | 15 Nov. | 60 | | 25 | 130 | 8.3 | 8.6 | 5.5 | 6.0 | 1.2 | 0.12 | 22 | 25 |
| | 15 Dec. | 90 | | 16 | 113 | 8.8 | 8.3 | 5.8 | 6.3 | 1.1 | 0.12 | 20 | 24 |
| | 15 Jan. | 120 | | 18 | 113 | 8.8 | 4.0 | 5.5 | 6.0 | 1.2 | 0.18 | 13 | 15 |
| | 15 Feb. | 150 | | 16 | 115 | 8.7 | 8.8 | 5.0 | 6.0 | 1.3 | 0.15 | 13 | 16 |
| | 15 Mar. | 180 | | 21 | 130 | 8.8 | 8.3 | 5.5 | 6.0 | 1.3 | 0.12 | 22 | 25 |
| | 15 Apr. | 210 | | 23 | 135 | 8.8 | 8.9 | 5.0 | 6.0 | 1.2 | 0.15 | 24 | 28 |
| **Average** | | | **100** | **21** | **124.5** | **8.6** | | **5.7** | | **1.24** | **0.15** | **21.9** | |
| T4 ($CPx\ FR_2xS_2$) | 15 Sep. | - | | 25 | 135 | 8.5 | 8.7 | 5.3 | 5.8 | 1.3 | 0.18 | 25 | 28 |
| | 15Oct. | 30 | | 25 | 132 | 8.5 | 8.9 | 5.9 | 6.0 | 1.3 | .16 | 25 | 28 |
| | 15 Nov. | 60 | | 20 | 128 | 8.4 | 8.8 | 5.3 | 5.5 | 1.1 | 0.15 | 21 | 24 |
| | 15 Dec. | 90 | | 15 | 115 | 8.5 | 8.5 | 5.5 | 5.7 | 1.0 | 0.12 | 20 | 24 |
| | 15 Jan. | 120 | | 18 | 118 | 8.5 | 8.7 | 5.7 | 5.9 | 1.2 | 0.16 | 13 | 16 |
| | 15 Feb. | 150 | | 20 | 120 | 8.9 | 8.5 | 5.4 | 6.0 | 1.4 | 0.12 | 13 | 16 |
| | 15 Mar. | 180 | | 24 | 130 | 8.5 | 8.7 | 5.6 | 6.0 | 1.2 | 0.15 | 20 | 24 |
| | 15 Apr. | 210 | | 25 | 130 | 8.5 | 8.7 | 5.2 | 5.5 | 1.3 | 0.15 | 21 | 25 |
| **Average** | | | **100** | **21.5** | **126** | **8.6** | | **5.28** | | **1.23** | **0.149** | **21.6** | |

In general all water quality parameters for treatments in the present study were within the permissible levels for normal fish growth and development.

**Body weight and length:**

Results presented in Table (6) show the effect of treatments on body weights of tilapia. At the start of the experiment averages of initial body weight of tilapia fish had ranged 1.01- 1.03g. and differences among the treatment groups were insignificant indicating that the distribution of the fish into the experimental groups was random. At the end of the experimental period final body weights of tilapia were found to be 25.12; 34.92; 45.32; 54.70; 34.80; 44.83; 54.87 and 65.02 g. for treatments ($EPxFR_1xS_1$); ($EPxFR_1xS_2$); ($EPxFR_2xS_1$); ($EPxFR_2xS_2$); (CP x $FR_1xS_1$); ($CPxFR_1xS_2$); ($CPxFR_2xS_1$), and ($CPxFR_2xS_2$), respectively. The statistical evaluation of results show that averages body weights increased in a significant linear manner with increased in the feeding rate from 5-1% to 10-2% and also concrete ponds (CP) with mixed sex (S2) recorded the higher averages of Body weights compared with the other treatments .These results indicate that the feeding rate required of growing Nile tilapia in experimental period started by 10 and ended by 2% of total fish biomass by adjusting over-winter feeding.

**Table (6): Least square means and standard error for the effect of treatments on body weight and body length of tilapia fish during winter months.**

| Items | No | Body Weight (g) | | Body length (cm) | |
|---|---|---|---|---|---|
| | | initial | final | initial | final |
| **Ponds** | | | | | |
| Earthen ponds(EP) | 400 | 1.03±0.01 | 39.94±0.24b | 1.00±0.01 | 9.75±0.02 b |
| Concrete ponds (CP) | 400 | 1.03±0.01 | 50.12±0.24 a | 1.00±0.01 | 11.43±0.02 a |
| **Feeding rate** | | | | | |
| 5-1% of body weight (FR1) | 400 | 1.02±0.01 | 34.85±0.24 b | 1.00±0.01 | 9.87±0.02 b |
| 10-2% of body weight (FR2) | 400 | 1.02±0.01 | 50.12±0.24 a | 1.00±0.01 | 11.30±0.02 a |
| **Sex** | | | | | |
| Mono sex (S1) | 400 | 1.03±0.01 | 40.11±0.24 b | 1.00±0.01 | 10.24±0.02 b |
| Mixes sex (S2) | 400 | 1.02±0.01 | 49.95±0.24 a | 0.99±0.01 | 10.94±0.02 a |
| **Treatments** | | | | | |
| EP × FR1 × S1 | 100 | 1.02±0.01 | 25.12±0.84 e | 1.00±0.07 | 8.52±0.22 g |
| EP × FR1 × S2 | 100 | 1.02±0.01 | 34.92±0.84 d | 1.00±0.07 | 9.19±0.22 f |
| EP × FR2 × S1 | 100 | 1.01±0.01 | 45.32±0.84 c | 1.01±0.07 | 10.10±0.22 e |
| EP × FR2 × S2 | 100 | 1.02±0.01 | 54.70±0.84 b | 0.99±0.07 | 11.21±0.22 c |
| CP × FR1 × S1 | 100 | 1.02±0.01 | 34.80±0.84d | 1.01±0.07 | 11.16±0.22 d |
| CP × FR1 × S2 | 100 | 1.02±0.01 | 44.83±084 c | 1.00±0.07 | 11.16±0.22 c |
| CP × FR2 × S1 | 100 | 1.01±0.01 | 54.87±0.84b | 1.00±0.07 | 11.67±0.22 b |
| CP × FR2 × S2 | 100 | 1.01±0.01 | 65.02±0.84a | 1.00±0.07 | 12.18±0.22 a |

Means with different letters in each column are significantly different (P<0.05)

Results presented in Table (6) are in a complete accordance with the results obtained by EL- Sagheer (2001) who cultured mono sex Nile tilapia intensively in earthen ponds. Also Nour *et al.* (1996) studied the effect of over wintering on feed utilization in concrete ponds. They found that supplementary feeding and pond cover increased feed and nutrient (protein and energy) utilization in winter.

At the experimental start differences in body length among treatments were insignificant .As present in the same table tilapia averages of final body length for treatment ($EPxFR_1XS_1$); ($EPxFR_1xS_2$); ($EPxFR_2XS_1$); ($EPxFR_2XS_2$); ($CPxFR_1XS_1$); ($CPxFR_1XS_2$); ($CPxFR_2XS_1$),and ($CPxFR_2XS_2$),were found to be 8.52; 9.19; 10.10; 11.21; 10.66; 11.16; 11.67 and 12.18 cm. respectively, and the statistical evaluation of results revealed that tilapia final length increased significantly ($P<0.05$) with increase feeding rate, concrete ponds with mixed sex recorded increase in final length compared with other treatments.

These results confirm those reported by Abd-EL. Ghany (1996); Ojaveer *et al.* (1996); Nour *et al.* (1996), Abdel –Hakim and moustafa. (2000) and Diab *et al* (2002 and 2004).

**Growth performance:-**

Results of SGR as affected by treatments are illustrated in Table (7). As shown in this table, SGR values increased from 1.73 to 1.84 for the ponds (EP) and (CP), respectively, and from 1.67 to 1.90 for increasing feeding rate from ($FR_1$) to ($FR_2$), respectively, and also increased from 1.73 to 1.84 for the sex from (S1) to (S2), respectively, indicating that fish fed on high feeding rate showed the higher SGR records compared with those on low feeding rate. Also, using mixed sex tilapia and cultivation in covered concrete ponds showed highest SGR. Mono sex Nile tilapia produced with hormone treatment (17α methyl testosterone) had low SGR records in the winter in Egypt compared with the mixed sex. Similar results were reported by El-Nemaki (1995) who studies the sensitivity of tilapia fish to temperature and salinity. Results of Al Azab (2001) found that SGR for Nile tilapia fed at a feeding rate of 4% of total biomass were 1.10, 1.02 and 0.95 for stocking density 50, 100 and 150 fish/$m^3$ respectively. Also. Abd EL-Ghany (1995) demonstrated that, incorporation of MT (17α methyl testosterone) into diets of Nile tilapia fingerlings following hormone withdrawal offers no potential for improving either growth or food utilization efficiency compared with the control (0 MT/kg diet). The values of growths and nutritional parameters of the control group were better than those of MT-treated fish.

In Table (7) the high values of weigh gain found to be in ($CPxFR_2xS_2$) being 64.01 g/fish and the low value in ($EPxFR_1S_1$) being 24.10 g/fish.

**Chemical composition of whole fish bodies:-**

As illustrated in Table (8), when feeding rate increased from 5-1% to 10-2%, the percentages of protein and fat were increased from 15.13; 3.07 – 15.55; 3.09 % to 16.13; 3.30 – 16.68; 3.50% and 14.11; 2.90 – 14.82; 3.04% to 15.10; 3.11 – 15.21; 3.08 %, respectively, and the percentage of moisture and ash were decreased from 78.7; 4.29 – 78.13; 4.01% to 77.40; 4.39 – 76.20; 5.51 % and from 75.80; 4.00 – 75.40; 5.96 % to 73.90; 6.67 – 73.20; 6.62 %, respectively.

**Table (7): Least square means and standard error for the effect of treatments on weight gain and specific growth rate of tilapia fish during winter months.**

| Items | No | Weight gain (g/fish) | Specific growth rate |
|---|---|---|---|
| **Ponds** | | | |
| **Earthen ponds(EP)** | 8 | 38.91 ±0.17b | 1.73±0.02b |
| **Concrete ponds (CP)** | 8 | 49.04±0.17a | 1.84±0.02 a |
| **Feeding rate** | | | |
| **5-1% of body weight (FR1)** | 8 | ٣٣,٩٠±0.17b | 1.67 ±0.02b |
| **10-2% of body weight (FR2)** | 8 | 49.10±0.17 a | 1.90±0.02 a |
| **Sex** | | | |
| **Mono sex (S1)** | 8 | 39.01±0.17 b | 1.73±0.02 b |
| **Mixes sex (S2)** | 8 | 48.60±0.17 a | 1.84±0.02 a |
| **Treatments** | | | |
| **EP × FR1 × S1** | 2 | 24.10±0.34 e | 1.52±0.02 d |
| **EP × FR1 × S2** | 2 | 33.90 ±0.34 d | 1.68±0.02 c |
| **EP × FR2 × S1** | 2 | 44.31±0.34 c | 1.81±0.02 bc |
| **EP × FR2 × S2** | 2 | ٥٣,٦٨±0.34 b | 1.90±0.02 ab |
| **CP × FR1 × S1** | 2 | 33.78±0.34 d | 1.68±0.02 c |
| **CP × FR1 × S2** | 2 | 43.81±0.34 c | 1.80±0.02 bc |
| **CP × FR2 × S1** | 2 | 53.86±0.34 b | 1.90±0.02 ab |
| **CP × FR2 × S2** | 2 | 64.01±0.34 a | 1.98±0.02 a |

Means with different letters in each column are significantly different (P<0.05)

**Table (8): The effect of treatments on the chemical analysis of Nile tilapia *O.niloticus* (% wet weight).**

| Variable | Composition | | | |
|---|---|---|---|---|
| | Moisture | Protein | Lipid | Ash |
| (EPxFR$_1$XS$_1$) | 78.7±1.21 a | 14.11±1.79 b | 2.90±0.44 b | 4.29±0.37 b |
| (EPxFR$_1$xS$_2$) | 78.13±1.21 a | 14.82±1.79 b | 3.04±0.44 b | 4.01±0.37 b |
| (EPxFR$_2$xS$_1$) | 77.40±1.21a | 15.10±1.79ab | 3.11±0.44ab | 4.39±0.37 b |
| (EPxFR$_2$XS$_2$) | 76.20±1.21ab | 15.21±1.79ab | 3.08±0.44ab | 5.51±0.37ab |
| (CPxFR$_1$XS$_1$) | 75.80±1.21 b | 15.13±1.79ab | 3.07±0.44ab | 4.00±0.37 b |
| (CPxFR$_1$XS$_2$) | 75.40±1.21 b | 15.55±1.79ab | 3.09±0.44ab | 5.96±0.37ab |
| (CPxFR$_2$XS$_1$) | 73.90±1.21 c | 16.13±1.79 a | 3.3±0.44 a | 6.67±0.37 a |
| (CPxFR$_2$XS$_2$) | 73.20±1.21 c | 16.68±1.79 a | 3.50±0.44 a | 6.62±0.37 a |

Means with different letters in each column are significantly different (P<0.05)

In general the body composition of Nile tilapia fish receiving higher feeding rate (10-2%) showed remarkable reduction in the percentages of moisture and ash with a concomitant increase in protein and lipid. Similar results were reported by Abd –El-Gany (1996) and Nour *et al* (1996) who reported that the body composition of fish receiving no feed showed decreases percentages of lipid and protein and increasing moisture and ash. Lovell and Sirikul (1974) reported that nonfood channel cat fish during cool weather had the lowest percentage of protein and highest percentages of fat in their carcasses compared to those fed fish indicating that fasting channel cat fish catabloized body protein for their metabolic energy needs in preference to or with the same affinity as depot fat.

**Survival rate**

Results presented in Table (9) illustrate the effect of treatments on survival rates of Nile tilapia .The results indicate that survival rate during the whole experimental period had ranged between 64.20% ($EPxFR_1XS_1$) and 85.85% ($CPxFR_2xS_2$), which indicate that treatments had remarkable effects on tilapia survival .These results are in accordance with the findings of Abd.El-Ghany (1996) who studied the positive benefits of winter feeding of Nile tilapia and common carp, he reported that fish not fed in winter lost ($P<0.05$) weight while those that received feed at 1% or 2% of body weight gained weight .Although winter feeding resulted in poor feed conversion efficiency and reduced growth rates, survival rates were good.

**Table (9): Least square means and standard error for the effect of treatments on survival rate of tilapia fish during winter months.**

| Items | No | Survival rate |
|---|---|---|
| **Ponds** | | |
| Earthen ponds(EP) | 8 | 72.01 ±0.87 b |
| Concrete ponds (CP) | 8 | 77.69 ±0.87 a |
| **Feeding rate** | | |
| 5% of body weight (FR1) | 8 | 69.19±0.87b |
| 10% of body weight (FR2) | 8 | 80.51±0.87 a |
| **Sex** | | |
| Mono sex (S1) | 8 | 72.59±0.87 b |
| Mixes sex (S2) | 8 | 77.11±0.87 a |
| **Treatments** | | |
| EP × FR1 × S1 | 2 | 64.20 ±1.64 f |
| EP × FR1 × S2 | 2 | 68.75 ±1.64 ef |
| EP × FR2 × S1 | 2 | 75.10 ±1.64 cd |
| EP × FR2 × S2 | 2 | 80.00 ±1.64 bc |
| CP × FR1 × S1 | 2 | 69.95 ±1.64 de |
| CP × FR1 × S2 | 2 | 73.85 ±1.64 de |
| CP × FR2 × S1 | 2 | 81.10 ±1.64 ab |
| CP × FR2 × S2 | 2 | 85.85 ±1.64 a |

Means with different letters in each column are significantly different ($P<0.05$).

Also, Nour *et al.* (1996) reported that supplementary feeding in concrete ponds cover increased growth performance, survival rate and feed and nutrient utilization (protein and energy were improved).In this connection, El-Nemaki (1995) reported that large fish responded faster than small fish when temperature dropped from 20 to 4; 8; 10°C. Mortality rate was 100% when tilapia were switched to either 4°C or 40°C.

## CONCLUSION

In conclusion, the results of the present study indicate on –site field trial the beneficial rearing of tilapia of covered concrete ponds (75% of the surfaces with polyethylene sheet) and surrounding the earthen pond with dried plant with the use higher feeding rate (10- 2%) by adjusting over wintering feeding for winter to promote good performance and increase survival rate . Moreover, it can improve tilapia resistance for cold weather during wintering.

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## دراسات عن تشتية زريعة أسماك البلطي النيلي

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- * المعمل المركزى لبحوث الأسماك بالعباسة – قسم إنتاج الأسماك ونظم الاستزراع السمكي–مركز البحوث الزراعية.
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تم تربية زريعة أسماك البلطى النيلى وحيد الجنس ومختلطة الجنس بهدف التعرف على أداء النمو بالإضافة إلى معدل الإعاشة وذلك فى فصل الشتاء فى أحواض ترابية محاطة بسياج من البوص لحمايتها من الرياح الباردة ، وأحواض خرسانية مغطاة بالبولي اثيلين عدا ٢٥% من مساحة السطح غير مغطاة حتى يمكن تهوية مياه الحوض، وقد بدأت فترة التربية في ١٥ سبتمبر ٢٠٠٣ وانتهت في ١٥ أبريل ٢٠٠٤.

تم استخدام عليقة تجارية تحتوي على ٢٥% بروتين خام في عدد ثماني أحواض ترابية وثماني أخرى خرسانية بنظامين للتغذية ٥-١% و ١٠-٢% من الوزن الكلي للأسماك طبقا لدرجات حرارة المياة كمعاملات لكل من البلطي وحيد الجنس والبلطي مختلط الجنس. وقد خلصت الدراسة الى النتائج التالية:

١- أكبر زيادة في متوسط وزن الجسم سجلت في المعاملة التى استخدمت أسماك البلطى مختلطة الجنس فى الأحواض الخرسانية مع معدل تغذية ١٠-٢% وأقل زيادة تم تسجيلها فى المعاملة التى استخدمت اسماك البلطى وحيد الجنس فى الأحواض الترابية بمعدل تغذية ٥-١%.

٢- أعلى معدل إعاشة وأداء نمو قد سجل في الأحواض الخرسانية التى استخدمت اسماك البلطى مختلطة الجنس ومعدل تغذية ١٠-٢% ويلى ذلك الأحواض الترابية بنفس معدل التغذية السابق ويأتى بعد ذلك الأحواض الخرسانية التى استخدمت الاسماك وحيدة الجنس ومعدل تغذية ٥-١% وأخيرًا الأحواض الترابية التى تم بها تغذية أسماك وحيدة الجنس بمعدل تغذية ٥-١%.

٣- أسماك وحيدة الجنس المنتجة بمعاملة الهرمون (١٧ ألفا ميثيل تستسترون) سجلت معدل نمو نوعي منخفض بالنسبة للمعاملات الأخرى تحت ظروف الشتاء المصرية.

الخلاصة:

فى ضوء النتائج السابقة نستطيع أن نوصى بتشتية أسماك البلطى النيلى وحيد الجنس والخليط فى مصر فى أحواض خرسانية بكثافة ٥٠ زريعة للمتر المكعب وبمعدل تغذية ١٠% ينخفض إلى ٢% من وزن الأسماك يوميا طبقا لنظام التغذية المتبع فى الدراسة ويتم تغطية ٧٥% من سطح الأحواض الخرسانية بالبلاستيك مع تغطية جوانب الأحواض الخرسانية بالكامل بالبلاستيك.