ISSN 110-2047. ALEX. J. VET.SCIENCE. 2001 , VOL 17 NO.1 : 55-67

EFFECT OF CERTAIN FEEDING SYSTEMS ON THE PRODUCTIVE TRAITS AND BODY COMPOSITION OF OREOCHROMIS NILOTICUS MONO-SEX FRY

M.A. Soltan and M.M. El-Telbany
Animal Husbandry Department,
Faculty Of Veterinary Medicine, Alexandria University

ABSTRACT *Oreochromis niloticus* mono-sex fry (0.04 g mean body weight) were stocked at a density of 34 fish/ m3 in different earthen ponds for a four weeks and receiving either commercial prepared feed mixed with fish meal or chicken manure and feed plus chicken manure for groups 1 – 3 respectively.

At the end of the experimental period, the highest fish weight was recorded in fish reared in the pond fertilized by chicken manure and also have the best feed conversion ratio, protein efficiency ratio and protein productive value, when compared with fish received commercial feed mixed with fish meal or feed plus chicken manure feeding. While the condition factor in fish reared in fertilized pond was significantly lower than in fish reared in pond supplemented by commercial feed or feed plus chicken manure fertilization (groups 1 and 3, respectively.

Moreover, fish mortality rate was significantly greater in fish reared in the pond fertilized by chicken manure than in fish reared in the pond supplemented by feed only or in fish reared in the pond supplemented by feed and fertilized by chicken manure, and the net fish yield during the last two week of experiment in pond supplemented by feed consequently increased, while highly decreased in the pond fertilized by chicken manure when compared with the first one.

Fish fed on the commercial prepared diet had the highest percentage of body protein content compared with fish in reared in the pond fertilized by chicken manure, while those groups showed reverse results with ash content.

The results suggest that the nursery rearing of *O. niloticus* fry in pond fertilized with chicken manure leading to high growth rate, while from the economical point of view and survival rate we can concluded that rearing in pond supplemented by prepared feed is more economical and highly significantly applied in the fish culture

INTRODUCTION

In recent years the search for inexpensive alternative sources of

animal protein has been focused substantially on aquaculture. Today more than half of the world's population depend on fish as a principal source of animal protein. The demand of fish is expanding rapidly throughout the world because of increasing population and income.

In the present investigation, ***Oreochromis niloticus*** was used for carrying out this work because its one of the most widely cultured fish in the world. Moreover, represent of great importance in our fish production and affords potential as a protein source in Egypt where ***O. niloticus*** are commonly known and have an attractive palatability to the consumer.

The modern practice for scientific aquaculture provides a high cost technology, feed alone constituting 67% of the total production cost (Tripathi and Ranadhir, 1982). Recent experiment based on using fertilizers for the production of low cost natural feed.

Animal manures have been used as fertilizers in fish production throughout the world, especially in tropical and subtropical regions (Lovshin et al., 1974; Miller, 1975). Manure stimulate both primary and secondary productivity (Rappaport et al., 1977; Schroeder, 1978; Noriega-Curtis, 1979) and may be available or cheaper than formulated diets. Tilapia have been reared in fresh water under conditions of monoculture and polyculture with chicken manure fertilization (Burns and Stickney, 1980; Behrends et al., 1989; Green et al., 1990; Green, 1992 and Osman, 1996).

Chicken litter has been used successfully as an organic fertilizer for tilapia production in many parts of the world (Rappaport and Sarig, 1978 and Green et al., 1979); it is easily transported, stored and dispersed over the pond surface because of its low moisture content. Reported tilapia yields from ponds fertilized by different manure are often difficult to compare with tilapia yields from artificially fed ponds because of differences in nutrient input.

The main objective of the present work was to study the effect of similar amount of nitrogen supplementation from different sources (chicken manure and commercial feed) on the growth performance, survival rate, production characteristics, body composition and economic evaluation of ***O. niloticus*** mono-sex fry rearing.

MATERIALS AND METHODS

Experimental nursery earthen ponds were constructed in that manner to keep a water column not less than 150 Cm above the pond – platform. : Three nursery ponds were constructed each of them was rectangular in shape with a dimension of 40 X 75 m with a total surface area 3000 m^2. Ponds were supplied with a good irrigation and drainage gates. The platforms were sloped toward a good constructed

catch ponds with a dimension of 4 X 25 m. The depth of the catch ponds were 80 cm. Ponds were subjected to sunlight for a period not less than 20 days for dryness, then filled with a freshwater 50 cm above the platforms.

Water supply: Freshwater maintained by periodic addition of water to compensate water losses through evaporation and seepage.

Experimental *Oreochromis niloticus* fish seeds: ***O. niloticus*** fries were obtained by using a semi-artificial technique adopted in the fish hatchery belongs to the private sector in Behaira governorate – Egypt. Fish fries were subjected to hormonal treatment for two weeks to be converted to all male sex using 17 – alpha methyl testasterone. Ponds were stocked at a rate of 34 fries /m3, starting at 1/8/2000 and lasted for 4 successive weeks) in the rearing ponds, fish body weight, averaged 0.04 g.

Experimental diet: The basal diet composed from 11% fish meal (72%) and 89% of commercial fish ration obtained from Marsedcoo Cop., which composed from yellow corn, soybean oil meal (44%), wheat bran, corn gluten (60%), fish meal (65%), bone meal, di-calcium phosphate, limestone, salt and molasses. The diet having not less than 25% crude protein, 2.2% crude fat and not more than 4.33% crude fiber. Chicken manure was used as an alternative nitrogen source in the fish pond. The basal diet and chicken manure were chemically analyzed according to AOAC (1985) method and showed in table 1.

Table (1): chemical composition of the basal diet and chicken manure.

	NITROGEN SOURCE	
	Supplemented basal diet	**Chicken manure**
Moisture	11.7	10.5
Crude protein	30.1	28.0
Ether extract	2.8	1.0
Crude fiber	3.8	11.5
Crude ash	10.1	19.5
NFE *	41.6	29.5

* Nitrogen free extract was calculated by difference.

Fertilization rate and experimental design: The experiment was designed as three fish groups. All fish groups received a similar amount of nitrogen from different sources. The experimental design is summarized in the following table.

Table (2): Outline of the experimental design:

GROUPS	SOURCE OF NITROGEN SUPPLEMENTATION %	
	Basal diet	Chicken manure
1	100	----
2	---	100
3	50	50

Fish in nursery pond No. 1: received basal diet four times daily. To minimize alternative feed sources and maintain water quality in fed pond, 80% net shadow was placed over fed pond to reduce algal growth.

Fish in nursery pond No. 2: received four times daily applications of laying hens manure reared at the deep litter system and the amount was corresponding to the nitrogen amount fed by the first group from the commercial feed. Prior to fish stocking, pond was conditioned by applying manure at a rate of 400 Kg/Pond to initiate the natural food web.

Fish in nursery pond No. 3: The feeding system during the experimental was 50% feed protein plus 50% from chicken manure protein. Prior to fish stocking, pond was conditioned by applying manure at a rate of 200 Kg/pond to restart the biological feed web.

Feeding rate: feeding fish four times daily at 30% of their wet body weight according to Jauncey and Ross (1982). The amount of feed fed was adjusted every two weeks after weighing of fish.

Measurements: Body weight and length of fish in different ponds were carried out biweekly throughout the experiment (each sample was several hundred fish) from each pond were seined biweekly at different places by using castanet, 25 mm mesh size (Huet, 1986). Body weight gain, specific growth rate (SGR), food conversion ratio (FCR), protein efficiency ratio (PER), protein productive value (PPV) and condition factor (K) were calculated according to Jauncey and Ross (1982).

Production characteristics:

1-Net fish yield (Kg/pond/day): it was calculated biweekly according to Diana et al., (1991) as follow:

Net fish yield = (Fish biomass at week x – fish biomass at week x-2)

2- Total fish yields (Kg/pond): It was calculated biweekly according to Diana et al (1991) as follow:

Total fish yield = mean fish weight X number of fish.

Body composition analysis:

representative samples were randomly chosen , 500 fish from the total at the start and 50 from each group at the end, weighed and grouped, where triple pooled samples of 2.0 g were taken, kept frozen till

analysis. Initial and final body composition was determined using standard AOAC (1985) method.

Mortalities: Dead fish were removed and recorded daily. While total population counts were performed on days 14 and 28. Survival rate was calculated by the following formula:

$$\text{Survival rate} = \frac{\text{Total number of fish at the end of the period}}{\text{Total number of stocked fish}} \times 100$$

Economical efficiency of the work: Which is the ratio between money output and money input (Abou-Raya , 1967). This study was carried out where the feed costs, fry price, management costs and the selling of fry (The price of harvested fry was dependent on the number and not size dependent), and the economic efficiency was calculated according to the following equation:

$$\text{Economic efficiency} = \frac{\text{Net return}}{\text{Total cost}} \times 100$$

Statistical analysis: Statistical analysis of the obtained data was performed using Statistical Analysis System (SAS, 1987).

RESULTS AND DISCUSSION

Body weight development and food conversion ratio:

Data concerning the body weight development of fish in various ponds throughout the experimental period and average values related to the body weight and food conversion are presented in table 3. At the end of the experiment, the highest final body weight was recorded in group 2 (2.29 g), followed by those of group 3 (1.51 g) and finally group 1 (1.34 g).

At the end of the experimental period, there are significant differences in fish body weight among different fish groups. While the percent of body gain related to the initial in the fish group was highly increased in the fish reared in pond supplemented with feed only in the third and fourth week when compared with the other group at the same period. These data disagree with Ernst et al. (1989) who reported that manured – pool fish weights (Florida red tilapia species) (11.3± 0.4 g) were significantly less than fed – pool weight (18.0± 0.6 g), this differences may be attributed to the different fish species and the age of the fish used.

Specific growth rate over the first two weeks were higher in fish which reared in the pond fertilized by chicken manure (No. 2) and in fish which reared in the pond supplemented by feed and fertilized by chicken manure (No. 3), than in fish reared in the pond (No. 1) supplemented by feed only. Over the next two weeks pond growth rates of fish in fertilized pond declined and remained significantly less than growth rate of fish reared in the pond supplemented by feed.

From the results given in table 3, it was noted that the average feed conversion ratio (FCR) of fish in groups 2 , 3 and 1 which received chicken manure only or chicken manure plus feed and feed only were (0.83, 1.12 and 1.13 respectively). These results may be attributed to the more availability of natural food (phytoplankton) in fish groups reared in ponds fertilized by chicken manure than those in fish of group 1. This phytoplankton represent 50 to 70% of tilapia growth (Schroeder, 1983). These results are supported by Green (1992) who found that the FCR of ***O. niloticus*** received pelleted feed only treatment (1.83) was significantly greater than that for feeding pelleted plus organic manure treatment (0.95). Also Osman (1996) reported the same result of ***O. niloticus.*** Moreover, we can noticed that the feed conversion ratio was clearly improved in the fish reared in the pond supplemented by feed with increase of fish age, more than in fish reared in the pond fertilized by chicken manure. Also protein efficiency ratio followed the same manner of FCR.

BODY LENGTH DEVELOPMENT:

Data concerning the body length development of fish in various groups throughout the experiment are presented in table 4. Statistical analysis of the obtained data indicated that no significant differences between the group 1 and 3 in their body length at the end of the experiment, which reared in the pond supplemented by feed only or feed plus chicken manure fertilization respectively, while body length in fish of group 2 which reared in the pond fertilized by chicken manure only was highly significant increase ($p<0.05$) when compared with other groups. The obtained average values of condition factor (K) indicated that condition factor was significantly lower in the fish reared in pond fertilized by chicken manure (1.01) than in the fish reared in pond supplemented by commercial feed only (2.19) or in the fish reared in pond fertilized by chicken manure plus feed supplementation (2.21).

These findings are in agreement with those obtained by Ernst et al., (1989) who reported that condition factor of Florida red tilapia were significantly lower in the fish reared in the fertilized pools than in pools supplemented by feed.

Survival rate:

The recorded survival rates in various fish groups during the experimental period are presented in table (5). It was clear from the obtained data that the mortalities of fish in all groups occurred mostly at the start of the experiment. The reason of death during this period may be attributed to the physical damage of the fish and stress during transportation of fish from spawning ponds to rearing ponds.

At the end of the experimental period (4 weeks) fish survival rates were significantly greater in fish reared in pond supplemented by feed only or fertilized by chicken manure plus feed supplementation (groups, 1 and 3

respectively) and the values were (88.24% and 80.39% respectively) than in the fish reared in pond fertilized by chicken manure (73.53%).

These findings are confirmed by the work of Ernst et al. (1989). They found that the overall survival rate% of Florida red tilapia was 69.9%in manured pools and 92.3% in fed pools. Also, Green et al. (1990) reported that increased tilapia mortality with increased manure input which may be leading to oxygen depletion and deteriorated water quality conditions. But our data disagree with the findings by Green (1992) who stated that no significant differences in survival rates between the reared mono-sex ***O. niloticus*** in the ponds treated with pelleted feed only or with feed plus organic manure, this difference may be attributed to average body weight of fish in both experiments.

PRODUCTION CHARACTERISTICS:

The results concerning total fish yield in different groups during the experimental period are presented in table 6. It was clear from the obtained data that the total fish biomass at the beginning of the experiment averaged 4.08 Kg/pond for all groups, while at the end of the experimental period, the data indicated highly increase of total fish yield in fish reared in the fertilized pond by chicken manure (171.75 Kg /pond). These results are in agreement with those reported by Green et al., (1990) who explained that tilapia gross yields increased significantly with increased chicken litter applications.

The results concerning the net fish yield in different groups are presented in table 6. It was clear from the obtained data that the net fish yield in the first two weeks of the experiment, in fish reared in the pond fertilized by chicken manure (5.6 Kg/pond/day) was higher than in fish reared in the pond supplemented by feed (1.81 Kg / pond / day) or in fish reared in the pond supplemented by feed plus chicken manure fertilization (3.31 Kg / pond / day)). While during the next two weeks, the net fish productivity in fish reared in the pond supplemented by feed increased to a mean of 6.51 Kg/pond/day and the fertilized fish pond highly decreased (6.38 Kg/pond/day) when compared with the first one.

The inability to sustain high fish productivity in the pond fertilized by chicken manure (No. 2) was an expected results, as reported by Schroeder , 1978; Burns and Stickney, 1980 and Ernst et al., 1989.

BODY COMPOSITION:

The proximate body composition of fish, as a percentage of fresh and dry matter basis, in different groups at the start and end of the experimental period are presented in table 7. It was clear from the obtained data that the moisture content of fish decreased towards the end of the experiment, and the dry matter content increased. These results were confirmed by Osman et al. (1991) who found that

dry matter content of tilapia increased with advanced age. Fish fed on the commercial prepared diet (group, 1) had the highest percentage of body protein compared with fish reared in the pond fertilized by chicken manure (group, 2), while these groups showed reverse results with body ash content, but the ash content slightly changed from start to the end of the experiment, our results agree with Hassan and Edwards (1992) who found that the ash content of fish body remained constant with advanced age. Moreover, the lipid body content slightly increased with advanced age but nearly similar in different groups. These results agree with Soltan (1990) who found that the body lipid of ***O. niloticus*** was relatively constant in all fish groups which fed on diet with or without poultry manure inclusion.

Nutrient retention data presented in (Table 8); indicated highest retention of dry matter, crude protein, ether extract and ash in fish reared in the pond fertilized by chicken manure (0.554 g, 0.349 g, 0.082 g and 0.1088 g , respectively) compared with the fish of group 1 which reared in pond supplemented by feed only. These findings indicated that organic fertilizers resulted an increase in nutrient retention (as a percentage of the initial) of fish body.

ECONOMIC EVALUATION:

From the commercial point of view, the cost/benefit analysis including, feed cost, manure cost and other productive cost. The data indicated that the economical efficiency % for the feed treatment (30.53%) was higher than chicken manure (9.84%) or mixed system of fry rearing (19.53%). Feed was more profitable than either feed plus fertilization or chicken manure fertilization only for two reasons (1), the higher survival rate, (2) the final price of mono-sex fry was computed on the basis of the number and not size dependent. These results are in agree with Garson et al. (1986) They noticed that the net income for the feed shrimp was higher than in shrimp treated with chicken manure or cow manure treatments.

The results suggest that nursery rearing of mono-sex ***O. niloticus*** fry in pond fertilized with chicken manure is feasible and leading to high growth rates, while from the economical point of view and fish survival rate we can conclude that rearing in pond supplemented by feed is more economical and highly significantly applied in fish culture.

REFERENCES

Abou- Raya, A.K. (1967): Animal and Poultry Nutrition, Dar, El-Marif, Cairo, (Arabic Text Book).

AOAC (1985): Association of Official Analytical Chemists Official Methods of Analysis (13 th ed) Washington DC.

Behrends, L.L.; Kingsley, J. B. ; Maddox, J.J. and Waddell, Jr. E. L. (1989): Integrated agriculture/aquaculture systems, paper, 5031, presented at summer meeting, American Society of

Agriculture Engineers, Univ. of Wisconsin, Madison WI, 11 pp (Cited in Green et al., 1990).

Burns, R.P. and Stickney, R.R. (1980): Growth of tilapia aurea in ponds receiving poultry wastes. Aquaculture, 20 : 117 – 121.

Diana, J. S.; Lin, C.K. and Schneeberger, P.J.(1991): relationship among nutrient inputs, water nutrient concentrations, primary production and yield of oreochromis niloticus in ponds Aquaculture, 92: 323 – 341.

Ernst, D. H.; Ellingson, L.J.; Olla, B.L.; Wicklund, R.I.; Watanabe, W.O. and Grover, J.J. (1989): Production of Florida red tilapia in sea water pools: nursery rearing with chicken manure and grow-out with prepared feed. Aquaculture, 80: 247 – 260.

Garson, G. I> ; Pretto. R.M. and Rouse, D.B. (1986): Effects of manures and pelleted feeds on survival, growth, and yield of penaeus stylirostris and panaeus vannamei in panama. Aquaculture, 59: 45 – 52.

Green, B.W. (1992): Substitution of organic manure for pelleted feed in tilapia production. Aquaculture, 101 : 27 – 36.

Green, B.W.; Phelps, R.p. and Alvarenga, H.R. (1979): The effect of manure and chemical fertilizers on the production of oreochromis niloticus in earthen ponds. Aquaculture, 76: 37 – 42.

Green, B.W.; Tiechert – Coddington, D.R. and Phelps, R.P. (1990): Response of tilapia yield and economics to varying rates of organic fertilization and season in two central American countries. Aquaculture, 90: 279 – 290.

Hassan, M.S. and Edwards, P. (1992): Evaluation of duckweed (Lemna perpusilla and spirodela polyrrihza) as feed for Nile tilapia (Oreochromis niloticus). Aquaculture, 104: 315 – 326.

Huet, M. (1986): Text book of fish culture breeding and cultivation of fish 2 nd Ed. Fishing News book Ltd 1 long Garden walk, Farandm, Surrey, England. 439 pp.

Jauncey, K. and Ross, B.R. (1982): Guide to tilapia feeds and feeding, Institute of Aquaculture University of Stirling Scotland Book, p. 111.

Lovshin, L.L.; Dasilva, A.B. and Fernandes, J.A. (1974): The intensive culture of all male hybrid of tilapia hornerum (male) X tilapia nilotica (female) in north east Brazil, paper carpas/G/74/SE22 presented at the FAO Aquaculture Cobnference for Latin America , Monteuideo, Uruguary, 26 Noember – 2 December 1974, 18 pp (Cited in Green et al., 1990).

Osman, S.Y. (1996): Effect of culture systems on the productive and hygienic traits of fish. Ph.D. (Animal Breeding and Production Fish "Production"), Faculty of Veterinary Medicine , Alexandria University.

Osman, M.M.; El---Katcha, M.I. and Orma, A. (1991): Effect of furazolidone in diets on growth performance and body composirion of tilapia nilotica fingerlings. Egypt, J. Appl., Sci., 6(4): 611 – 621.

Miller, J. W. (1975): Fertilization and feeding practicesa in warm-water pond fish culture in Africa. Paper CI FA/75/SR 4 presented at the FAO/CIFA symposium on Aquaculture in Africa. Accra, Ghana, 30 September – 6 October, 1975, 29 pp (Cited in Green et al., 1990).

Noriega – Curtis P. (1979): Primary productivity and related fish yield in intensely manured ponds. Aquaculture, 17: 335 – 344.

Rappaport, U. and Sarig, S. (1978): The results of manuring on intensive growth fish farming at the Ginosar station ponds in 1977. Bamidgeh, 30 (2): 27 – 36.

Rappaport, U.; Sarig, S. and Bejerano, Y. (1977): Observations on the use of organic fertilizers in intensive fish farming at the Ginosar station in 1976. Bamdgeh, 29 (2): 57 – 70.

SAS (1987): Statistical Analysis System. User's Guide: Statistics SAS Institute, Cray, North Carolina.

Schroeder , G. L. (1978): Auto-trophic and hetero-trophic production ofmicroorganisms in intensely manured fish ponds and related yields. Aquaculture, 14: 303 – 325.

Schroeder, G.L. (1983): The role of natural foods in tilapia growth: A study based on stable isotope analysis. Proceedings of the International Symposium on tilapia in Aquaculture, Nazareth, Israel, 8 – 13 May 1983: 313 – 322.

Soltan. M.A. (1990): Nutritive value of certain feeding stuffs incorporated in practical dierts for Nile tilapia. M.V.Sc. (Animal Nutrition and Deficiency Diseases) Faculty Of Vet. Med. Alex. University.

Tripathi, S. D. and Ranadhir, M. (1982): An economic analysis of composite fish culture in India. In: Aquaculture Economic Research in Asia: Proceedings of a workshop held in Singapore, 2 – 5 June, 1981. IDRC, Ottawa, Ont, PP, 90 – 96.

Table (3): Average values of the growth performance parameters of fish in different groups.

PARAMETERS	GROUPS		
	1	2	3
Initial weight(g)	0.04 [a]	0.04 [a]	0.04 [a]
Weight at 2 week (g)	0.31 c	0.97 [a]	0.56 b
Final weight(g)	1.34 ±0.14 [c]	2.29 ± 0.15 [a]	1.51 ± 0.13 [b]
Total gain (g)	1.3 ± 0.13 [c]	2.25 ± 0.15 [a]	1.47± 0.13 [b]
Weekly gain (g)	0.33	0.56	0.37
Specific growth rate ((SGR)[1]	1.63 ± 0.95 [b]	2.75 ± 0.11 [a]	1.83 ± 0.12 [b]
FCR [2]			
0 – 2 wk	0.62	0.19	0.34
2 – 4 wk	1.26	1.27	1.57
0 – 4 wk	1.13 ± 0.14 [a]	0.83 ± 0.03 [b]	1.12 ± 0.09[a]
PER [3]			
0 – 2 wk	5.29	18.24	10.2
2 – 4 wk	2.63	2.81	2.20
0 – 4 wk	2.93 ± 0.22 [b]	4.32 ± 0.22 [a]	3.05 ± 0.20 [b]
PPV [4]	49.21	94.05	46.89

Means having the same letters are not significantly different at $p<0.01$.

Values are means ± standard error.

1-Specific growth rate = 100 (log e Wf – log e Wi /T) where Wf is the final weight (g) , Wi is the initial weight (g) and T the time between weighing in days.

2-Food conversion ratio = Feed fed (g)/Weight gain (g)

3-Protein efficiency ratio = Weight gain (g) / Protein consumed (g)

4- protein productive value = 100 X protein retained in the body (g) / protein consumed (g)

Table (4): Body length (cm) development of fish throughout the experiment in different groups.

PARAMETERS	GROUPS		
	1	2	3
Initial body length	1.32	1.32	1.32
Final body length	3.94 ± 0.16 [b]	6.10 ± 0.09 a	4.09 ± 0.12 [b]
Increase in length	2.62	4.78	2.77
K final 1)	2.19 ± 0.34 [a]	1.01 ± 0.09 [c]	2.21 ± 0.23 [b]

Means having the same letters are not significantly different at $p<0.01$.

Values are means + standard error.

1- Condition factor = 100 (W/L3) where W, is the fish weight (g) , L is the length in Cm

Table (5): Survival rate in different fish groups:

	GROUPS		
	1	2	3
Initial stocked No.	102000	102000	102000
No. after 2 weeks	95000	85000	9000
Survival rate (0-2wk)	93.14	83.33	88.24
No. after 4 weeks	90000	75000	82000
Survival rate (2 – 4 Wk)	94.74	88.24	91.11
Survival rate(0 – 4 wk)	88.24	73.53	80.39

Table (6): production characteristics in different fish groups throughout the experiment.

EXPERIMENTAL PERIOD (WK)	GROUPS		
	1	2	3
Total fish yield(1)			
0	4.08	4.08	4.08
2	29.45	82.45	50.4
4	120.6	171.75	123.82
Net fish yield (2)			
0 – 2	1.81	5.60	3.31
2 – 4	6.51	6.38	5.24
0 - 4	4.16	5.99	4.28

1= Total fish yield (Kg/pond) 2= Net fish yield (Kg/pond/day)

Table (7): Proximate body composition of fish in different groups at the start and end of the experimental period.

	INITIAL	FINAL		
		Group (1)	Group (2)	Group (3)
% on fresh basis:				
Moisture	86.71	76.52	75.59	76.66
DM	13.29	23.48	24.41	23.34
CP	9.58	16.52	15.40	15.23
EE	1.77	3.74	3.62	3.81
Ash	1.78	3.03	4.78	3.53
CHO	0.16	0.19	0.61	0.77
% on DM basis				
CP	72.07	70.35	63.10	65.25
EE	13.33	15.97	14.85	16.33
Ash	13.38	12.89	19.57	15.12
CHO	1.22	0.79	2.48	3.3

DM = Dry matter, CP= Crude protein, EE= Ether extract, CHO= Carbohydrate

Table (8): Nutrient retention in fish of different experimental groups.

ITEMS	GROUPS		
	1	2	3
Dry matter (DM):			
DM retained (g)	0.31	0.554	0.347
DM increased % of initial	5831.45	10421.37	6527.46
Crude protein (CP):			
CP retained (g)	0.218	0.349	0.226
CP increased % of initial	5688.94	9107.52	5897.7
Ether extract (EE):			
EE retained (g)	0.049	0.082	0.057
EE increased % of initial	6920.94	11581.92	8050.85
Crude ash :			
Ash retained (g)	0.0399	0.1088	0.0526
Ash increased % of initial	5603.93	15280.89	7387.64

Table(9): Costs and returns analysis of tilapia mono-sex fry rearing in different experimental fish groups (per pond).

DESCRIPTION	GROUPS		
	1	2	3
Land/pond	75	75	75
Feed [1] or fertilizer cost [2]	188	89.8	138.9
Management	100	100	100
Veterinary supervision	50	50	50
Gas and oil	10	10	10
Fry /1000 [3]	918.0	9180	19810
Repair and maintenance	50	50	50
Total costs	9653	9554.8	9603.9
Total revenue[4]	12600	10500	11480.0
Net income	2947	945.2	1876.1
Economical efficiency %	30.53	9.84	19.53

1- Price of one Kg of commercial feed = 1.4 LE
2- Price of one tone from chicken manure = 165 LE
3- Price of 1000 from fry before stocking = 90 LE
4- Price of 100 from fry after experiment = 140 LE