Egyptian J. Nutrition and Feeds (1999) 2 (Special Issue): 765-778

EFFECT OF STOCKING RATE, ORGANIC FERTILIZATION AND SUPPLEMENTARY FEED ON GROWTH PERFORMANCE, CARCASS AND CHEMICAL ANALYSIS OF NILE TILAPIA, *Oreochromis niloticus*

M. A. Soltan[1], N. F. Abdel-Hakim, [2] and M. N. Bakeer[3]

1 - Fact. Agric. Moshtohor, Zagazig university, Banha Branch
2 -Fac. Agric. Al-Azhar University
3 -Central Laboratory for Aquaculture Research at Abassa, Sharkia Governorate, Egypt

SUMMARY

This study was carried out to investigate the effect of stocking rate of tilpaia and fertilization rate as well as artificial feeding on the growth performance, carcass traits and whole body analysis of Nile tilapia *O. niloticus* throughout 105 days growth period. Fish were stocked in six earthen ponds each of a total area of 0.24 feddan representing two stocking densities (1000 and 2000 fish per pond), within each stocking density two manuring rates (100 and 150 kg poultry litter/pond) and one artificial feeding (diet containing 25% protein) were tested. At the experimental start the initial weight of the experimental fish was 16.7 g on the average. Results obtained can be summerized on the following:

- Treatments applied had significant effect on final body weight, body length, body width and body depth for the favor of the lower stocking density and artificial feeding.
- Feeding tilapia on artificial diet increased total production at harvesting after 105 day compared with the manuring at both rates tested, however increasing the rate of manuring tended to increase the total yield.
- Increasing the fish stocking density resulted in an increase in the total fish yield in all treatments tested.
- Treatments applied released significant effects on carcass traits tested.
- Whole body protein, fat and ash contents were influenced significantly by the treatments applied, however moisture contents in the whole body were not significantly affected.
- The same trend was noticed in flesh contents of moisture, protein, fat and ash.

INTRODUCTION

Tilapia are freshwater cichlids originally cultured as early as 2500 B.C. in Egypt, and they have been used for aquatic vegetation control, food and recreation (Sample, 1992).

According to FAO data, the annual production of Nile tilapia *(Oreochromis niloticus)* in Egypt for 1989 was 25000 MT and 19857 MT for 1993 (FAO, 1995) and these amounts constitute 80.7% and 76.3% of the total production of freshwater fishes in the two years 1989 and 1993, respectively.

Rapid growth rates, high tolerance to low water quality, efficient food conversion, ease of spawning, resistance to disease, and good consumer acceptance make tilapia a suitable fish for culture especially in the tropics and subtropics, including most of the areas suffering from a lack of animal protein.

Despite the popularity of tilapia culture, the overall production of market-size tilapia per hectare has remained relatively low because of the introduction of poor culturable species, mixed-six culture and poor management.

Feed often represents 60% or more of the total fish production costs. A biologically feasible production system can be uneconomical because production costs associated with feed are expensive (Green, 1992).

The utilization of organic manure as the principal nutrient for earthen ponds is a traditional management practice in Asian aquaculture. The manure can be used in direct or indirect integration of fish and livestock. In the direct integration systems, fresh manure is continuously added to the ponds, while, in the indirect integration, the manure is transported to the ponds and used in fresh or treated forms in different mauring regimes (Pekar 1994).

The readily decomposable organic matter of the manure provides dissolved and particulate substances for bacteria, and the bacterial particles supply food to the filter-feeding and detritus-consuming animals, while, the mineralized fraction of the manure stimulates phytoplankton productivity similar to the action of inorganic fertilizers (Hepher and Pruginin 1981).

Schroeder (1980) demonstrated that, half of common carp growth in a polyculture system was based on natural foods found on pond bottom and banks, even in the presence of full ration of enriched feed pellets. Growth of tilapia in the same system was based 70% on natural food.

Manipulation of stocking densities is an established management consideration in pond aquaculture. Net fish yield tends to increase with increasing stocking density, but competition for natural food (Diana et al., 1991) and increased aggressive territorial behavior set limits to this positive relationship (Knud-Hansen and Kwei, 1996).

The chemical composition of an individual fish should characterize its physiological condition and, in general, its health. Furthermore, this physiological status determines the individual's ability to compete successfully (e.g., through optimal foraging and reproduction), sustained growth, maintain and repair tissues, and cope with stresses induced by environmental changes, (Brown and Murphy, 1991). Also knowledge of the proximate composition of the fish and factors affecting proximate composition allows determination of efficiency of nutrients transfer from the feed to the fish, and make it possible to predictably modify carcass composition (Shearer, 1994).

The objective of the present study is to evaluate the effects of stocking rate, inorganic fertilization and supplementary feed on growth traits, carcass analysis and the chemical composition of whole fish, fish flesh and by-products of Nile tilapia, *O. niloticus*.

MATERIALS AND METHODS

The present experiment was carried out at the Central Laboratory of Aquaculture Research at Abbassa, Sharkia Governorate, Egypt. Six earthen ponds each measuring 20×50 m containing approximately 1000 m^3 of freshwater were used in the experiment. Each pond had a surface area of 0.24 Feddan. The following six treatments (three feeding regime in two stocking rate for each) were used:

Treatment 1 (F1+SR1): fertilization by poultry litter (100 kg/pond/week) and stocking rate of 1000 fish/pond

Treatment 2 (F1+SR2): fertilization by poultry litter (100 kg/pond/week) and stocking rate of 2000 fish/pond

Treatment 3 (F2+SR1): fertilization with poultry litter (150 kg/pond/week) and stocking rate of 1000 fish/pond

Treatment 4 (F2+SR2): fertilization with poultry litter (150 kg/pond/week) and stocking rate of 2000 fish/pond

Treatment 5 (F3+SR1): supplementary feed and stocking rate of 1000 fish/pond

Treatment 6 (F3+SR2): supplementary feed and stocking rate of 2000 fish/pond.

Fish in the 5th and 6th treatments fed on the supplementary feed (25% protein) two times daily (9 a.m. and 2 p.m.) six days a week at a rate 3% of their biomass weight

Experimental ponds are supplied with freshwater from Ismaelia canal. The water level was maintained at approximately 1.0 meter and loss of water due to evaporation and leakage was replaced whenever necessary. Fingerlings *O. niloticus* had an average weight of 16.7g were stocked. A biweekly fish sample of 50 fish were weighed for determination of food amount for the next two weeks.

At harvesting (105 day after start) a sample of 150 fish from each pond were taken randomly and body weight (BW); body length (BL); body width (W) and body depth (BD) were measured.

Specific growth rate (SGR) were calculated according to Jauncey and Rose (1982) using the following formula:

$$\mathbf{SGR=100[(Ln\ Wt.2-Ln\ Wt.1/t]}$$

Where:

Ln = $(\log 10\ x)^{3.303}$, wt.1=first fish weight in grams; wt.2=following fish weight in grams and t =period in days.

Carcass and chemical analysis:

At harvesting, a sample of 20 fish were taken randomly from each pond. The first 10 fish in each sample were exposed to carcass test as described by Lovell (1981) and flesh as well as by-products of each individual fish were chemically analyzed for their proximate analysis individually. The other 10 fish were used for the chemical analysis of the whole fish body. All chemical analysis were conducted according to the methods of A.O.A.C (1990).

Statistical analysis:

The statistical analysis of data was carried out by applying the computer program Harvey (1990) by adopting the following fixed model.

$$\mathbf{Y_{ijk} = \mu + T_i + S_j + (TS)_{ij} + e_{ijk}}$$

where:

Y_{ijk} = observation of the ijk-th fish

μ = overall mean

T_i = fixed effect of the i-th treatment.

S_j = fixed effect of the j-th stocking density.

$(TS)_{ij}$ = interaction between the effect of i-th treatment and j-th stocking density

e_{ijk} = random error assumed to be independently randomly distributed (0, δ^2e).

Differences among means were tested for significance according to Duncan's multiple range test (1955).

RESULTS AND DISCUSSION

Growth traits:

Table (1) show the effect of feeding regime, stocking rate and their interactions on the different body measurements studied. Regardless of stocking rate, the increasing of fertilization rate (from 100 to 150 kg/pond/week) increase the body weight from 76.7 to 88.6 g, body length from 15.7 to 17.0 cm, body width from 2.07 to 2.32 cm and body depth from 5.36 to 5.81 cm. This result may be due to the increase in the production of primary production, phytoplankton and zooplankton resulted from the increase in fertilization rate. Results also referred to the higher body weight (107.5 g), length (18.0 cm), width (2.45 cm) and depth (6.11 cm) obtained with fish fed the supplementary feeding compared to the fish under the two fertilization rates used in this experiment. These results may be attributed to the availability of both natural and supplementary feed for fish in the third feeding regime (supplementary feed) and natural food only for the first and second feeding regime. Under the polyculture system of Nile tilapia and silver carp, Soltan (1998) had the same results for Nile tilapia and the opposite results were obtained with silver carp stocked with Nile tilapia in the same pond. In this respect, Abdel-Hakim and Hafez (1995) reported that, increasing poultry manure levels (500, 750 and 1000 kg/ha) increased significantly ($P<0.05$) growth performance of silver carp in the form of body weight and body length.

Regardless of feeding and fertilization rates, body weight; length, width and depth were negatively correlated to the stocking density of fish, however total fish yield at harvesting increased with increasing the stocking density. These results may lead us to recommended that, lower stocking densities of Nile tilapia of the marketable size is desired of the short rearing period otherwise higher stocking densities could be applied if the season will be expanded for longer period. Teichert-Coddington et al., (1990), Diana et al., (1991), Abdel-Wares (1993) found that, final mean weight of Nile tilapia, *O.niloticus* decreased with increasing stocking rate but the net yield was increased. With regard to the interactions between the feeding regime and stocking rate, results revealed that the 5^{th} treatment (F3 and SR1) produced the heavier, longest and deepest fish compared to the other treatments. The significance of variations due to the effect of interaction between feeding regime and stocking rate on body weight; length; width and depth showed that these two factors act dependently on each other and also each of them had its own significant effect.

Averages condition factor (K) for the experimental groups are given in Table (1). As evident in this table, feeding regime and stocking rate seemed to have no influence on the fish condition factor, indicating that these factors act independently on each other and each of them had its own insignificant effect on condition factor. Hafez et al., (1998) found that, the manuring rate (150, 300 and 450 kg/feddan) and stocking rate of 3200 and 4800 fish/feddan had insignificant effect on condition factor.

It could be concluded that poultry litter at both low and high levels used in this experiment promote growth performance of Nile tilapia in the form of body weight, body length, body width and body depth. These growth parameters are increased significantly with increasing manuring rate but these parameters obtained with the two manuring rates used in this study were lower than that obtained with the supplementary feed and the differences among fertilization rates and feeding regime were significant (Table 1).

Specific growth rate (SGR):

Results presented in table (2) revealed that artificial feed application in Nile tilapia reared in ponds improved the SGR values as compared to the two fertilization rates tested. Also these results showed that within each treatment applied the SGR values obtained at lower stocking rate were better than those obtained with higher ones. The increase in growth performance by artificial diets than fertilization was also reported by Hassouna et al., (1998). The better SGR with supplementary feed reflect the availability of all feeding materials due to the presence of artificial diet and natural food together in the pond. The obtained results are in the same direction to that reported by Soltan (1998) with Nile tilapia.

Total yield:

As presented in table (3) regardless of stocking density averages of fish total yield as affected with treatments applied per experimental pond and that calculated per feddan for F1, F2 and F3 were found to be 101.3; 125.1 and 153.7 kg/pond and 425.46; 525.42 and 645.54 kg/feddan, respectively. These results indicate that increasing the rate of organic fertilization increased the tilapia total yield, however the artificial feeding resulted in the highest fish yield compared to poultry litter fertilization. In this respect the lowest yield was obtained by F1 (100%) followed by F2 (123.5%) and artificial feed F3 (151.7%), respectively. These results are in agreement with those reported by Collis and Smitherman (1978) who showed that hybrid tilapia grew only 62% in manured ponds compared to those received a diet of high protein contents (100%). Also Barash and Shroeder (1984) showed that substitution of 46% of the feeds of fish by fermented cow manure did not decreased the total fish yield however the complete substitution of feeds by manure decreased the total yield by about 47%. In this connection results obtained by Green (1992) revealed that layer chicken litter can replace 27 to 58% of tilapia pelleted supplemented feed without significant effects on the total yield. Also Soltan (1998) showed that Nile tilapia fed on natural food enhanced by organic fertilization gained about 70.13% of the yield obtained with fish received supplementary feeding.

Regardless of treatments applied, fish total yield per pond and per feddan as affected with stocking density (1000 fish/pond or 2000 fish/pond) were 95.0 and 158.4 kg/pond and 399.0 and 665.3 kg/feddan, respectively. These results indicate that increasing tilapia stocking density from 1000 fish/pond to 2000 fish/pond increased the total yield by 66.7% (table 3). These results are in partial agreement with those obtained by Abdel-Wares (1993) who reported increased fish yield at harvested by increasing the stocking rate.

As shown in Table (3) the 6th pond (F3 × SR2) had the highest fish production (193.6 kg) and the first pond (F1 × SR1) had the lowest fish production (74.3). Lin (1994) reported that tilapia growth was lowest in fertilized ponds and highest in feed ponds and 52-89% of the variance in yield was explained by feed and fertilizer.

The present results show that, using poultry litter in two fertilization rates (100 and 150 kg/pond/week) as an organic fertilizer produce lower total yield for tilapia than using the supplementary feed , but where manure is available at a nominal cost it is preferable to use it as the net returns would be profitable compared with artificial feed alone. The choice of the optimal stoking rate of Nile tilapia and feeding type depend economically on the costs of feeding and the price of fish and the desired final market product and market size..

Carcass traits:

Fish filleting is an important process for preparing a much better fish flesh than dealing directly with whole fish. Fish filleting has the following advantages; it is easier to prepare, more convenient for the consumer to cook, easier for packing and transportation, especially when the refrigerated space in the transportation means is limited (Hussein, 1990).

Regardless of stocking rate, dressing percentage as affected with treatments applied were found to be 49.82; 50.19 and 49.31% for F1; F2 and F3, respectively and differences among treatments in this trait were insignificant. On the other hand stocking rate showed significant effect on dressing percentage for the favor of lower one (table 4). The same trend was observed with flesh percentage where the treatments applied had insignificant effect on this parameter and the stocking rate released a significant effect for the favor of the lower one.

As evident in table (4) the percentages of by-product as affected by feeding regime or stocking rate were significant whereas the carcasses obtained from fish group fed the supplementary feed produced the higher percentage of the two fertilization rates. Also results revealed that the high stocking rate showed the higher percentage of by-products.

Carcass traits of Nile tilapia as affected by the interaction between the treatments applied and stocking density are presented in table (4). As shown in this table, the differences in dressing percentages among the experimental groups were found to be significant ($P<0.05$) for the favor of the group fed on artificial diet at lower stocking rate followed by the other treatment groups respectively. On the other hand, fish grew in the ponds fertilized with low rate at low density showed significantly ($P<0.05$) higher flesh percentage compared to the other groups. The same table show that the highest percentages of by-products were reported by the (F3 ×SR2) group followed by the other treatment group (table 4).

Chemical analysis:

a) Whole fish:

The changes in chemical composition during development and in response to different factors are the result of differential growth of tissues. The main tissues involved in whole-body growth are bones, muscles and adipose tissues. The relative development of these tissues is very important for the conformation of fish and thus its yield in processing (gutting, filleting) (Fauconneau et al., 1995).

As evident in table (5) regardless of stocking rate, the whole body of fish fed the supplementary feed had the higher percentage of fat and the lower percentages of moisture, protein and ash with significant differences for the percentages of protein, fat and ash when compared to the two different fertilization rates of poultry litter and this probably due to the high energy content of the commercial pellets. These results are agreed to those demonstrated by Eves et al., (1995), they indicated that, Nile tilapia *O. niloticus* fed septage contained less fat than pellet-fed. Also Billard (1995) reported that, the protein content in the body is higher when carp fed zooplankton and benthos compared with a feeding regime based on cereals and formulated pellets.

When the stocking rate is doubled the percentages of protein and fat were decreased but the percentage of moisture and ash were increased (Table, 5). With regard to the interaction between feeding regime and stocking rate, table (5) show that T5 (F3 ×SR1) had the higher percentage of fat and the lower percentage of protein and ash.

b) Flesh:

Feeding regime had significant effect on protein and ash percentages of flesh. Where the low fertilization rate produce the higher protein and ash percentages compared to the high fertilization rate and supplementary feed. On the other hand feeding regime had insignificant effect on moisture and fat percentage but stocking rate had the significant effect on protein, fat and ash percentage. The interaction between stocking rate and feeding regime had significant effect on the percentages of moisture, protein and fat (Table, 5) whereas the first treatment (F1 × SR1) released higher percentages of protein and ash.

c) By-products:

By-products or fish wastes are those non-edible parts of the fish body. They include fish head, skin, bones and cartilage, fins, scales and viscera which includes gonads, intestine and liver. After some processing, fish wastes represent a good source for animal nutrition which can be prepared as protein source for laying hens and broilers due to its high contents of fish protein containing the essential amino acids.

Analysis of variance showed that there were insignificant effect of the studied factors (feeding regime, stocking rate and their interactions) on the percentage of moisture, protein and fat but these factors had the significant effect on the percentage of ash which was higher for fish fed the organic fertilization compared to the fish fed the artificial feed. As shown in table (5) the high mean contents of protein,(43.7%), fat (20.5%) and ash (29.4 %) in tilapia by-products make these by-products are a suitable source of fish meal for fish diets.

Economic efficiency:

Table (6) show that the total costs of organic fertilization are lower than the feeding with supplementary feed. Whereas the net returns were greater with supplementary feed , the economic efficiency (% net returns to operating costs) was high for organic fertilization compared with supplementary feed especially with the high fish stocking rates.

From economic view, it could be reported that, the two fertilization rates tested with the high stocking rates (F1×SR2 and F2 × SR2) seemed to be adequate to achieve favorable results and would be more economic than other treatments. Green (1992) work on Nile tilapia reported that net returns with chicken litter plus feed was greater than feed only. Also, Hassouna et al., (1998) reported that, net returns of Nile tilapia ponds fertilized with inorganic fertilizers plus feed was greater than feed only. In the present study the highest net returns was obtained with organic fertilization with the high stocking rate (74 .2%).

REFRENCES

Abdel-Hakim, N. F. and F. A. Hafez (1995): Effect of poultry manure levels on growth performance of silver carp. Egypt. J. Agric. Res., 73(2).

Abdel-wares, A. A. (1993): Studies on growth and development of Tilapia nilotica as affected by different environmental factors. M.Sc. Thesis, Faculty of Agriculture, Al-Azhar University, Egypt.

A.O.A.C. (1990): Official Methods of Analysis. Association of Official Analytical Chemists. Washington, D. C.

Barash, H. and Schroeder, G. L., (1984): Use of fermented cow manure as a feed substrate for fish polyculture in Stagant water ponds. Aquaculture, 36:127-140.

Billard, R. (1995): The major carps and other cyprinids. pp. 21-55 in: C.E. Nash and A. J. Novotny (Editors). Production of aquatic animals (fishes). World Animal science, C8.

Brown, M. L. and Murphy, B. R. (1991): Relationship of relative weight (Wr) to proximate composition of juvenile Striped bass and hybrid Striped bass. Trans. Am. Fish. Soc., 120:509-518.

Collis, W. J. and Smitherman, R. O. (1978): Production of tilapia hybrids with cattle manure of a commercial diet. pp 43-54. In R. O. Smitherman, W. L. Shelton and J. H. Grover (editors). Culture of exotic fishes symposium proceedings. Fish culture section, American Fisheries Society, Auburn, Alabama.

Diana, J. S., Dettweiler, D. J. and Lin, C. K. (1991): Effect of Nile tilapia (*Oreochromis niloticus*) on the ecosystem of aquaculture ponds, and its significance to the trophic cascade hyopthesis. Canb. J. Fish. Aquat. Sci. 48:183-190.

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

Eves, A., Turner, C., Yakupitiyage, A., Tongdee, N. and Ponza, S. (1995). The microbiological and sensory quality of septage-raised Nile tilapia *(Oreochromis niloticus).* Aquaculture, 132:261-272.

FAO (1995): Aquaculture production statics (1984-1993). Fisheries Circular. No. 815 Revision 7. Rome, Italy.

Fauconneau, B., Alami-Durante, H., Laroche, M., Marcel, J. and Vallot, D. (1995): Growth and meat quality relations in carp. Aquaculture, 129:265-297.

Green, B. W. (1992): Substitution of organic manure for pelleted feed in tilapia production. Aquaculture, 101:213-222.

Hafez, F. A., El-Helaly, E. A. and Mahmoud, A. A. (1998): Performance of silver carp (*Hypophthalmichthys molitrix*) as affected by level of duck manure and stocking density. Egypt. J. Agric. Res., 76(4):1701-1718.

Harvey, W. R. (1990): User's guide for LSMLMW. mixed model least-squares and maximum likedlihood computer program. Ohio state University, Columubs, USA:

Hepher, B. and Pruginin, Y. (1981): Commercial fish farming with special reference to fish culture in Israel. John Wiley and Sons, Inc., New York. Pp.175-191.

Hassouna, M. M. , El-Maksoud, A. M. S., Radwan, M. S. M. and Abd El-Rahman (1998): Evaluation of three commercial feeding regimes for Nile tilapia, *Oreochromis niloticus* L., reared in earthen ponds. Egypt. J. Anim. Prod., 35:267-277.

Hussein, A. A. (1990): Biochemical studies on fish by-products. M. Sc. Thesis, Faculty of Agriculture, Zagazig University, Egypt.

Jauncey, K. and Rose, B. (1982): A guide to tilapia feeds and feeding. Institute of Aquaculture, University of Sterling, Scotland.

Knud-Hansen, C. F. and Kwei, L. C. (1996): Strategies for stocking Nile tilapia (*Oreochromis niloticus*) in fertilized ponds. In R.S.V. Pullin. J. Lazard. M. Legendre, J. B. Amon Kothias and D. Pauly (eds.). The Third International Symposium on Tilapia in Aquaculture. ICLARM Conf. Proc. 41. 575 p.

Lin, k. (1994): Supplemental feeding of Tilapia in fertilized ponds. CRSP Research Reports. 94-73.

Lovell, R. T. (1981): Laboratory manual for fish feed analysis and fish nutrition studies. Auburn University, Alabama.

Pekar, F. (1994): Organic carbon production and related fish yields in intensively manured fish ponds. Fish Culture Institute, Hungary.

Sample, W. D. (1992): Tilapia culture in the United States: What are the prospects. Aquaculture magazine, 18:75-76.

Schroeder, G. L. (1980): Fish farming in manure-loaded ponds. Pages 73-86 in R. S.V. Pullin and Z. H. Shehadeh (Editors). Integrated agriculture aquaculture farming systems, International Centre for Living Aquatic Resources, Management, Manila.

Shearer, K. D. (1994): Factors affecting the proximate composition of cultured fishes with emphasis on salmonids. Aquaculture, 119:63-88.

Soltan, M. A. (1998): Productive studies on tilapia fish. Ph.D. Thesis, Faculty of Agriculture, Moshtohor, Zagazig University, Banha branch.

Teichert-Coddington, D. R. and Green, B. W. (1990): Influence of primary productivity, season and site on tilapia production in organically fertilized ponds in two central American countries. Paper EIFAC/ 90/Symp.E8,FAO-EIFAC. Symposium on production enhancement in Still Water Pond Culture, rague, Czechoslovakia.

Teichert-Coddington, D. R. Behrends, L. L. and Smitherman, R. O. (1990): Effects of manuring regime and stocking rate on primary production and yield of tilapia using liquid swine manure. Aquaculture, 88:61-68.

Egyptian J. Nutrition and Feeds (1999) 2 (Special Issue): 765-778

Table (1): Means and standard error (Mean±SE) of the effect of feeding regime and stocking rate on the body measurements of Nile tilapia, *O. niloticus.*

Variable	No.	Body weight (gm)	Body length (cm)	Condition factor (K)	Body width (cm)	Body depth (cm)
Feeding regime (F)						
F1 (poultry litter 100kg/pond)	300	76.7±1.41 a	15.7±0.09 a	1.82±0.02 a	2.07±0.017 a	5.36±0.039 a
F2 (poultry litter 150kg/pond)	300	88.6±1.41 b	17.0±0.09 b	1.77±0.02 a	2.32±0.017 b	5.81±0.039 b
F3 (artificial feed)	300	107.5±1.41 c	18.0±0.09 c	1.82±0.02 a	2.45±0.017 c	6.11±0.039 c
Stocking rate (SR)						
SR1 (1000 fish/ pond)	450	96.9±1.15 b	17.5±0.08 b	1.80±0.02 a	2.34±0.014 b	5.97±0.032 a
SR2 (2000 fish/ pond)	450	80.8±1.15 a	16.3±0.08 a	1.80±0.02 a	2.22±0.014 a	5.54±0.032 b
F × SR						
F1×SR1	150	75.8±1.99 b	16.4±0.13 b	1.80±0.03 a	2.11±0.024 b	5.52±0.055 b
F1×SR2	150	65.4±1.99 a	15.1±0.13 a	1.84±0.03 a	2.03±0.024 a	5.19±0.055 a
F2×SR1	150	98.9±1.99 c	17.7±0.13 c	1.77±0.03 a	2.43±0.024 d	5.86±0.055 c
F2×SR2	150	78.2±1.99 b	16.3±0.13 b	1.77±0.03 a	2.20±0.024 c	5.75±0.055 d
F3×SR1	150	116.1±1.99 d	18.3±0.13 d	1.84±0.03 a	2.48±0.024 d	6.54±0.055 e
F3×SR2	150	98.8±1.99 c	17.6±0.13 c	1.80±0.03 a	2.43±0.024 d	5.68±0.055 df
Overall mean	900	88.9±0.81	16.9±0.05	1.80±0.01	2.28±0.010	5.76±0.22
ANOVA						
S.O.V	df	F-ratio				
Feeding regime (F)	2	170.87***	151.05***	1.889	132.07***	96.89***
Stocking rate (SR)	1	98.02***	111.28***	0.001	36.09***	49.01***
F×SR	2	3.48*	4.38**	1.070	7.90***	24.32***
Remainder df	894					
Remainder MS		595.511	2.551	0.14	0.087	0.447

\+ Means with the same letter in each column are not significantly different.

* P<0.05 ** P<0.01 *** P<0.001

Table (2): Effect of feeding regime and stocking rate on the specific growth rate of Nile tilapia.

Item	Treatments (feeding regime and stocking densities)					
	F1+SR1	F1+SR2	F2+SR1	F2+SR2	F3+SR1	F3+SR2
Live body weight/ fish (g)						
At the start	15.9	16.8	16.9	17.3	16.5	16.9
At harvesting	75.8	65.4	98.9	78.2	116.1	98.8
Total gain/fish (g)	59.9	48.6	82	60.9	99.6	81.9
Specific growth rate (SGR)	1.49	1.29	1.68	1.44	1.86	1.68

Table (3): Total yield of *O. niloticus* as affected by feeding regime and stoking rate.

	Total production/pond		Total production(kg)/feddan
	(kg)	%	
Feeding regime (F) +			
F1 (Poultry litter, 100 kg/pond/week)	101.3	100	425.46
F2 (Poultry litter, 150 kg/pond/week)	125.1	123.5	525.42
F3 (Supplemental feed)	153.7	151.7	645.54
Stocking rate (SR) ++			
SR1 (1000 fish / pond)	95	100	399.00
SR2 (2000 fish / pond)	158.4	166.7	665.28
F × SR			
F1 × SR1	74.3	100	312.06
F1 × SR2	128.2	173.2	538.44
F2 × SR1	96.9	130.9	406.98
F2 × SR2	153.3	207.2	643.86
F3 × SR1	113.8	153.8	477.96
F3 × SR2	193.6	261.6	813.12
Overall mean	126.7		532.14

+ Average of 2 ponds (2 stocking rate) ++ Average of 3 ponds (3 feeding regimes)

Table (4): Means and standard error (Mean±SE) of the effect of feeding regime and stocking rate on the carcass analysis of Nile tilapia, *O. niloticus*.

Variable	No.	Dressing %	Flesh %	Head %	Skeleton %	Viscera %	By-product %
Feeding regime (F)							
F1 (poultry litter 100kg/pond)	20	49.82±0.73 a	39.39±0.79 a	30.40±0.60 a	10.35±0.28 a	8.97± 0.27 b	54.95±0.71 a
F2 (poultry litter 150kg/ pond)	20	50.19±0.73 a	39.59±0.79 a	30.33±0.60 a	10.68±0.28 ab	8.96± 0.27 b	55.87±0.71 a
F3 (artificial feed)	20	49.31±0.73 a	37.99±0.79 a	33.59±0.60 b	11.34±0.28 b	7.67± 0.27a	58.57±0.71 b
Stocking rate (SR)							
SR1 (1000 fish/ pond)	30	51.89±0.60 b	40.79±0.65 b	30.64±0.49 a	11.17±0.23 b	8.01± 0.22 a	55.35±0.58 a
SR2 (2000 fish/ pond)	30	47.52±0.60 a	37.19±0.65 a	32.24±0.49 b	10.41±0.23 a	9.05± 0.22 b	57.57±0.58 b
F × SR							
F1×SR1	10	53.12±1.03 b	42.02±1.12 b	29.20±0.85 a	11.10±0.40 bc	8.76± 0.38 bc	54.64±1.00 a
F1×SR2	10	46.52±1.03 a	36.76±1.12 ae	31.60±0.85 ac	9.60±0.40 a	9.18± 0.38 bc	55.26±1.00 a
F2×SR1	10	50.86±1.03 cb	40.38±1.12 bc	29.42±0.85 a	10.66±0.40 ac	8.72± 0.38 bc	54.36±1.00 a
F2×SR2	10	49.52±1.03 ca	38.80±1.12 ab	31.24±0.85ad	10.70±0.40 ac	9.20± 0.38 ac	57.38±1.00ac
F3×SR1	10	51.70±1.03 cb	39.96±1.12 bde	33.30±0.85 bcd	11.76±0.40 bc	6.56± 0.38 a	57.06±1.00ac
F3×SR2	10	46.92±1.03 a	36.02±1.12 a	33.88±0.85 bc	10.92±0.40 bc	8.78± 0.38 bc	60.08±1.00bc
Overall mean	60	49.77± 0.42	38.99± 0.46	31.44±0.35	10.79± 0.16	8.53± 0.15	56.46±0.41
ANOVA							
S.O.V	df	F- ratio					
Feeding regime (F)	2	0.37	1.21	9.62***	3.18*	7.91***	7.07**
Stocking rate (SR)	1	25.34***	15.35***	5.33*	5.52*	11.47***	7.38**
F × SR	2	3.35*	1.38	0.60	1.87	3.70*	0.96
Remainder d.f	54						
Remainder MS		10.64	12.62	7.21	1.60	1.41	10.02

Means with the same letter in each column are not significantly different.
* P<0.05 ** P<0.01 *** P<0.001

Table (5): Means and standard error (Mean±SE) of the effect of feeding treatment and stocking rate on the body composition of Nile tilapia, *O. niloticus.*

Variable	No.	Whole body				Flesh				By-products			
		Moisture%	Protein %	Fat %	Ash %	Moisture%	Protein%	Fat %	Ash %	Moisture%	Protein%	Fat %	Ash %
Feeding regime (F)													
F1 (poultry litter 100kg/pond)	20	74.7±0.5 a	61.3±0.8 bc	11.3±0.8 a	23.5±0.6 b	77.9±0.2 a	86.9±0.7 b	6.9±0.4 a	6.7±0.2 b	69.0±0.6 a	44.2±0.7 a	20.4±1.1 a	31.9±0.8 b
F 2 (poultry litter150kg/ pond)	20	73.9± 0.5 a	59.9±0.8 ac	12.0±0.8 ac	23.8±0.6 b	77.3±0.2 a	81.0±0.7 c	6.9±0.4 a	5.6±0.2 a	68.9±0.6 a	43.4±0.7 a	20.7±1.1 a	30.3±0.8 b
T3 (artificial feed)	20	73.8± 0.5 a	58.4±0.8 a	14.3±0.8 bc	21.7±0.6 a	77.4±0.2 a	78.7±0.7 a	7.6±0.4 a	5.7±0.2 a	68.3±0.6 a	43.4±0.7 a	20.4±1.1 a	26.0±0.8 a
Stocking rate (SR)													
SR1 (1000 fish/ pond)	30	73.8± 0.4 a	60.3±0.7 a	14.4±0.6 b	22.3±0.5 b	77.4±0.2 a	82.8±0.5 b	7.9±0.3 b	5.8±0.2 b	68.8±0.5 a	43.8±0.6a	21.7±0.9 a	28.4±0.6 a
SR2 (2000 fish/ pond)	30	74.5± 0.4 a	59.5±0.7 a	10.7±0.6 a	23.7±0.5 a	77.6±0.2 a	81.6±0.5 a	6.3±0.3 a	6.3±0.2 a	68.7±0.5 a	43.5±0.6a	19.2±0.9 a	30.4±0.6 b
F × SR													
F1×SR1	10	65.1±0.7 a	61.6±1.2 bd	13.1±1.1 be	23.0±0.8 b	77.7±0.3 b	89.3±0.9 b	5.8±0.6 a	6.8±0.3 b	69.1±0.8 a	44.7±1.0 a	20.8±1.5 a	34.5±1.1 b
F1×SR2	10	75.1± 0.7 a	60.9±1.2 cd	9.5±1.1 a	23.9±0.8 b	78.0±0.3 b	84.6±0.9 c	7.9±0.6 be	6.6±0.3 b	68.8±0.8 a	43.6±1.0 a	20.1±1.5 a	29.3±1.1 c
F2×SR1	10	73.3± 0.7 a	60.0±1.2 ad	13.4±1.1 ce	24.0±0.8 b	78.1±0.3 b	86.1±0.9 dc	7.5±0.6 ce	5.1±0.3 a	69.5±0.8 a	42.6±1.0 a	21.7±1.5 a	29.6±1.1 dc
F2×SR2	10	74.5± 0.7 a	59.8±1.2 ad	10.7±1.1 ae	23.6±0.8 b	76.5±0.3 a	75.9±0.9 a	6.2±0.6 ae	6.2±0.3 bc	68.4±0.8 a	44.2±1.0 a	19.6±1.5 a	31.1±1.1 dc
F3×SR1	10	73.9± 0.7 a	59.3±1.2 ad	16.7±1.1 d	19.7±0.8 a	76.4±0.3 a	73.1±0.9 a	10.3±0.6 d	5.4±0.3 ac	67.6±0.8 a	44.0±1.0 a	22.7±1.5 a	21.1±1.1 a
F3×SR2	10	73.7± 0.7 a	57.6±1.2 a	12.0±1.1 ae	23.8±0.8 b	78.3±0.3 b	84.3±0.9 c	4.9±0.6 a	6.0±0.3 bc	69.0±0.8 a	42.8±1.0 a	18.0±1.5 a	30.9±1.1 bc
Overall mean	60	74.1± 0.3	59.9±0.5	12.5±0.4	23.0±0.3	77.5±0.1	82.2±0.4	7.1±0.2	6.0±0.1	68.7±0.3	3.7±0.4	20.5±0.6	29.4±0.4
ANOVA													
S.O.V	df	F-ratio											
Feeding treatment (T)	2	0.86	2.91	4.23**	3.59*	2.19	39.83***	0.99	8.66***	0.41	0.40	0.02	15.43***
Stocking rate (S)	1	1.32	0.75	17.13***	4.76*	0.95	2.52*	10.81***	4.38*	0.00	0.12	4.09	5.18*
T × S	2	0.58	0.22	0.43	3.94*	19.48***	68.49***	21.18***	2.4	1.26	1.26	0.90	23.56***
Remainder df	54												
Remainder MS		5.05	14.15	11.82	6.98	0.76	9.02	3.35	0.83	6.65	9.90	23.42	12.05

\+ Means with the same letter in each column are not significantly different. * P<0.05 ** P<0.01 *** P<0.001

Table (6): Effect of feeding regime and stocking rate on the economic efficiency of Nile tilapia*, O. niloticus.*

Item	Treatment					
	F1+SR1	F1+SR2	F2+SR1	F2+SR2	F3+SR1	F3+SR2
Costs						
Price of fingerlings L.E.	100	200	100	200	100	200
Price of supplementary feed L.E.	-	-	-	-	255	406
Price of poultry litter L.E.	60	60	90	90	-	-
Labour for rearing fish L.E.	50	50	75	75	25	25

Equipment (pump + diesel) L.E.	50	50	50	50	50	F3+SR2
Weed control L.E.	25	25	25	25	25	
Total costs	285	385	340	440	455	200
Returns	371.1	641.0	484.8	766.5	569.0	406
Net returns L.E.	86.1	256	144.8	326.5	114	-
% Net returns to operating costs	30.2	66.5	42.6	74.2	25.1	25

Egyptian J. Nutrition and Feeds (1999) 2 (Special Issue): 765-778

تأثير معدل الكثافة والتسميد العضوى وكذلك الأعلاف الإضافيه على نمو ومكونات الذبيحه والتحليل الكيميائى لأسماك البلطى النيلى

مجدي عبد الحميد سلطان١ نبيل فهمى عبد الحكيم ٢ محمد بكير ٣
١- قسم الإنتاج الحيوانى – كلية الزراعة بمشتهر– جامعة الزقازيق (فرع بنها)
٢- قسم الإنتاج الحيوانى كلية الزراعة – جامعة الأزهر
٣- المعمل المركزى لبحوث الثروة السمكيه بالعباسه – وزارة الزراعة

أجريت هذه التجربة بإستخدام ستة أحواض ترابيه مساحة كل منها ١٠٠٠ م٢ (٢٠ × ٥٠ م) وذلك بالمعمل المركزى لبحوث الثروة السمكيه بالعباسه – مركز أبوحماد – محافظة الشرقية. وقد استهدفت هذه التجربة دراسة تأثير إستزراع كثافتين مختلفتين من أسماك البلطى النيلى هذا بالإضافة إلى دراسة تأثير تسميد الأحواض تسميداً عضوياً بإستخدام فرشة الدجاج ودراسة تأثير ذلك على صفات النمو وصفات الذبيحة والتحليل الكيميائى لأسماك البلطى.

وعند بداية التجربة قسمت هذه الأحواض الستة إلى ثلاث معاملات غذائيه ، المعامله الأولى تم تسميد الأحواض فيها بإستخدام ١٠٠ كجم فرشة دجاج للحوض والمعاملة الثانية تم تسميدها بإستخدام ١٥٠ كجم فرشة دجاج للحوض أما المعاملة الثالثة فقد غذيت الأسماك فيها بإستخدام أعلاف الأسماك المصنعه والمحتويه على ٢٥% بروتين خام وذلك بمعدل ٣% من وزن الأسماك الموجوده فى كل حوض يومياً (ستة أيام أسبوعياً) . ومن أهم النتائج المتحصل عليها مايلى:

- أتضح أن مقاييس الجسم (الوزن والطول والعرض وكذلك العمق) قد زادت بزيادة معدل التسميد العضوى بإستخدام فرشة الدجاج (من ١٠٠ إلى ١٥٠ كجم/أسبوع للحوض) كما أن الأسماك المغذاه على أعلاف الأسماك المحتويه على ٢٥% بروتين خام قد أظهرت قيماً أكبر لهذه المقاييس مقارنة بتلك التى حصلنا عليها بإستخدام التسميد العضوى وكانت الفروق بين المعاملات الغذائية الثلاثة فروقاً معنويه. كما أدت مضاعفة كثافة الأسماك المرباه فى الحوض من ١٠٠٠–٢٠٠٠ سمكه/حوض أدت إلى إنخفاضاً معنوياً لقيم هذه المقاييس. وكانت أكبر قيم حصلنا عليها لهذه المقاييس للأسماك التى ربيت فى الحوض الخامس المحتوى لى الكثافه المنخفضه (١٠٠٠ سمكة/للحوض) حيث غذيت الأسماك على الأعلاف الإضافية.
- بالنسبة للإنتاج الكلى فقد أعطى الحوض السادس (المعاملة السادسة) أكبر إنتاج (١٩٣٫٦ كجم/للحوض) حيث أحتوى هذا الحوض على ٢٠٠٠ سمكه غذيت بإستخدام أعلاف الأسماك بينما أقل الأحواض إنتاجاً هو الحوض الأول (المعاملة الأولى) (٧٤٫٣ كجم/للحوض) الذى احتوى على ١٠٠٠ سمكه غذيت بإستخدام الغذاء الطبيعى والذى تمت تنميته بإستخدام ١٠٠ كجم من فرشة الدجاج.
- لم يكن لتأثير المعاملة الغذائية (التسميد أو التغذية على أعلاف الأسماك) تأثير معنوى على بعض مكونات الذبيحة مثل نسبة اللحم و نسبة التصافى ولكن كان لها تأثيراً معنوياً على نسبة المخلفات (الأجزاء الغير مأكولة) حيث زادت نسبة هذه المخلفات فى ذبائح الأسماك التى حصلت على المعاملة الغذائية الثالثة (علف مصنع) (٥٨٫٥٧%) يليها الأسماك التى حصلت على المعاملة الغذائية الثانية (٥٥٫٨٧%) ثم الأسماك التى حصلت على المعاملة الغذائية الأولى (٥٤٫٩٥%) على التوالى. كما وجد كذلك أن الكثافة الأولى (١٠٠٠ سمكه/للحوض) قد أعطت نسب أعلى من اللحم والتصافى ونسب أقل من الأجزاء الغير مأكولة مقارنة بالأسماك التى ربيت بإستخدام الكثافة الثانية، ٢٠٠٠ سمكه/للحوض) .
- لم تؤثر المعاملة الغذائية أو كثافة الأسماك فى الحوض معنوياً على نسبة الرطوبه أو البروتين فى السمكة الكاملة وكذلك لم تؤثر المعاملة الغذائية أو كثافة الأسماك فى الحوض معنوياً على نسبة الرطوبه فى اللحم وعلى نسبة الرطوبه والبروتين والدهن فى المخلفات ولكن كان لهذين العاملين (المعاملة الغذائية وكثافة الأسماك فى الحوض) تأثيراً معنوياً على باقى المكونات الكيميائية الأخرى فى السمكة كاملة واللحم والمخلفات (الأجزاء الغير مأكولة).