Abbassa International Journal for Aquaculture

Volume (3) Number (2), 2010

ISSN 1687-7638

Egyptian Society for Water, Aquaculture and Environment

Abbassa, Abou Hammad, Sharkia, EGYPT

ISSN 1687-7638

ABBASSA INTERNATIONAL JOURNAL FOR AQUACULTURE

Published by

Egyptian society for water, aquaculture and environment,
Central Laboratory for Aquaculture Research (CLAR),
Agricultural Research Center (ARC), Giza, Egypt

All correspondence should be addressed to:

Abbassa International Journal for Aquaculture, Abbassa – Abou Hammad – Sharkia – Egypt. Tel.: 0020553401028 – Fax: 0020553400498

GENERAL INFORMATION

Abbassa International Journal for Aquaculture is Egyptian specific publication in aquaculture of the Egyptian society for water, aquaculture and environment. The journal is published in four volumes per year to include results of research in different aspects of aquaculture sciences. The journal publishes also special issues of advanced topics that reflect applied experiences of importance in aquaculture sector.

Abbassa Int. J. Aqua., V0l.3 No.(2) 2010. *470 -496*

EFFECT OF DIFFERENT STOCKING DENSITY AND FEEDING TYPE ON GROWTH PERFORMANCE, FEED UTILIZATION AND BODY CHEMICAL COMPOSITION OF BLUE TILAPIA (*OREOCHROMIS AUREUS*) FINGERLINGS

Amal S. Hassan and Ibrahim M. Samra

Department of Fish Production and Aquaculture Systems, Central Laboratory for Aquaculture Research, Abbassa, Abo-Hammad, Sharkia, Egypt.

Received 23/ 11/ 2010 *Accepted 27/ 12/ 2010*

Abstract

This study was designed to study the effect of stocking density and feeding type on growth performance, feed utilization and body chemical composition of Blue Tilapia (*Oreochromis aureus*) fingerlings and determine in Central Laboratory for Aquaculture Research, Abbassa, Abou Hammad, Sharkia Governorate. Using in this study 2× 2 factorial designs, two different stocking densities low and high of Blue Tilapia, *Oreochromis aureus* (2.5 and 5.0 g total biomass/ L)were combined with two different diets (formulated or commercial) containing 25 % crude protein to obtain 4 experimental treatments were subjected to be studied as the following :

1- The first treatment 2.5 g/ L low stocking density +feed of formulated diet.

2- The second treatment 2.5 g/L low stocking density + feed of commercial diet.

3- The third treatment 5.0 g/ L high stocking density +feed of formulated diet.

4- The fourth treatment 5.0 g/ L high stocking density + feed of commercial diet.

In this study was used twelve glass aquarium, all glass aquarium 80×40 ×40 cm and used three replicate in all treatment and Blue Tilapia fingerlings were reared in the same condition. Fish were daily fed at a rate 3% of their biomass for ten weeks.

Results obtained indicate that:

-There were significant differences in AWG, ADG and SGR among treatments. The first treatment (2.5 g/L stocking density +

feed of formulated diet) recorded the highest values for the above parameters, while the lowest level of these values was observed with fourth treatment (5.0 g/ L stocking density + feed of commercial diet).

-Feed conversion ratio (FCR), protein efficiency ratio (PER), protein productive value (PPV %) and energy utilization (EU %) were significantly affected by the experimental treatments.

-The formulated diet at the lowest stocking density in the first and second treatments recorded the best values of feed and protein utilization compared with other treatments.

- Body dry matter (%) was not significantly affected by the experimental treatments, while CP%, EE% and ash % significantly differed among treatments.

-The formulated diet at the lower density recorded the highest CP and EE contents.

-The best economic efficiency (expressed as feed cost / kg weight gain) was observed in the first treatment (2.5 g/L stocking density + feed of formulated diet), While the lowest efficiency was recorded for fourth treatment (5.0 g/ L stocking density +feed of commercial diet).

This is study it can concluded rereading of Blue Tilapia (*Oreochromis aureus*) fingerlings in low stocking density and using formulated diet as content of 25% protein for gave the best of growth relatives, productive performance, good feed conversation and good body chemical composition compared with high stocking density and fed commercial diet for gave many money by men rearing and culture of these types of fish.

INTRODUCTION

Stocking density is a key factor in determining the productivity and profitability of commercial fish farms. Knowledge of fish stocking density practices is vital to judge the impact of the importance of any density limits on economic sustainability; Commercial farmers are thought to use a combination of intuition and experience to decide upon the most appropriate stocking density (Ellis *et al*., 2002).

Studies of the relationship between health and stocking density are further complicated by the interaction with other variables such as feed availability and type or water quality (Robel and Fisher, 1999 and Ellis *et al*., 2002). One of the most economically important species of tilapia is Blue tilapia,

Oreochromis aureus and these types of fishes has high growth rate under warm- water temperature, and could grow well on practical diets containing plant or animal –based diets (El-Sayed., 2006; FAO., 2004 and Stickney and Wurts, 1986).

Nutrition is the most important factor of the culture process; it is often represent the major operating cost of aquaculture. Under intensive culture system, fish totally depend on complete balanced diets during their life stages. Aqua-culture should know the optimum quality and quantity of feeds introduced to fish to avoid poor growth, health and productive performance. Fish cannot grow well without feeds and they should not be underfed. From the economical point of view, fish producers mostly use the cheaper and more balanced fish diets to cover the nutrient requirements of fish during the growing and production periods (Magouz *et al*., 2002).

The improvement in the efficiency of protein utilization at lower stocking densities was found in the work of many researchers (Sharms and Chakrabarti 1998, El-Sagheer, 2001, Baumgarner *et al*., 2005, Ibrahim *et al*., 2006, Ridha, 2006 and Piccolo *et al*., 2008).

There have been several reports indicating that rate of survival become reduced when fish are held at high stocking densities. This reverse relationship could be attributed to social stresses, stress-related disease and depuration the productive performance (Sharma and Chakrabarti, 1998, Saoud *et al*., 2005 and Bolasina *et al*., 2006), Increased mortality and decreased the survival rate related with higher stocking density was frequently reported by (El-Sagheer, 2001 , Ibrahim *et al*., 2006 and Piccolo *et al*., 2008) .

The present experiment was carried out to study the effects of different stocking density and feeding type on growth performance, efficiency of feed and protein utilization and body chemical composition of Blue Tilapia (*Oreochromis aureus*) fingerlings with average initial body weight of 10 grams.

MATERIALS AND METHODS

Experimental design and feeding regime:

The present study was carried out in Fish Research Laboratory, Central Laboratory for Aquaculture Research, Abbassa, Abou Hammad, Sharkia Governorate to study the effects of stocking density and feeding type on growth performance, efficiency of feed and protein utilization and body chemical composition of Blue Tilapia (*Oreochromis aureus*) fingerlings. In 2× 2 factorial designs, two different stocking densities low and high (2.5 and 5.0 gram total biomass/ L) were combined with two different diets (formulated or commercial) containing 25 % crude protein to obtain four experimental treatments were subjected to be studied as the following :

1- The first treatment 2.5 g/ L stocking density + feed of formulated diet (LD-FD).

2- The second treatment 2.5 g/L stocking density + feed of commercial diet (LD-CD).

3- The third treatment 5.0 g/ L stocking density + feed of commercial diet (HD-FD).

4- The fourth treatment 5.0 g/ L stocking density + feed of formulated diet (HD-CD).

At set of 12 glass aquaria representing the four treatments in replicates, each 80×40×40 cm filled with dechlorinated tap water at constant level of 80 liters were used. Two thirds of the water in each aquarium was daily replaced after removing accumulated excreta and all water in the aquaria were totally replaced every week.

Each aquarium was supplied with compressed air through a central air compressor (80 liters). Water temperature was thermostatically controlled using automatic electrical heaters and maintained 24◦C. fish were exposed to 12 hr illumination: 12 hr darkness photoperiod using 40 watt fluorescent lamps. Change water rate 10% every day. Fish were daily fed at a rate 3% of their biomass and weekly weighted for adjusting feed amounts according to the new weights. The calculated amount of feed was daily offered by hand to fish, in equal portions at 9.00 am and 3.00pm and fed 7 days per week. Two diets were tested; the first one was commercial diet while the second diet was formulated from available ingredients in the local market to contain 25% crude protein.

The formulated diet was prepared by mixing the dry ingredients in few amounts during the mixing process; water was gradually added with continuous mixing until clumping. Diet was passed through 4 mm sieve of an electric meat grinder, lasted in a forced oven at 70◦C until drying, and stored in a refrigerator until use. Amino acids content of experimental diets were determined by using a high performance amino acids analyzer as described by Moor *et al*. (1958). Composition and chemical analysis of the experimental fish feed (commercial or formulated diets) are presented in Table (1), while amino acids profile is given in Table (2).

Experimental fish:

Blue Tilapia (*Oreochromis aureus*) fingerlings with an average initial body weight of 10 grams were obtained from located in Central Laboratory for Aquaculture Research, Abbassa, Abou Hammad, Sharkia Governorate. Fish were kept for two weeks in 500 L fiberglass tanks for adaptation to the new environment. Fish were stocked into aquaria at low and high stocking densities (2.5 and 5.0 grams/L), respectively. Enough number of the same fish were immediately killed and kept in a deep freezer at -16°C until the chemical analysis at the end of the experimental period.

Sampling and analytical methods:

Representative samples of fish were randomly taken at the beginning and at the end of the experimental period. Fish samples were killed and kept frozen (-16°C) until performing the body chemical analysis.

Samples of the experimental fish feed (formulated or commercial diets) were taken, ground and stored in deep freezer at -15°C until proximate analysis. All of chemical analyses of fish and fish feed were determined according to A.O.A.C. (1990).

Growth performance parameters:

The growth performance parameters were calculated according to the following equations:

- Average weight gain (AWG) = Average final weight (g) – Average initial weight (g).

- Average daily gain (ADG) = Average final weight (g) – Average initial weight (g)/ Time (days)

- Specific growth rate (SGR %) = 100[Lnwt1- Lnwt0/T].

Were: Ln: Natural log, Wt0: Initial weight (g), Wt1: Final weight (g) and T: Time in days.

Feed and protein utilization parameters:

The feed utilization parameters were calculated according to the following equations:

Feed conversion (FCR) = Total feed consumption (g) / Weight gain (g).

Protein efficiency ratio (PER) = Body weight gain (g) / Protein intake (g).

Protein intake (g)]. Protein productive value (PPV %) =100 [Retained protein (g) / Energy utilization (EU %) = 100 [Retained energy (Kcal) / Energy intake (Kcal)].

Economic evaluation:

Economic evaluation of the experimental fish feeds (commercial or formulated diets) has been calculated by estimating the feed cost in Egyptian pound (LE) required to produce one unit of fresh fish , where feed cost / Kg fresh fish (LE) =Feed cost / Kg ×Feed conversion ratio (FCR).

Statistical analysis:

The obtained data of fish growth, feed utilization, survival rate and proximate chemical composition were subjected to two-way ANOVA. Differences between means were tested at the 5% probability level using Duncan' s multiple range test (1955). All the statistical analyses were done using SPSS program version 10 (SPSS, Richmond, USA) as described by Dytham (1999).

RESULTS AND DISCUSSION

Effect of stocking density and feeding type on growth performance:

Fish growth significantly increased by time (Figure 1) and fish performance (final body weight, weight gain, daily weight gain, and SGR) were significantly affected by feeding type, stocking density, and their interaction Table (3).

Results in Table (3) showed that average weight gain (AWG), average daily gain (ADG), specific growth rate (SGR) and survival rate (SR %) of Blue Tilapia fingerlings reared at the lower density (2.5 g/L) and fed the formulated diet (25%CP) grew better than those reared at higher density (5.0 g/L) and fed the commercial diet (22.5%CP) .

The best growth performance and survival rates were observed in the first treatment (LD-FD) 2.5 g/L stocking density + feed of formulated diet, While the lowest performance was recorded for fourth treatment (HD-CD) 5.0 g/ L stocking density +feed of commercial diet.

This may be due to the increased stresses and stocking caused by crowding and social interactions among fish treatments. These results agree with Barcellos (1999), Ridha (2006) Ibrahim *et al*. (2006) and Piccolo *et al*. (2008) who showed that increasing stocking density for tilapia and other speeches reflected a stress and lower growth and survival rates for these fishes under laboratory conditions.

On the other hand, Cruz and Ridha (1995) recommended a stocking density of 1000 fish /m3 (equivalent to 2g / L) at a feeding rate of 2.5 % for the optimum production of O. spilurs fingerlings (2 g average body weight) grown in tanks during winter using underground seawater.

Many reports indicated the adverse relationship between weight gain and stocking density in many warm-water fish species, i.e. Nile tilapia (El-Sagheer, 2001; El-Sayed, 2002 and Ibrahim *et al*. 2006), O. spilurus (Cruz and Ridha, 1995), channel catfish (Esquivel *et al*., 1997), sea bass (Papoutsoglou *et al*., 1998) and carp (Sharma and Chakrabarti, 1998).

The effects of stocking density regardless of feed types on growth performance and survival rates in the present study are shown in Table (4). The results of specific growth rate (SGR) in the present study are agree with those indicated by Moustafa (1993) who found that SGR of caged tilapia (30g BW) decreased linearly as the stocking density increased from 80 to 140 fish / m2 .

These results agree with were obtained in many fish species reared under different culture systems as follows: Nile tilapia held in glass aquaria (Eid and Magouz, 1995 and Ibrahim *et al*. (2006), Nile tilapia reared in tanks, floating cages and concrete ponds (Eid and El-Gamal,1996), Nile tilapia reared in earthen ponds (El-Sagheer, 2001), *O. spilurus* in tanks (Cruz and Ridha, 1995), grass carp held in re-circulating systems (Sharma and Chakrabarti, 1998), sea bass in tanks (Papoutsoglou *et al.*, 1998).

It could be concluded that conclusions derived from stocking density experiments could be varied widely according to the variations in experimental conditions (e.g., species, culture systems, initial fish size, differences in biomass attained, feed quality, water current speed, etc. Therefore, generalization of such conclusions could be very erroneous (Eid and El-Gamal, 1996).

Results in Table (5) observed significant differences were detected among diet types, irrespective of stocking density; it was observed that the diet type significantly influenced the AWG, ADG and SGR. The formulated diets gave higher values in these parameters compared with the commercial diets. The differences found in growth measurements may be also due to the difference in dietary protein level and crude fat; In addition, increasing fishmeal amount was effective for covering the essential amino acids profile required for higher growth.

These results agree with were obtained by Egna and Boyd (1997) who showed that 7-15 % animal protein source (fishmeal, meat meal …etc.) is necessary to avoid the shortage in amino acids requirements in channel catfish.

The dietary lipid level (4%) of the commercial diet was lower than that reported by Wilson (1991), who stated that dietary lipid levels of 5 to 6%as the lipid requirements for tilapia. Accordingly, the formulated diet (6.25% lipid) was more efficient to supply the lipid requirements of fish. In this connection, Hanley (2001) who found that no significant differences in terms of growth rate, feed conversion efficiency and protein gain as the dietary lipid level increased from 5 to 12% and concluded that the protein rather than energy was of greater significance in such feeds.

On the other hand, many studies reported that tilapia require 8% lipid in their diet to obtain higher growth and it must be a goal in tilapia nutrition to maximize the use of protein for growth via minimize its use for energy by supplying adequate amounts of alternative dietary energy sources (Magouz *et al.,* 2002).

Effect of stocking density and feeding type on survival rates:

Table (3) indicates that there were significant differences were observed in survival rates among fish treatments as affected by stocking density and diet type, favoring lower stocking densities. Clear trend was observed in survival rates among the experimental treatments, The first treatment was gave the best and lowest survival rate compared with other treatments and the fish reared in the low stocking density was gave the best and highest survival rate compared with the fish reared in the high stocking density, fish fed formulated diet was gave the best and highest survival rate compared with fish fed commercial diet. Over the recent years, many evidences have been accumulated to support the negative relationship between fish stocking densities and their survival rates (Eid and El-Gamal, 1996; El-Sagheer, 2001 and Ibrahim *et al*., 2006).

On the other side, Cruz and Ridha (1995) showed that no significant differences in survival rates among fish groups reared under different stocking densities. Also, El-Saidy *et al.* (1999) and Magouz *et al.* (2002) did not any significant effects in survival rates among tilapia groups fed different dietary protein levels.

Effect of stocking density and feeding type on protein and feed utilization:

Results in Table (6) showed that the best FCR value was for Blue Tilapia fingerlings reared at the lower density (2.5 g/L) and fed the formulated diet (25%CP) in the first treatment (LD-FD), but the worst value was of Blue Tilapia fingerlings reared at higher density (5.0 g/L) and fed the commercial diet (22.5%CP) in the fourth treatment (HD-CD).

Averages of protein efficiency ratio (PER) and protein productive value (PPV) were significantly values, the differences among treatments were significant, favoring the lower density with formulated diet in the second treatment. Energy utilization also reflected some significant differences among fish treatments. The best EU was recorded for the first treatment followed by the third treatment, the first treatment and the lowest value in the third treatment. No significant differences were detected in feed intake among fish treatments as affected by stocking density and diet type, although the amount of feed intake in the third treatment was somewhat lower than those in the other treatments. Many reports indicated that FCR became worst at the higher densities (Eid and El-Gamal, 1996; Sharma and Chakrabarti, 1998; El-Sagheer, 2001; El-Sayed, 2002; Ibrahim *et al*., 2006; Ridha, 2006 and Piccolo *et al*., 2008)

Also, as shown in Table (7) feed intake was reduced and associated with higher stocking density may be explained by the aggressive behavior of tilapia (Huang and Chiu, 1997) and their competition for their feed. Similar results were reported by El-Sagheer (2001).However, no significant differences in PER values were detected between different stocking densities under the conditions of this study. Eid and El-Gamal (1996) who showed that an adverse relationship between both of PPV and PER on one side and stocking density on the other hand under several types of culture systems.

El-Sagheer (2001) who found that all of the parameters of protein and feed utilization became worse with increasing fish stocking density.

Effects of diet type regardless of stocking density on FCR, PER, PPV and EU are summarized in Table (8).There were significant affected and they were poorer in fish fed commercial diet than those fed the formulated diet. The decline in protein and feed utilization efficiency may be due to the reduction in dietary protein and lipid levels as well as reduced animal protein percent and in turn, the levels of essential amino acids. In this context, Eid *et al.* (1995) who observed a relatively poorer FCR and PER related to plant protein as compared with fishmeal based-diet and the probable consequence of either amino acids imbalance or lower digestibility or both of them.

The increased ability of fish fed the formulated diet to utilize the feed and protein as compared with those fed the commercial diet may be attributed to the addition of vitamins and minerals premix to the formulated diet. The use vitamins and minerals premix, even in very low levels was proven to improve the feed utilization and in turn, fish growth as well as to avoid deficiency signs (Wilson, 1991).

In this respect, Lim (1999) studded that the importance of supplementing vitamins mixture to feeds in the intensive culture systems, especially when the feeding of fish depends only on the artificial diets as a result for inadequate or absent natural fish feed.

Effect of stocking density and feeding type on body chemical composition:

Table (9) indicated that there are significant differences in the whole body composition among the experimental treatments except for DM. CP , EE , ash and DM values ranged from 60.4 to 55.1 %, 19.5 to 16.2%, 19.5 to 16.20 % and 27.33 to 25.33 %, respectively. Carcass DM tended to decrease with increasing stocking density.

Carcass CP and EE tended to increased with using formulated diet, But Carcass ash tended to increased with using commercial diet at different stocking densities.

Fadholi and Zonneveld (2001) who found that no significant differences in DM and CP contents in red tilapia reared in earthen ponds at different stocking densities.

Whole body composition including DM, CP, EE and ash are shown in Table (10), as affected by stocking density irrespective of the type of diet. The data illustrates that there were no significant differences in the whole body composition among fish treatments reared on different stocking densities.

Table (11) showed that the carcass composition of the experimental fish as affected by the diet type regardless of the stocking density. It was showed that the CP and EE contents of the Whole body composition increased significantly in fish treatments fed the formulated diet as compared with those fed on the commercial diet, while the opposite trend was recorded for the ash content.

These results are agreement with those reported by Magouz *et al*. (2002), who found that the CP% content of Nile tilapia significantly improved as the dietary protein level increased from 20 to 30%, but the EE content showed the opposite trend.

The findings of the present study were confirmed by those obtained by Silva *et al.* (2001) and Magouz *et al.* (2002) who showed that comparable results. ON the same trend, Piccolo *et al.* (2008) evaluated the effect of feed quality and stocking density on Dover sole (*Solea solea*) and found that except for the lipid content, which was higher in the low-density group, proximate composition of sole's muscle was not influenced by treatments. Furthermore, changes in protein and lipids contents in fish body could be linked with changes in their synthesis and/or deposition rate in muscle (Soivio *et al*., 1989 and Abdel-Tawwab *et al*., 2006).

This positive relationship between CP% and EE% in our work was confirmed by the findings of El-Saidy *et al.* (1999). Body ash content decreased in fish fed the formulated diet (25%CP) as compared with those fed the commercial diet (22.5%CP) and this disagreed with the findings of El-Saidy *et al.* (1999).The incorporation of higher amounts of bone meal (4%), di-calcium phosphate (3.5%) and limestone (3%), may be the reason for increased ash content in fish fed on the commercial diet.

Effect of stocking density and feeding type on economic analysis:

Table (12) illustrates that fish fed the formulated diet and reared at the lower density (2.5 g/L) and fed the formulated diet (25%CP) in the first treatment (LD-FD) had the highest economic efficiency as compared with the other treatments. This may be due to the superiority of this diet to satisfy nutrient requirements of fish and consequently resulted in much higher growth when compared with the commercial diet. Moreover, the lower density was more efficient in terms of feed utilization, growth performance and survival rates as compared with those of the higher stocking density.

It could be concluded that blue tilapia, Oreochromis oureus fingerlings exhibited a better growth when fed on formulated diet that may be well constructed and formulated meeting the fish requirement more than the commercial one. The appropriate fish density was 2.5 g / L hence; however, the high density (5.0 g / L) might be cause a chronic stress that retarded the fish growth. More investigations or work should be done in earthen fishponds.

Table (1): Composition and proximate analysis of formulated and commercial diets.

Ingredients (%)	Commercial diet	Formulated diet
Fish meal (72%)	-	10.0
Fish meal (65%)	5.0	-
Soybean meal (44%)	27.0	34.0
Corn gluten (60%)	10.0	-
Wheat bran	15.0	20.0
Yellow corn	30.0	30.0
Sunflower oil	-	5.0
Bone meal	4.0	-
Di-calcium phosphate	3.5	0.5
Limestone	3.0	-
Molasses	2.0	-
Salt	0.5	-
Min. and Vit. Mix. @	-	0.5
Total %	100	100
Proximate analysis (%)		
Dry matter	89	89
Crude Protein	22.5	25.0
Ether Extract (%)	4	6.25
Crude fiber (%)*	4.50	3.95
Ash	15.52	11.33
NFE	54.51	54.47
ME(k cal/kg)**	3239	3532
Protein/ energy ratio (mg protein/kcal ME)	69.55	70.1

@ Vitamins: Vit A:5.7143 IU, Vit B1 : 571 Mg , Vit B2 : 343 mg , Vit C : 7.143 µg, Vit B6: 571 mg , Vit B12 : 7.143µg, Vit K3: 1.429mg, Vit D3: 85.714 IU , Biotin : 2.857mg , Folic acid :86mg, Pantothenic acid : 1.143mg .

Minerals: Iodine :114 gm , Cobalit :229 gm , Phosphorus: 28.57mg,Manganese :68.57mg , Iron : 34.286mg , Zinc : 51.43 mg , Selenium : 286 gm, Copper: 5.714 mg, Starch: 57 gm, Natural H: 29gm, CaCo3:1000gm.

*Crude fiber did not include in calculating ME of the diets.

** Metabolizable energy (ME) calculated using values of 4.50, 4.10 and 3.49 Kcal / Kg for protein, fat and carbohydrate, respectively.

Table (2): Amino acids contents of the experimental diets.

Amino acid (mg/100mg)	Commercial diet	Formulated diet
Essential amino acids		
Argenine	1.56	2.21
Histidine	0.56	1.23
Isoleucine	0.89	2.04
Leucine	1.77	2.47
Lysine	1.26	2.07
Methionine	0.31	0.55
Phenylalanine	1.11	1.46
Threonine	0.78	1.44
Tryptophan	ND*	ND
Valine	1.02	2.29
Non-essential amino acids		
Alanine	1.13	1.56
Aspartic	2.21	3.31
Cystine	0.32	0.31
Glutamic	4.21	3.72
Glycine	1.05	1.32
Proline	1.25	2.31
Serine	0.97	1.22
Tyrosine	0.85	0.94

* ND = Not determined

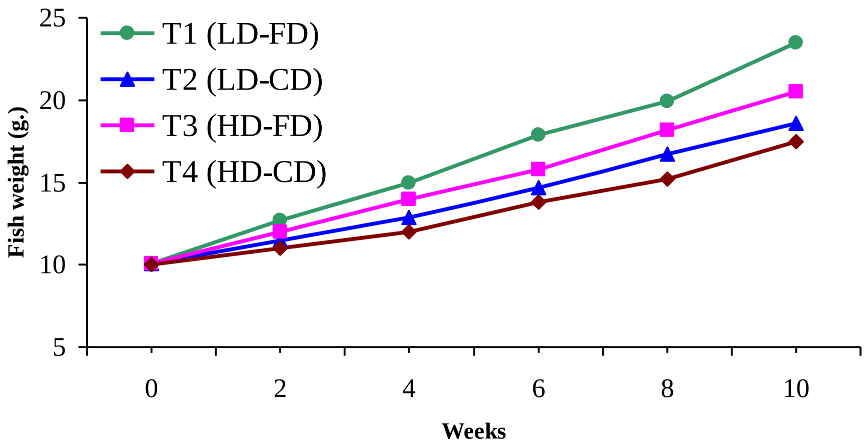

Figure (1): Changes in live body weight (g) of blue tilapia fed on the formulated diet (FD) or commercial diet (CD) under two stocking densities during the experiment (10 weeks).

Table (3): Effect of stocking densities and feed type on growth performance of Blue Tilapia.

Treatments	Stocking density	Feed type	AIW (g/fish)	AFW (g/fish)	AWG (g/fish)	ADG (g/fish /day)	SGR (%/day)	SR %
1(LD-FD)	Low (2.5)	Formulated	10.1[a] ±0.20	23.5[a] ±0.47	13.4[a] ±0.27	0.19[a] ±0.004	1.21[a] ±0.025	96.70[a] ±3.33
2(LD-CD)	Low (2.5)	Commercial	10.1[a] ±0.20	18.6[c] ±0.37	8.5[c] ±0.17	0.12[c] ±0.003	0.87[c] ±0.018	93.30[a] ±3.17
3(HD-FD)	High (5.0)	Formulated	10.1[a] ±0.20	20.5[b] ±0.41	10.4[b] ±0.21	0.15[b] ±0.004	1.01[b] ±0.018	90.00[b] ±2.91
4(HD-CD)	High (5.0)	Commercial	10.0[a] ±0.20	17.5[c] ±0.35	7.5[c] ±0.15	0.11[d] ±0.003	0.80[c] ±0.014	86.70[c] ±1.70

[a–d]Means ± standard error in the same column with different letters, differ significantly ($P \leq 0.05$).

Table (4): Effect of stocking densities on growth performance of Blue Tilapia.

Stocking **density**	**AIW (g/fish)**	**AFW (g/fish)**	**AWG (g/fish)**	**ADG (g/fish/day)**	**SGR (%/day)**	**SR %**
Low (LD) (2.5)	10.01[a] ±0.20	21.05[a] ±0.45	11.04[a] ±0.23	0.16[a] ±0.004	1.04[a] ±0.019	95.00[a] ±3.31
High (HD) (5.0)	10.01[a] ±0.20	19.03[b] ±0.41	9.02[b] ±0.19	0.13[b] ±0.003	0.91[b] ±0.017	88.35[b] ±1.92

[a-b] Means ± standard error in the same column with different letters, differ significantly ($P \leq 0.05$).

Table (5): Effect of feed type on growth performance of Blue Tilapia.

Feed type	**AIW (g/fish)**	**AFW (g/fish)**	**AWG (g/fish)**	**ADG (g/fish/day)**	**SGR (%/day)**	**SR %**
Formulated (FD)	10.01[a] ±0.20	22.00[a] ±0.46	11.99[a] ±0.24	0.170[a] ±0.004	1.11[a] ±0.015	93.35[a] ±3.02
Commercial (CD)	10.01[a] ±0.20	18.08[b] ±0.40	8.07[b] ±0.18	0.115[b] ±0.003	0.84[b] ±0.012	90.00[b] ±2.67

[a-b] Means ± standard error in the same column with different letters, differ significantly ($P \leq 0.05$).

Table (6): Effect of stocking densities and feed type on feed and protein utilization of Blue Tilapia.

Treatments	**Stocking Density (g/L)**	**Feed type**	**Feed intake (g/fish)**	**FCR**	**PER**	**PPV (%)**	**EU (%)**
1(LD-FD)	**Low (2.5)**	**Formulated**	**16.50[ab] ±0.57**	**1.20[c] ±0.06**	**1.98[a] ±0.039**	**41.06[a] ±0.80**	**20.70[a] ±0.40**
2(LD-CD)	**Low (2.5)**	**Commercial**	**17.30[a] ±0.73**	**2.10[a] ±0.13**	**1.29[c] ±0.026**	**25.60[c] ±0.51**	**12.20[c] ±0.24**
3(HD-FD)	**High (5.0)**	**Formulated**	**15.70[b] ±0.60**	**1.50[b] ±0.02**	**1.62[b] ±0.032**	**29.80[b] ±0.60**	**14.70[b] ±0.29**
4(HD-CD)	**High (5.0)**	**Commercial**	**16.60[ab] ±0.58**	**2.20[a] ±0.14**	**1.21[c] ±0.024**	**22.70[d] ±0.45**	**11.30[c] ±0.23**

[a-d] Means ± standard error in the same column with different letters, differ significantly ($P \leq 0.05$).

Table (7): Effect of stocking densities on feed and protein utilization in Blue Tilapia.

Stocking Density	Feed intake (g/fish)	FCR	PER	PPV (%)	EU (%)
Low (LD) (2.5)	16.90 [a] ±0.59	1.65 [b] ±0.04	1.64 [a] ±0.033	33.33 [a] ±0.62	16.45 [a] ±0.32
High (HD) (5.0)	16.15 [a] ±0.55	1.85 [a] ±0.07	1.42 [b] ±0.029	26.25 [b] ±0.53	13.00 [b] ±0.27

[a-b] Means ± standard error in the same column with different letters, differ significantly ($P \leq 0.05$).

Table (8): Effect of feed type on feed and protein utilization in Blue Tilapia.

Feed Type	Feed intake (g/fish)	FCR	PER	PPV (%)	EU (%)
Formulated (FD)	16.10 [a] ±0.56	1.35 [b] ±0.04	1.80 [a] ±0.035	35.43 [a] ±0.65	17.70 [a] ±0.41
Commercial (CD)	16.95 [a] ±0.59	1.85 [a] ±0.07	1.25 [b] ±0.026	24.15 [b] ±0.51	11.75 [b] ±0.24

[a-b] Means ± standard error in the same column with different letters, differ significantly ($P \leq 0.05$).

Table (9): Effect of stocking densities and feed type on body chemical composition of Blue Tilapia.

Treatments	**Stocking Density (g/L)**	**Feed type**	**DM %**	**On dry matter basis%**		
				CP	**EE**	**Ash**
1(LD-FD)	Low (2.5)	Formulated	26.33 [a] ±0.83	58.33 [a] ±1.97	18.62 [a] ±0.71	16.41 [b] ±0.54
2(LD-CD)	Low (2.5)	Commercial	26.00 [a] ±0.78	55.91 [b] ±1.52	17.03 [b] ±0.64	19.52 [a] ±0.69
3(HD-FD)	High (5.0)	Formulated	26.40 [a] ±0.86	57.51 [ab] ±1.83	18.75 [a] ±0.72	16.23 [b] ±0.52
4(HD-CD)	High (5.0)	Commercial	25.71 [a] ±0.65	55.22 [b] ±1.46	16.34 [b] ±0.53	19.71 [a] ±0.73

[a-b] Means ± standard error in the same column with different letters, differ significantly ($P \leq 0.05$).

Table (10): Effect of stocking density on body chemical composition of Blue Tilapia.

Stocking density	**DM%**	**On dry matter basis%**		
		CP	**EE**	**Ash**
Low(LD) (2.5)	26.17 [a] ±0.82	57.12 [a] ±1.79	17.83 [a] ±0.70	18.47 [a] ±0.69
High(HD) (5.0)	26.06 [a] ±0.79	56.37 [a] ±1.65	17.55 [a] ±0.68	17.97 [a] ±0.64

[a-b] Means ± standard error in the same column with different letters, differ significantly **(**$P \leq 0.05$).

Table (11): Effect of feed type on body chemical composition of Blue Tilapia.

Feed type	DM%	On dry matter basis%		
		CP	EE	Ash
Formulated (FD)	26.37 [a] ±0.81	57.92 [a] ±1.82	18.69 [a] ±0.81	16.82 [b] ±0.63
Commercial (CD)	26.20 [a] ±0.79	55.57 [b] ±1.61	16.69 [b] ±0.65	19.62 [a] ±0.74

[a-b] Means ± standard error in the same column with different letters, differ significantly ($P \leq 0.05$).

Table (12): Effect of stocking densities and feed type on the economic efficiency of Blue Tilapia fingerlings.

Treatments	Stocking Density (g/L)	Feed type	Feed cost / kg diet (LE)	Feed cost / kg fresh fish (LE)	Relative feed cost/ kg fresh fish (%)
1(LD-FD)	Low (2.5)	Formulated	1.58	3.22	101.03
2(LD-CD)	Low (2.5)	Commercial	1.60	5.23	165.29
3(HD-FD)	High (5.0)	Formulated	1.58	4.01	127.53
4(HD-CD)	High (5.0)	Commercial	1.60	5.44	172.05

REFERENCES

Abdel-Tawwab, M., Y.A.E. Khattab, M.H. Ahmad, and A.M.E. Shalaby (2006): Compensatory growth, feed utilization, whole body composition and hematological changes in starved juvenile Nile tilapia, *Oreochromis niloticus* (L.). Journal of Applied Aquaculture, 18:17-36.

A.O.A.C. (1991). Official Methods of Analyses. 15*th* edition. K. Helrich (Ed.). Association of Official Analytical Chemists Inc., Ar, VA, USA.

Barcellos, L.J.G., S.Nicolaiewsky, S.M.G. de Souza and F. Lulhier. (1999). The effect of stocking density and social interaction on acute stress response in Nile tilapia Oreochromis niloticus (L.) fingerlings. Aquaculture Research, 30: 887-892.

Baumgarner, B.L., T.E. Schwedler, A.G.Eversole, D.E. Brune and J. A. Collier. (2005). Production characteristics of channel catfich, Ictalurus punctatus, stocked at two densities in the partitioned aquaculture system. Journal of Applied Aquaculture, 17(2): 75-83.

Cruz, E. M. and M. T. Ridha. (1995).Survival rates of tilapia, Oreochromis spilurus, fingerlings reared at high densities during winter using warm underground sea water. Aquaculture Research, 26: 307-309.

Duncan, D. B. (1955): Multiple range and multiple F test. Biometrics, 11:1-42.

Dytham, C. (1999): Choosing and using statistics: A Biologist’s guide. Blackwell Science Ltd., London, United Kingdom.

Egna, H. S. and C. E. Boyed (1997). Dynamics of pond aquaculture. CRC Press LLC, Boca Raton, Florida. USA.

Eid, A.E. and El-Gamal. (1996). Effects of stocking density on growth performance of Nile tilapia (Oreochromis niloticus) reared in three different culture systems. J. Anim. Prod., 33 (Special Issue): 485-498.

Eid, A.E., M. A. Dansoury, F. Z. Swidan and K. A. El-Sayed. (1995). Evaluation of twelve practical diets for fingerlings Nile tilapia

(*Oreochromis niloticus*). Proc. 5th Sci. Conf. on Animal Nutrition. 12-13, Dec. Suez Canal University, Ismailia, Egypt.

El-Sagheer, F. H. M. (2001). Effect of stocking densities, protein levels and feeding frequencies on growth and production of tilapia monosex in earthen ponds. Ph.D. Thesis. Fac. of Agriculture, Alexandria University.

Ellis, T., B. North, A.P. Scott, N.R. Bromage, M. Porter, and D. Gadd (2002): The relationships between stocking density and welfare in farmed rainbow trout. Journal of Fish Biology 61, 493-531.

El-Saidy, S. D., M. A. Gaber and F. I. Magouz. (1999). Growth response of Nile tilapia fry (*Oreochromis niloticus*) fed diets containing different levels of protein . Egypt. J. Aquat. Biol. & Fish., 3(3): 137-158.

El-Sayed A.-F.M. (2002): Effects of stocking density and feeding levels on growth and feed efficiency of Nile tilapia (*Oreochromis niloticus* L.) fry. Aquaculture Research, 33: 621-626.

El-Sayed, A.-F.M. (2006): Tilapia Culture. CABI Publishing, CABI International Wallingford, Oxford shire, UK.

Esquivel, B. M., J. R. Esquivel and E. Zaniboni. (1997). Effects of stocking density on growth of channel catfish, Ictalurus punctatus, fingerlings in southern Brazil. Journal of Applied Aquaculture, 7(3):1-6.

Fadholi.R. M. and N.M. Zonneveld. (2001). Feed intake and growth of red tilapia at different stocking densities in ponds in Indonesia. Aquaculture, 109:183-194.

FAO (2004): Food and Agricultural Organization Fishery Statistics. Aquaculture Production at: http: www.faostat.fao.org/FAO Stat./notes/units-e.html.

Hanley, F. (2001). Effects of feeding supplementary diets containing varying levels of lipid on growth, feed conversion and body composition of Nile tilapia (*Oreochromis niloticus* L.). Aquaculture, 103:623-634.

Huang, W-B. and T.-S. Chiu. (1997): Effects of stocking density on survival, growth, size variation, and production of *Tilapia* fry. Aquaculture Research, 28: 165-173.

Ibrahim. M.A., Y. A. Hammouda, Manal .M. A. Zaki EL-Din, F. I. Magouz and A. M. Tahoun (2006).Effect of stocking density and diet composition on growth performance and feed utilization of Mono-sex Nile tilapia (Oreochromis Niloticus) fingerlings . Egypt. J. Agric. Res., 84(1B):353-370.

Lim, C. (1999). Practical feeding – tilapias in Lovell, R.T. Nutrition and feeding of fish. Van Norstrand Reinhold. New York.

Magouz, F. I., M. K. Mosen and N. M. Abd-El-Moniem. (2002). Utilization of different sources and levels of lipids in the diet of Nile tilapia (*Oreochromis niloticus*). Proc, 2nd Conf. Food borne Contamination and Egyptians Health, 23-24 April, El-Mansoura, Egypt.

Moor, S., D. H. Speckman and W. H. Stein. (1958). Chromatography of amino acids on sulfonated polystyrene resins. Analyt. Chem., 30:1185.

Moustafa, E. T. (1993). Studies on factors affecting productive performance of Tilapia nilotica raised in cages. Ph. D. Thesis, Faculty of Agriculture, Al-Azhar University.

Papoutsoglou, S. E., G. Tziha, X. Vrettos and A. Athanasiou. (1998). Effects of stocking density on behavior and growth rate of European sea bass (Dicentrachus labrax) juveniles reared in closed circulated system. Aquacultural Engineering, 18:135-144.

Piccolo, G., S. Marono, F. Bovera, R. Tudisco, G. Caricato, and A. Nizza (2008): Effect of stocking density and protein/fat ratio of the diet on the growth of Dover sole (*Solea solea*). Aquaculture Research, 39: 1697-1704.

Ridha, M. T. (2006). Comparative study on growth performance of three strains of Nile tilapia (*Oreochromis niloticus*) at two stocking densities. Aquaculture Research, 37(2): 172-179.

Robel G. L. and W.L. Fisher (1999): Bioenergetics estimate of the effects of stocking density on hatchery production of small mouth bass fingerlings. North American Journal of Aquaculture, 61: 1-7.

Sharma, J. G. and R. Chakrabarti. (1998). Effects of different stocking densities on survival and growth of grass carp, Ctenopharyngodon idella, larvae using a recirculating culture system. Journal of Applied Aquaculture, 8(3):79-83.

Soivio, A., M. Niemisto, and M. Backstrom (1989): Fatty acid composition of *Coregonus muksun* Pallas: Changes during incubation, hatching, feeding and starvation. Aquaculture, 79: 163-168.

Stickney, R.R. and W.A. Wurts (1986): Growth response of blue tilapia to selected levels of dietary menhaden and catfish oils. Prog. Fish-Cult., 48: 107– 109.

Wilson, R.P. (1991). Handbook of nutrient requirements of finfish. CRC Press Inc., Boca Ration, Florida, USA.

تأثير أختلاف كثافة الأستزراع ونوع الغذاء على أداء النمو والكفاءة الغذائية والمكونات الكيميائية لجسم أصبعيات البلطى الأزرق

أمل سيد حسن محمد – ابراهيم موسى سمرة

قسم أنتاج الأسماك و نظم الأستزراع – المعمل المركزي لبحوث الثروة السمكية ، العباسة ، ابوحماد ، محافظة الشرقية ، مصر

الملخص العربى

أجريت هذة التجربة بالمعمل المركزى لبحوث الثروة السمكية بالعباسة أبو حماد بمحافظة الشرقية وذلك لدراسة تأثير أختلاف كثافة الاسماك ونوعية الغذاء المقدم على أداء النمو والكفاءة الغذائية ومكونات جسم أصبعيات اسماك البلطى الازرق.

حيث تم أستخدام أصبعيات البلطى الأزرق بمتوسط وزن حوالى ١٠ جم / سمكة وتم توزيع الأسماك فى أحواض زجاجية مقاس ٨٠ × ٤٠ × ٤٠ سم بمعدلات كثافة استزراع كوحدة وزن ٢.٥، ٥.٠ جم / لتر و تم تغذية الاسماك فى كل كثافة اما على عليقة تجارية جاهزة او على عليقة مصنعة فى المعمل تحتوى كل منهما على ٢٥ % بروتين وتم تغذية الاسماك بمعدل ٣% من وزن الجسم يوميا لمدة عشرة أسابيع وكانت المعاملات كالتالى:–

- المعاملة الاولى كثافة الاستزراع ٢.٥ جم / لتر + التغذية على عليقة مصنعة معمليا
- المعاملة الثانية كثافة الاستزراع ٢.٥ جم / لتر + التغذية على عليقة تجارية
- المعاملة الثالثة كثافة الاستزراع ٥.٠جم / لتر + التغذية على عليقة مصنعة معمليا
- المعاملة الرابعة كثافة الاستزراع ٥.٠ جم / لتر + التغذية على عليقة تجارية

و تم اجراء التجربة فى اثنا عشر حوض لكل معاملة ثلاث مكررات وتم التربية تحت نفس الظروف واستمرت التجربة عشرة اسابيع . وكانت أهم النتائج المتحصل عليها كالاتى :

١– كانت هناك فروق معنوية فى وزن الجسم (AWG) ومعدل النمو اليومى (ADG) وكذلك معدل النمو النوعى (GR) بأختلاف المعاملات المدروسة ، واعطت المعاملة الأولى اعلى قيم للمعاملات السابقة . بينما اعطت المعاملة الرابعة اقل قيمة لهذه المعاملات.

٢– تأثرت قيم معامل التحويل الغذائى (FCR) وكذلك الكفاءة النسبية للبروتين (PER) والقيمة الانتاجية للبروتين (PPV%) كفاءة استخدام الطاقة تأثرا معنويا باختلاف المعاملات

حيث اعطت المعاملة الاولى (كثافة الاستزراع ٢.٥ جم / لتر + التغذية على عليقة مصنعة معمليا) افضل القيم.

٣- لم يتأثر محتوى الجسم من المادة الجافة معنويا بأختلاف المعاملات، بينما تأثر محتواة من كلا من البروتين الخام والرماد والمستخلص الاثيرى واعطت المعاملة الاولى والثالثة (كثافة الاستزراع ٢.٥ جم / لتر + التغذية على عليقة مصنعة معمليا و كثافة الاستزراع ٥.٠جم / لتر + التغذية على عليقة مصنعة معمليا) اعلى قيمة لمحتوى الجسم من البروتين الخام والمستخلص الاثيرى.

٤- لم تتأثر معنويا قيمة كلا من الزيادة فى الوزن ومعدل النمو ، بينما تأثرت معنويا قيم معدل النمو النوعى بأختلاف كثافة الاستزراع ، ولم تتأثر معنوية كلا من معامل التحويل الغذائى والكفاءة النسبية للبروتين وكذلك القيمة الانتاجية للبروتين وكفاءة استخدام الطاقة (EU%) بأختلاف كفاءة الاستزراع ، و كانت افضل قيم للمعاملات السابقة مع كثافة الاستزراع المنخفضة (٢.٥ جم / لتر).

٥- لم يتضح وجود فروق معنوية فى محتوى الجسم من كلا من المادة الجافة والبروتين الخام والمستخلص الاثيرى والرماد بين كثافتى الاستزراع ، وان كان معدل الاعاشة انخفض معنويا بزيادة كثافة الاستزراع.

٦- اوضحت دراسة الكفاءة الاقتصادية (تكلفة الغذاء / كجم زيادة فى الوزن) ان المعاملة الاولى (كثافة الاستزراع ٢.٥ جم / لتر + التغذية على عليقة مصنعة معمليا) هى الافضل اقتصاديا، بينما المعاملة الرابعة (كثافة الاستزراع ٥.٠ جم / لتر + التغذية على عليقة تجارية) هى الاقل اقتصاديا.

وتوصى التجربة بتربية أصبعيات اسماك البلطى الأزرق بكثاقة ٢.٥جم / لتر مع أستعمال العلائق المصنعة معمليا والتى تحتوى على ٢٥% بروتين تحت ظروف التجربة لأعطاء افضل معدلات وزن وافضل كفاءة انتاجية و أفضل مواصفات مكونات جسم بالمقارنه بالكثافة الاعلي والتى غذيت على العليقة التجارية مما يعود على مربى هذة الانواع من الاسماك بزيادة العائد من الاستزراع والتربية.