Comparison of growth, survival and feed utilization efficiency in a selected strain of Florida red tilapia off-spring (*Oreochromis spp.*) and origin blue tilapia (*O. aureus*)

Essa[1], M.A., Omar[2], E.A., Srour[2], T.M. and El-hamamy[1], M. A.
1- Aquaculture Division, National Institute of Oceanography and Fisheries, Alexandria, Egypt
2- Animal and Fish Production Department, Faculty of Agriculture (Saba Basha), Alexandria University, Egypt

Abstract

This study was conducted to compare performance in a domesticated strain of Florida red tilapia (*Oreochromis spp.*) that had been selected for resistance low water temperatures in winter over 5 generations to that of origin unselected blue tilapia (*O. aureus*), because it's more tilapia species resistant to the cooler water ponds, under different stocking densities conditions (35,50 and 65 fry / aquarium) during nursing period even access to fingerlings necessary to conduct the second selection phase for the fifth generation off-spring during the winter. Fish were reared in twelve glass aquaria (70 L volumes of water /aquarium duplicated per treatment) with an average initial weight of 0.022± 0.002 g. One experimental diet was formulated to contain 41.41 % crude protein and 477.87 Kcal gross energy / 100 g. fish in each aquarium were fed two times diets daily (six days a week) at a rate of 10-15 % of body weight for 90 days. The Florida red tilapia out performed blue tilapia by growing faster by 73.9% to a large size ingested a greater amount of feed by 131.6% exhibiting greater efficiency in feed conversion and also appeared to utilize dietary lipids for energy while sparing protein for growth. The results revealed also that red tilapia reared at a density (50 fry / aquarium) had best growth (3.37 g), survival (76 %) and feed utilization efficiency parameters the same trends were observed for blue tilapia reared at density (50 fry / aquarium). Challenge test for cold water showed that there was no significant difference between selected red tilapia strain and origin blue tilapia in cold water tolerance despite that the lowest lethal temperature of 50% individuals was 7.5 °C for selected red tilapia and 7.0 °C for origin blue tilapia.

Introduction

Genetic selection and breeding in the field of aquaculture is very important to improve all the qualities that lead to improved production efficiency and profitability, particularly growth rates, resistance to disease and unfavorable environmental conditions (Essa, 1987 and Lovshin, 1998).

Tilapias are first in weight harvested from culture ponds and cages in Egypt. GAFRD (2012) estimated that 610617 ton of tilapias were farmed in 2011 because of its rapid growth, ability to resist poor water quality, and disease, tolerate wide range of salinity, low oxygen levels and to convert lowest quality of organic, animal, agricultural and domestic waste materials into high quality protein (Mohamed, 2002). The Nile tilapia (*Oreochromis niloticus*) is the most widely cultured tilapia not only in Egypt but also in the world. However, the red tilapia, Oreochromis sp., is increasing in popularity among producers due to its attractive color, increased marketability especially in Asia and Latin America, as well as high salinity tolerance in some strains (Lovshin, 1998, Helal *et al.*, 2004 and Romana- Eguia *et al.*, 2010). Under Egyptian conditions unfortunately the Florida red tilapia hybrid is not cold tolerant, death occurred to some fish at water temperature below 16 °C (Dowidar and Essa, 1988, Essa *et al.*, 1996 and Helal *et al.*, 2004).

Although it can design selective breeding programs to improve production traits, the most important of these qualities for red tilapia is the resistance to cold water ponds in winter in order to reduce the mortality rate which means increasing production and farm income. Therefore, the present work aimed to study the growth, survival and feed efficiency of offspring from selected Florida red tilapia as well as origin blue tilapia, *Oreochromis aureus*, during nursing period under different densities. Also made a comparative study of their fingerlings stage for resistance to cold water in winter. Blue tilapia has been chosen as a control treatment because it is more tilapia species resistant to the cooler water ponds (Chervinski, 1982 and Cnaani *et al.*, 2000).

Materials and Methods

Fish and culture facility:

This study was carried out at El-Max Research Station, National Institute of Oceanography and Fisheries, Alexandria. The experimental Florida red tilapia, *Oreochromis spp.*, was introduced from Mariut Fish Farms Project, Egyptian Ministry of Agriculture in 2008 for the implementation of selective breeding program for the production of new strain red tilapia resistant to cold pond water in winter by using individual selection program according to Gjedrem and Baranski (2007), for five generations until 2012.

During the present study offspring from red tilapia fifth generation were tested from the point of view of the impact of stocking density on the growth, survival and feed utilization efficiency parameters during nursing period between August 20 and November 9, 2012 (90 days) compared with origin blue tilapia in order to reach fingerling stage necessary to conduct the second selection phase for red tilapia fifth generation during winter. During experimental nursing period, the fish were transferred into their respective nursery glass aquaria (70 L each). A total number of 600 healthy experimental fish fry with an average initial weight of 0.02g and length 1.10 cm were chosen, measured and then distributed randomly into three duplicated stocking densities(35, 50 and 65 fry per 70 L aquarium) for selected red tilapia and origin blue tilapia fry. In experimental aquaria, a static system was used, and 25% of the water was changed daily.

Water Quality:

Water quality parameters in the experimental glass aquaria in the experiment were determined according to the methods of APHA (1992).

Water temperature during experimental period varied between 21 and 27 °C. Dissolved oxygen and ammonia were almost in the desirable concentrations, where the oxygen not less than 4.0 mg per liter and ammonia not exceed 0.015 mg per liter (Azaza *et al.*, 2008). Water parameters such as dissolved oxygen, pH and temperature in the nursery aquaria were monitored every three days.

Experimental diets:

Chemical proximate analysis of feed ingredients used in the present study presented in Table (1). One experimental diet was formulated to contain 41.41% crude protein and almost 477.87 Kcal gross energy/100g for formulation of the experimental diet in the following in the ingredients were used: Fish meal, Soybean meal, Corn gluten, Yellow corn, Starch, Wheat, Flour, Soybean oil, Vitamins and minerals mixture. Each ingredient was ground and thoroughly mixed with the other dietary ingredients, vitamins and minerals mixture. A few drops of oil were added at the same time of mixing with warm water (45 °C), which was slowly added until the diets began to clump. Diet dried for 48 hours at a 70 °C in a drying oven with out processed by a pellet mill machine. Fry in each aquarium were fed three times daily (six days a week) at a rate of 10-15 % of body weight for 90 days.

Proximate analysis of diet and fish:

The chemical analysis of ingredients, diet and fish sample were analyzed according to (AOAC, 1990) methods for dry matter, crude protein, ether extract, crude fiber and Ash. Gross energy (GE)contents of the experimental diet and fish samples were calculated by using factors of 5.65, 4.45 and 4.12 Kcal/g of protein, lipid and carbohydrates, respectively (NRC, 1993).

Measurements of growth performance:

Total weight gain, average daily gain, specific growth rate, feed conversion ratio, protein and energy utilization were calculated according to Recker (1975) and Castell and Tiews (1980).

<u>Total Weight Gain :</u>

Average total weight gain (g/fish) = (average Final weight - average Initial weight)

<u>Average Daily Gain (ADG):</u>

Average daily gain (g/fish/day) = (average Final weight - average Initial weight)/ Experimental period (days).

<u>Specific Growth Rate (SGR% / fish / day):</u>

Specific growth rate (SGR) % / day) = 100 × (Ln WT - Ln WI) / duration period(d).

Where WT: Final weight means of fish in grams and WI: Initial weight means of fish in grams Where Ln: Natural log and d is the duration period.

<u>Survival rate:</u>

Fish survival rates will be calculated using the formulae: (No. of fish at the end / No. of fish at start) ×100.

Measurements of feed and nutrient utilization:

Feed Conversion Ratio (FCR):

Feed Conversion Ratio = Dry matter feed intake (g) / Weight gain (g)

Protein Efficiency Ratio (PER):

Protein Efficiency Ratio (PER) = Weight gain (g) / Protein intake (g)

Protein Productive Value (PPV %):

Protein Productive Value (PPV %) = 100 (protein gain/protein intake)

Challenge test for cold:

Four aquaria were placed in cold room operated by a thermostatically controlled chilling unit. The fry were acclimated at ambient temperature (16°C). Each aquarium was constantly aerated using 2 air-stones connected to an air-pump. The temperature of the aquarium water was adjusted to the desired level by adjusting the thermostat controlled chilling unit. The acclimatizing fry was done at 16 °C for 24 hours. After that aquarium water temperature was monitored each half hour from the beginning to the end of the experiment. The temperature measurements were done at half hour, while the dissolved oxygen (DO), pH and total ammonia, were measured one time during the experiment. Dissolved oxygen ranged between 4.1 and 6.3 mg/l; pH, 7.6–8.3; ammonia, 0.01–0.015 mg/l. Temperature was first lowered to 16 °C within 24 h, and then water temperature was reduced at a rate of 0.5 °C every half hour till the end of the experiment, on the death of all the fish. Aquaria were observed once each half hour for any fish mortality. Death was defined according to Rezk and Kamel (2011) as the point at which fish lost balance, fell on their side and ceased fin, body and opercula movements and lost response to external stimulation. Throughout the experiment, dead fish were removed from the tanks at the end of each hour with a scoop net, and their tag and aquarium numbers recorded. Mortality was recorded hourly for each fish. Temperature at death (TAD), recorded hourly, was used in this study to measure the cold tolerance.

Statistical analysis

The experimental designed in completely randomized factorial experiments in complete block design with two replications in the two seasons. F-test and analysis of variance of treatments difference was performed according to Steel and Torrie (1980). Statistical analysis was done by, ANOVA, F-test, and L.S.D procedures available within the SAS software package (Statistical analysis version 9.13, 2008).

Table (1): The composition and Chemical analysis (%on dry matter basis) of the experimental basal diets

Ingredients	Experimental diet (%)
Fish meal (70% - Danish)	31.42
Fish meal (62% - Vietnam)	3.5
Soybean meal(45-solv VN)	24.5
Corn gluten (corn)	3.5
Yellow corn	7.0
Starch	2.45
Rice bran	10.5
Wheat flour	14.0
Soybean oil	0. 1
Trace mineral premix*	1.0
Vitamin and minerals premix	2.0
Total	**100**
Chemical analysis (%)	
Dry matter (DM) (%)	89.98
Crud protein (CP) (%)	41.41
Ether extract (E.E) (%)	7.29
Ash (%)	8.85
Crude fiber (CF) (%)	4.34
Nitrogen free extract (NFEg/100g) **(%)	38.11
Gross energy (Kcal/100g) (GE)***(%)	477.87
P/E ratio (mg CP/Kcal) ****(%)	86.66

*Premix Composition:- Each 3 kg contains
Vit A 1200000 i.u., Vit D 300000 i.u., Vit E 700 mg, Vit K3 500 mg, Vit B1 500 mg, Vit B2 200mg, Vit B6 600mg, Vit B12 3mg, Vit C 450mg, Niacin 3000mg, Methionine3000mg, Cholin chloride 10000mg, Folic acid 300mg, Biotin 6mg, Panthonic acid 670mg, Magnesiam salphate 3000mg, Copper sulphate 3000mg, Iron sulphate 10000mg, Zinc sulphate , 1800mg, Cobalt sulphate 300mg, Carrier upto 3000mg.

**NFE= Nitrogen free extract (calculated by differences)

**** GE= Gross energy: - Gross energy was calculated using factors 5.65, 9.45, 4.12 Kcal per gram of protein, lipid and carbohydrate, respectively after (NRC, 1993).

*** P/E= Protein to energy ratio mg crude protein/Kcal GE.

Results and Discussions

Growth performance and survival rate (%):

The mean values of the growth performance and survival rate (%) of the selected strain of Florida red tilapia and origin blue tilapia fry reared at different densities for 90 days are summarized in Table (2). All groups of fish increased their growth performances steadily following exposure to their respective stocking density treatments. But it is noticeable that the selected red tilapia actuality outweighs the origin blue tilapia in this performance. The highest growth performance of red tilapia, Oreochromis spp. in terms of final mean body weight (FBW), and mean body weight gain (WG), average daily weight gain (ADG) and specific growth rate (SGR) was observed on the red tilapia reared at a density of 35 fry/aquarium, followed by 50 fry/aquarium, but the differences were insignificant. While the best survival rate was observed in the red tilapia reared at a density 50 fry /aquarium (76.0 %) followed by 65 fry /aquarium (66.9%) and then 35 fry, 58.5%.

In all treatments the lowest growth performance and survival rate % were observed on the origin blue tilapia, regardless of population density, and were significantly different ($p<0.05$) (Table 2). These results are in agreement to the earlier works of Pruginin *et al.* (1988), Watanabe *et al.* (1997) and Romana-Eguia *et al.* (2010), who reported that red tilapia are genetic mutants selected from tilapia species in the genus Oreochromis: Nile tilapia, Blue tilapia, *O. aureus*, Mozambique tilapia, *O. mossambicus*, and Zanzibar tilapia, *O. hornorum*. They compared the growth of Philippine red tilapia, Florida red tilapia as well as wild-types, Nile tilapia (*O. niloticus*) and Blue tilapia (*O. aureus*) in 500 m^2 plastic lined earthen ponds stocked with the 4 tilapia strains in the same ponds. Ponds were filled with brackish water and provided with aeration and 1 to 10 % water exchange per day. Ponds were harvested after 120 days and specific growth rates for Philippine red tilapia, Florida red tilapia, Nile and Blue tilapias were 3.22, 3.96, 4.56 and 2.83 percent per day, respectively.

Table (2): Mean values of growth performance parameters of selected strain of Florida red tilapia and origin blue tilapia fry reared under different stocking densities for 90 day.

Item	IW (g\fish)	FBW (g\fish)	WG (g\fish)	ADG (g/fish/day)	SGR (%/day)	SR (%)	K value
			Tilapia species (TS)				
(Red Tilapia) R.T	0.022	3.17±0.06[a]	3.15±0.06[a]	0.035±0.001[a]	5.52±0.11[a]	67.16±8.5[a]	1.6
(Blue Tilapia) B. T	0.023	1.38±0.06[b]	1.36±0.06[b]	0.015±0.00[b]	4.54±0.11[b]	32.47±8.5[b]	1.52
			Stocking density (SD) (Fish/aquarium)				
35	0.022	2.37±0.08[a]	2.35±0.08[a]	0.026±0.001[b]	5.19±0.14[a]	48.5±10.39[a]	0.96
50	0.022	2.59±0.08[a]	2.56±0.08[a]	0.028±0.001[a]	5.30±0.14[a]	50.5±10.39[a]	2.38
65	0.022	1.87±0.08[b]	1.85±0.08[b]	0.021±0.001[b]	5.94±0.14[a]	50.3±10.39[a]	1.35
			Interaction (TS×SD)				
R. T *SD35	0.022	3.75±0.11	3.73±0.11	0.04±0.04	5.82±0.19	58.5±14.7	1.22
R. T *SD 50	0.022	3.37±0.11	3.36±0.11	0.04±0.002	5.69±0.19	76±14.7	2.21
R. T *SD 65	0.025	2.39±0.11	2.37±0.11	0.03±0.002	5.31±0.19	66.9±14.7	1.37
B. T *SD 35	0.025	0.99±0.11	0.97±0.11	0.01±0.002	4.34±0.19	38.5±14.7	0.70
B. T *SD 50	0.025	1.80±0.11	1.78±0.11	0.02±0.002	4.99±0.19	25±14.7	2.55
B. T *SD 65	0.022	1.35±0.11	1.33±0.11	0.015±0.002	4.68±0.19	33.8±14.7	1.32
L.S.D 0.05	-	0.154	0.154	0.003	0.273	20.751	-

***the means in the same column bearing different superscript are significantly different ($P \leq 0.05$).**
IW: Initial weight, FBW: Final body weight, WG: Weight gain, ADG: Average daily gain, SGR: Specific growth rate, and K: Condition factor.

Feed and nutrient utilization:

The mean values of feed and nutrient utilization parameters of the selected strain of Florida red tilapia and origin blue tilapia fry reared at different densities for 90 days are summarized in Table 3. The best feed nutrient utilization parameters (feed conversion ratio (FCR), protein efficiency ratio (PER), Protein productive value (PPV), and energy utilization %) were observed on the red tilapia reared at a stocking density 50 fry /aquarium followed by 35 fry /aquarium and then 65 fry /aquarium. Florida red tilapia used less feed to produced one unit of weight gain when compared with blue tilapia. In all treatments the poorest feed and nutrient utilization parameters was observed on blue tilapia, and were significantly different ($P<0.05$) when compared with red tilapia. These results were confirmed the earlier work of Pullin and Lowe-McConnell(1982) as well as Essa *et al.*, (1996), who reported that the feed utilization parameters of red tilapia are slightly less than its counterpart in the Nile tilapia and higher than that of the blue tilapia.

Table (3): Mean values of feed and nutrient utilization parameters of selected strain of Florida red tilapia and origin blue tilapia fry reared under different stocking densities.

	FI (g/fish)	FCR (g)	PER (g)	PPV (%)	EU (%)
Tilapia species (TS)					
(Red Tilapia) R. T	7.46±0.27^{a}	2.37±0.10^{b}	1.02±0.02^{a}	55.3±1.3^{a}	51.33±1.2^{a}
(Blue Tilapia) B. T	4.29±0.27^{b}	3.15±0.10^{a}	0.76±0.02^{b}	35.6±1.3^{b}	39.51±1.2^{b}
Stocking density (SD) (Fish/aquarium)					
35	6.81±0.33^{a}	2.90±0.13^{a}	0.83±0.03^{b}	40.24±1.5^{b}	41.79±1.5^{b}
50	6.53±0.33^{a}	2.55±0.13^{b}	0.95±0.03^{a}	49.80±1.5^{a}	48.33±1.5^{a}
65	5.24±0.33^{b}	2.83±0.13^{b}	0.95±0.03^{a} b	46.36±1.5^{a}	44.21±1.5^{a}
Interaction (TS ×SD)					
R. T *SD35	8.94±0.46	2.40±0.18	1.01±0.04	54.44±2.2	50.80±2.1
R. T *SD 50	7.52±0.46	2.24±0.18	1.08±0.04	57.94±2.2	53.98±2.1
R. T *SD 65	5.92±0.46	2.49±0.18	0.97±0.04	53.63±2.2	49.45±2.1
B. T *SD 35	4.67±0.46	4.81±0.18	0.50±0.04	26.03±2.2	24.46±2.1
B. T *SD 50	5.54±0.46	3.11±0.18	0.78±0.04	41.66±2.2	40.50±2.1
B. T *SD 65	4.57±0.46	3.44±0.18	0.70±0.04	39.10±2.2	37.36±2.1
L.S.D 0.05	0155	0.25	0.055	3.061	2.996

***the means in the same column bearing different superscript are significantly different ($P \leq 0.05$).**

FI: Feed intake, FCR: Feed conversion ratio, PER: Protein efficiency ratio, PPV: Protein productive value, E. Gain: Energy gain, and EU: Energy utilization.

Whole body composition:

The mean values of whole body composition of the selected strain of Florida red tilapia and origin blue tilapia fry reared at different densities are summarized in Table 4. The results showed that there were slightly significant differences in dry matter, protein content, fat content, Ash, and energy content in the body fish due to differences in population density. Protein content, fat content and energy content were increased significantly with increasing the stocking density, where under 65 fry /aquarium. However, DM and Ash were decreased. Dry matter, fat content and energy content were the highest in blue tilapia, while protein content in red tilapia. These results were in agreement with the work of Narejo *et al.* (2010) for *Labeo rohita* fry.

Table (4): Mean values of carcass composition parameters of selected strain of Florida red tilapia and origin blue tilapia fry reared under different stocking densities.

Item	DM (%)	% on dry matter basis		
		CP	E. E	Ash
Tilapia species (TS)				
(Red Tilapia) R. T	27.65±0.13[b]	54.36±0.06[a]	29.46±0.13[b]	16.18±0.10[a]
(Blue Tilapia) B. T	28.06±0.13[a]	53.98±0.06[b]	30.66±0.13[a]	15.36±0.10[b]
Stocking density (SD) (Fish/aquarium)				
35	27.40±0.16[b]	53.48±0.08[b]	28.99±0.15[b]	17.53±0.12[a]
50	28.70±0.16[a]	53.68±0.08[b]	30.53±0.15[a]	15.79±0.12[b]
65	27.46±0.16[b]	55.35±0.08[a]	30.61±0.15[a]	14.04±0.12[c]
Interaction (TS×SD)				
R.T *SD35	28.12±0.22	54.16±0.11	29.45±0.22	16.39±0.17
R. T *SD 50	28.10±0.22	53.58±0.11	29.45±0.22	16.97±0.17
R. T *SD 65	26.74±0.22	55.40±0.11	29.35±0.22	15.25±0.17
B. T *SD 35	26.68±0.22	52.85±0.11	28.53±0.22	18.62±0.17
B. T *SD 50	29.30±0.22	53.78±0.11	31.60±0.22	14.62±0.17
B. T *SD 65	28.19±0.22	55.30±0.11	31.87±0.22	12.83±0.17
L.S.D 0.05	0.314	0.151	0.306	0.232

*the means in the same column bearing different superscript are significantly different ($P \leq 0.05$).

DM: Dry matter, CP: Crude protein, E. E: Ether extract.

Challenge test for cold

The water pond cold tolerance among the tested fish, selected Florida red tilapia strain and origin blue tilapia, slightly varied as shown in Table(5). The mortality was started for selected Florida red tilapia at 9.5 °C, while the origin blue tilapia began to die at 8.5 °C.

The lowest lethal temperature of 50% individuals was 7.5 °C for selected Florida red tilapia and complete mortality occurred at 7.0 °C. At the same time the lowest lethal temperature of 50% individuals was 7.0 °C for origin blue tilapia (Table 5). These good results that suggest the possibility of improvement to resist cold recipe for red tilapia through selective breeding program - perhaps due to the continuation of these fish living in a special ponds through the winter season for several generations. These agreed with the findings of Cnaani et al.(2000) who reported that better fish survival rate during winter due to longer period of time as the fish were exposed to low temperatures on the farms. Similar trend was observed also by Fjalestad *et al.*(2005) who found that farmed Atlantic salmon fish from seven generations of selection for growth rate seems to be less sensitive to environmental stress than genetically wild fish.

Conclusion, The selected farmed Florida red tilapia from 5 generations showed that tolerance to cold was positively correlated with selection and seems to be less sensitive to low water temperatures in winter without any negative effects on the growth, survival and feed utilization efficiency parameters.

Table (5): Tolerance of low water temperatures for selected Florida red tilapia strain *Oreochromis spp.* and origin blue tilapia *Oreochromis aureus.*

Time	Water Temp. (°C)	Selected Red Tilapia No. of mortality fish		Origin Blue Tilapia No. of mortality fish	
		aquarium 1	aquarium 2	aquarium 1	aquarium 2
20:00 PM	16.0	-	-	-	-
22:30	14.0	-	-	-	-
23:00	13.5	-	-	-	-
23:30	13.0	-	-	-	-
24:00	12.5	-	-	-	-
00:30 AM	12.0	-	-	-	-
1:00	11.5	-	-	-	-
1:30	11.0	-	-	-	-
2:00	10.5	-	-	-	-
2:30	10.0	-	-	-	-
3:00	9.5	1	1	-	-
3:30	9.0	1	1	-	-
4:00	8.5	2	2	1	2
4:30	8.0	2	3	5	3
5:00	7.5	4	3	2	1
5:30	7.0	8	7	2	4
6:00	7.0	2	3	6	8
7:00	7.0	-	-	4	2
Total		**20**	**20**	**20**	**20**

References:

AOAC (1990). Association of Official Analytical Chemists. The Official Methods of Analyses Association of Official Analytical Chemists International.15th edition, Arlington, VA, 2220, USA.

APHA (American Public Health Association), (1992). Standard methods for the examination of water and wastewater. 18th ed. APHA, Washington, DC.

Azaza M.S., Dhraïef M.N., and Kraïem M.M. (2008). Effects of water temperature on growth and sex ratio of juvenile Nile tilapia, Oreochromis niloticus (Linnaeus) reared in geothermal waters in southern Tunisia, Journal of Thermal Biology, 33: 98-105.

Castell, J.D. and Tiewes, K. (1980). Report of the EIFAC, IUNS and ICES Working Group on the standardization of Methodology in Fish Research, Hamburg, FRG,212-23 March, 1979. IFAC Tech. Pap. (3) 24.

Chervinski, J. (1982). Environmental physiology of tilapias. P. 119-128: In R.S.V. Pullen and R.H. Lowe-McConnell (eds.) The biology and culture of Tilapias, ICLARM conference proc. 7, 432 p. International Center For Living Aquatic Resources Management, Manila, Philippines.

Cnaani, A., Gall, G.A.E. and Hulata,G. (2000). Cold tolerance of tilapia species and hybrids. Aquaculture International, 8, 289–298.

Cnaani, A., Gilbert, C. R. and Taphom, D. C. (2000). Cold tolerance of tilapia species and hybrids. Aquaculture International 8(4): 289-298.

Dowidar, N. M. and Essa, M. A. (1988). Acclimation of red tilapia in Egypt. Proc. First conf. Role of scientific Research in Development of fish Resources, 6-8 Aug., Fac. Agric., Alexandria University. Pp. 63-72, Egypt.

Essa, M. A. (1987). Hybridization between five important species of family Cyparidae. Ph.D. thesis, Fac. Agriculture, Alex. Univ. by scientific channel system between Egypt and Hungary.

Essa, M. A. and Haroun, M. R. (1998). Cross-breeding experiments on some important fishes of family Cichlidae (Genus Oreochromis) and evaluation of their hybrids. Egyptian Journal of Aquatic Biology and Fisheries. Vol. 2 (3): 43-61.

Essa, M. A., Hassan, N. A. and Salama, M. E. (1996). Growth performance and socio-economic feasibility of red tilapia, Oreochromis spp., and its black progeny reared in net-enclosures. J. Egyptian-German Society of Zoology, 19 (B): 27-44.

Fjalestad, K.T.(2005). Selection and breeding programs in aquaculture, Selection methods. edited by Trygve Gjedrem Springer Dordrecht, Berlin, Heidelberg, New York 364P.

GAFRD, (General Authority of Fish Resources Development) **(2012).** Fish Statitistics Book 2012, Cairo, Egypt.

Gjedrem, T. and Baranski, M. (2007). The success of selective breeding in Agriculture. Reviews: Methods and technologies in Fish Biology and Fisheries, vol. 10:13-23.

Helal, A. M., Essa, M. A. and Abo El-Wafa, M. A. (2004). Preliminary investigation in the intensive and semi-intensive marine cage culture of Florida red tilapia under different environmental conditions. Egypt. J. Agriculture Sci., Mansoura Univ., 29(2): 585-594.

Lovshin, L. L. (1998). Criteria for selecting Nile tilapia and red tilapia for culture. 2nd Symp. Management and Nutrition of fishes, held in Piracicaba, SP, Brazil on July 22-23, 1998.

Mohamed, K.A.E.A. (2002). Study to determine maximum growth capacity and amino acid requirements of tilapia genotypes. Ph.D. Dissertation.Geroge-August-Univ. Göttingen.

Narejo, N. T., Dayo, A., Dars, B. A., Mahesar, H., Laghari, M. Y. and Lashari, P. K. (2010). Effect of stocking density on growth and survival rate of labeo rohita (hamilton) fed with formulated feed. Sindh Univ. Res. Jour., 42(1): 35-38.

National Research Council (1993). Health Effects of Ingested Fluoride. Washington (DC): National Academy Press;

Pruginin, Y., Fishelson, L., Koren, A., (1988). Intensive tilapia farming in brackishwater from an Israeli desert

Pullin, R.S.V. and Lower-McConnell, R.H. (1982). The Biology and Culture of Tilapia. Proceedings of the International Conference on the Biology and Culture of Tilapias, Bellagio, Italy. International Center for Living Aquatic Resources Management, Manila, Philippines.

Recker, W.E.: (1975). Computation and interpretation of biological statistics of fish population.Fish Res.Borard Can.Bull., 191.

Rezk, M. A. and Kamel, E. A. (2011). Cold tolerance of selective breeding of *Oreochromis niloticus* and *Oreochromis aureus*. Egyptian Journal of Aquaculture, 1 (1):43.

Ricker, W.E. (1975). Computation and interpretation of biological statistics of fsh populations. Bulletin of the Fisheries Research Board of Canada 191. 382 pp

Romana-Eguia, M. R., Ikeda, M., Basiao, Z. and Taniguchi, N. (2010). Growth comparison of Asian Nile and tilapias strains in controlled and uncontrolled farm conditions. Aquaculture International, Vol. 18, Issue6, pp. 1205-1221.

Steel, R.G.D. and J.H. Torrie. (1986). Principles and Pro- cedures of Statistics: A Biometrical Approach (2nd Ed.).

Watanabe, W. O., Olla, B. L., Wicklund, R. I. and Head, W. D. (1997). Salt water culture of the Florida red tilapia and other Saline-tolerant tilapias. A Review. Pp. 55-141 In: Costa-Pierce, B. A. and J. E.

Rakocy, eds. Tilapia Aquaculture in the Americas, Vol. 1. World Aquaculture Society, Baton Rouge, Louisiana, 70803, USA.

الملخص العربى

دراسة مقارنة لمعايير النمو والاعاشة وكفاءة الاستفادة من الغذاء فى سلالة منتخبة للبلطى الاحمر فلوريدا وبلطى حسانى غير منتخب

محمد عبد الرازق عيسى[١] - إجلال على عمر[٢] - طارق محمد سرور[٢] - محمد عبد العزيز الحمامى[١]

[١] شعبة تربية الاحياء المائية- المعهد القومى لعلوم البحار والمصايد- الاسكندرية

[٢] قسم الانتاج الحيوانى والسمكى- كلية الزراعة ساباباشا- جامعة الاسكندرية

أجريت الدراسة الحالية بمحطة بحوث الاسماك بالمكس والتابعة للمعهد القومى لعلوم البحار والمصايد بالاسكندرية بهدف اختبار النسل الناتج فى الجيل الخامس من البرنامج الانتخابى المفرد لانتاج سلالة بلطى احمر فلوريدا مقاومة لدرجات الحرارة المنخفضة خلال فصل الشتاء بالاحوض السمكية. كانت معايير الاختبار معايير النمو والاعاشة والاستفادة من الغذاء بالمقارنة بيرقات البلطى الحسانى غير المنتخب على اساس أنه اكثر انواع البلطى مقاومة للبرودة وذلك تحت كثافات عددية مختلفة (٣٥ و ٥٠ و ٦٥ يرقة / حوض ٧٠ لتر) . غذيت اليرقات (٠.٠٢٢ جم) على علف ناعم ذو محتوى بروتينى ٤١.٤% بمعدل ١٠ – ١٥ % من الوزن الكلى للاسماك على ثلاث مرات يوميا ولمدة ٩٠ يوما. اظهرت نتائج الدراسة ان البلطى الاحمر المنتخب قد تفوق فى معدل النمو عن نظيرة البلطى الحسانى بمقدار ٧٣.٩% وهذا نتيجة كفاءته الغذائية العالية حيث استهلك كمية اقل من العلف لانتاج وحدة وزن واحدة بالمقارنة بالبلطى الحسانى خصوصا تحت ظروف كثافة عددية ٥٠ يرقة للحوض. بأجراء اختبار البرودة اتضح أنه لا توجد اختلافات كبيرة فى تحمل درجات الحرارة المنخفضة بالشتاء بين البلطى الاحمر المنتخب والبلطى الحسانى حيث حدث نفوق بنسبة ٥٠% من اسماك البلطى الحسانى عند درجة حرارة ٧ درجة مئوية اما فى حالة البلطى الاحمر المنتخب حدث نفوق عند ٧.٥ درجة مئوية. باقى الأسماك نفقت عند استمرار تعرضها لهذة الدرجات بعد ساعة ونصف.