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REDUCING THE ARTIFICIAL FOOD BY USING SAFE SANITATION ALTERNATIVES UNDER A POLYCULTURE SYSTEM

Ahmed F. Fath El-Bab

Central Laboratory for Aquaculture Research at Abbassa, Agriculture Research Center, Egypt.

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Abstract

The present study was carried out to investigate the effect of treated poultry manure as safe organic matter (rigirs) at rate of 100kg/feddan weekly and artificial feed on growth, economic efficiency and pond productivity of Nile tilapia, *Oreochromis niloticis* and grey mullet, *Mugil cephalus*. Ten ponds (½ feddan) were stocked by Nile tilapia and grey mullet. Ten ponds (two replicates for each treatment) were designed for five treatments and stocked with *Oreochromis niloticus* (4500 fish/pond), grey mullet (1500 fish/pond). The experimental earthen ponds used in the study were treatment 1(control): artificial feeding throughout the experimental period (26 weeks), treatment 2: ponds fertilized by (rigirs) at rate of 50kg/ pond weekly for the first month of the experimental period, followed by pelleted artificial feed until the end of experiment, treatment 3: ponds fertilized by (rigirs) at rate of 50kg/ pond weekly for the first two months of the experimental period, followed by pelleted artificial feed until the end of experiment, treatment 4: ponds fertilized by (rigirs) at rate of 50kg/ pond weekly for the first three month of the experimental period, followed by artificial feed until end of experiment, and treatment 5: ponds fertilized by (rigirs) at rate of 50kg/ pond weekly during the whole experimental period (26 weeks). Results obtained are summarized in the following:

Growth parameters:

Nile tilapia (ON): Treatment 1 recorded the highest ranges of body weight (BW), body length (BL), daily weight gain (DWG) and specific growth rate (SGR),while treatment 3 recorded the highest ranges of condition factors (K).

Grey mullet (GM): Treatment 1 recorded the highest ranges of body weight (BW), body length (BL), daily weight gain (DWG) and specific growth rate (SGR),while treatment 2 recorded the highest ranges of condition factors (K).

Chemical composition:

Nile tilapia: treatment 1 recorded the highest ranges of fat and ash%, treatment 4 recorded the highest ranges of protein content. While, treatment 2 recorded the highest ranges of moiture.

Grey mullet: treatment 4 recorded the highest ranges of moiture and protein content. treatment 1 recorded the highest fat content, while treatment 2 recorded the highest ranges of ash%.

Economical evaluation, content of the obtaind results showed that, the use of rigir at the first three months of culture Nile tilapia and grey mullet at rate of 100 kg / feddan / week, after that use artificial feed containing 25% crude protein at rate of 3 % of total biomass of in earthen ponds could be recommended for producing Nile tilapia and grey mullet. From the economical point of view, this treatment showed the best ratio of returns to total costs.

INTRODUCTION

Oreochromis niloticus and grey mullet (*Mugil cephalus*) are considered in Egypt as fish species of high market value. Afifi *et al*. (1996) indicated that both tilapia and mullet showed the best response in their growth performance when they stocked together in earthen ponds fertilized with organic fertilizer (chicken manure), chemical fertilizers (super phosphate and urea) and supplementary diet containing 11% crude protein. Ease cultivation of tilapia and mullet, resistance to poor water quality and disease, tolerance to a wide range of environmental conditions, ability to convert efficiently organic domestic and agricultural wastes into high quality protein, good growth rates and amenability to intensification are some of the basic characteristics of both species which make them ideal candidates for intensive and semi-intensive culture (Afifi *et al*., 1996).

Grey mullet is commonly cultured with tilapia in Egypt. Tilapia and mullet are popular and favored by the Egyptian consumers for their good quality flesh and comparatively larger size of their adults. Both species are highly priced and feasible culture in fishponds. One way of increasing the food availability in fishponds is fertilization of ponds by chemical or/and organic fertilizers which is often a mean of increasing the primary natural productivity

of the ponds as reported by FAO (1980). The present study aimed to investigate the effect of rigir and comparing with artificial feeding on the production of Nile tilapia and Grey mullet fingerlings in the intermediate fish farming for youth projct.

MATERIALS AND METHODS

The study had been done in a private farm (in Tollumbat No. 7 in Riyad City, Kafr El-Sheikh governorate, Egypt) to evaluate the effect of treated fertilization and artificial feeding on earthen ponds productivity stocked with Nile tilapia, *Oreochromis niloticus* and grey mullet, *Mugil cephalus*. Rigirs is a product produced by Misr El-Salam International Company for producing organic fertilizer, Alexandria governorate. Rigirs consists of compressed and heat treated chicken manure in order to be free from parasites, Salmonella, Shigella and *E. coli*. The procedures done in this study such as fertilizers application per treatment, pond preparation, stocking rate and pond daily management are described in details. Also water quality measurements, fish sampling and data collected during harvest are recorded too. Equations and statistical methods for analysing the specific growth rate, daily weight gain and the condition factor are given. The current experiment was conducted using randomized block design for five treatments of similar surface area (2100 m^2 each).

Ponds description and preparation:

The experimental ponds were equal in water volume (2625 m^3) and dimensions (21x100 m) with the same average water depth of 125 cm. The farm water source was mainly agricultural drainage water and comes from El-Gharbia drainage canal. The water system of the experimental ponds is maintained by gravity. Ponds inlet and outlet pipes were covered with narrow mesh screen to prevent unwanted fish or predators to get into ponds. Partial filling of the ponds to 50% of target level started on the following day after applying the initial fertilization dose from relevant fertilizers. Two days prior to stocking fingerlings fish, ponds water level increased and reached the maximum target water depth.

Experimental fish:

The experimental ponds were stocked with fish species; *Oreochromus niloticus* and *Mugil cephalus*. *O. niloticus* fingerlings were stocked at an average initial total length of 9.44cm and an average initial total weight of 10.20g for all treatments. The average initial total length of G. mullet fingerlings were 13.94cm and an average initial total weight of 13.80g for all treatments. The fingerlings of *O. niloticus* and *M.cephalus* were collected from different fish farms Riyad City, Kafer El-Shiek Governorate. Each pond was stocked with 6000 fish (4500 *O. niloticus* and 1500 *M.cephalus*) corresponding to the rate of 12000 fish/ feddan. The trial lasted for 182 days started on the 15th of April and harvested on 14th October 2013.

Fertilizers applications:

Ponds were fertilized for the twenty sixth weeks. Fertilization occurred once a week by broadcasting of rigir. The chemical composition of rigir is show in Table (1).

Table 1. Chemical analysis of rigirs on D.M basis.

Item	Rigir
Cubic meter weight (kg/ m3)	730
Humidity %	9.6
pH	8.01
Electric conductivity mmhos/cm	4.2
Total nitrogen %	2.38
Ammonia nitrogen ppm	1040
Organic matter %	59.68
Organic carbon %	29.58
Ash %	40.32
C:N ratio	13:1
Total phosphorus %	1.79
Total potassium %	1.91
Iron ppm	768
Manganese ppm	398
Copper ppm	40
Parasites	Nil

Organic fertilizer and Supplementary feed:

Rigirs is a product for fish farm produced by Misr El-Salam International Company for producing oraganic fertilizer, Alexandria Governorate. Rigirs consists of chicken manure but compressed and heat treated in order to be free from parasites, Salmonella, Shigella and *E. coli*. at rate of 50kg/ (pond-½feddan) /weekly.

Commercial diet was manufactured by Sherbeen-Domiatte, local factory. Sample of fish feed was collected from several sacks and send for proximate analysis at the Central Laboratory for Aquaculture Research at Abbassa. Chemical analysis of experimental artificial feed is presented in Table (2). The fingerlings were fed commercial floating diet to keep the diets available for fish contain 25% crude protein (pellets 3 mm in diameter), and fed six days per week at a daily feeding rate of 3% of the estimated fish-weight twice at 9.00am and 3.00pm during the experimental period. Feed was applied by broadcasting over pond water surface in the same place and fish were considered satiated when they did not show an interest on the feed.

Table 2. Composition and proximate chemical analysis of the experimental ration.

Ingredients	%
Yellow corn	33
Wheat bran	17
Fish meal (72% CP)	10
Meat meal	7
Soybean meal (44% CP)	10
Decorticated cotton seed meal	7
Poultry slaughter by-products	8
Fat	5
Vitamin premix*	1.5
Mineral premix.**	1.5
Total	100
Proximate analysis (% of dry weight)	
Moisture	10.20
Crude protein	22.08
Ether extract	6.54
Crude fiber	6.72
Ash	6.06

* Each gram of vitamin premix contains 20000 IU vit. A , 2000 IU vit.D_3, 400 IU vit E, 20 mg Niacin, 4.5 mg riboflavin, 3 mg pyridoxine, 0.013 mg vit. B12, 100mg choline chloride and 2mg vit K.

** Each gram contains 0.83 mg Ca, 0.63 mg P, 0.78 mg Na, 0.018 mg Zn and 0.001 mg Cu. The Mixture was prepared by mixing 35 parts of dicalcium phosphate, 3 parts of mineral premix and 2 parts of common salt.

Feed quantity was adjusted according to average body weight of the sample in each pond. In order to determine the average weight of fish, biweekly samples were taken by seining, where 30 fishes / species from each pond (replicate) were collected and then retaind again to the pond after individual measuring the weight and length.

Water management:

Water temperature, pH and dissolved oxygen were daily daily measured at 6 a.m. and 12 p.m. using thermometer, dissolved oxygen meter (YSI model 57) and pH meter (model Corning 345), respectively. Determinations of the other water quality parameters (alkalinity, ammonia, nitrite and nitrate) were carried out every two weeks according to the methods of Boyd (1979).

Fish samples and measurements:

Random samples (30 fish from each species for each pond -120 fish for each treatment) were taken every 15 days during the experimental period. During this experiment, body measurements (body weight in g and body length in cm) at biweekly interval throughout the whole experiment period.

Condition factor was determined by using the following formula:

K%= [weight (g) / length $(cm)^3$] ×100

Specific growth rate **(SGR %)** = $\frac{LnW2 - LnW1}{t} x\, 100$ (Jauncey and Rose, 1982)

Harvesting:

At the end of the experiment (14^{th} of October, 2013), ponds were gradually drained from the water and fish were harvested by seining and transferred to fiberglass tanks and carried to the processing centre where they washed, and the fish of the different fish species were sorted and collectively weighed.

Chemical analysis of fish:

At the end of the experiment, five fish were chosen from each species from each pond and exposed to the chemical composition of whole fish body (AOAC, 1990).

Statistical analysis:

The statistical analysis of data collected was carried out by applying the computer program (SAS, 1996). Differences among means were tested for significance according to Duncan's multiple range test (1955).

RESULTS AND DISCUSSION

Water quality analysis:

Water samples were monthly collected from the experimental ponds and analyzed during the experimental period (182 days) Results of water quality parameters of the experimental ponds (as averages) are summarized and tabulated in Table (3). In general, the averages of water temperature ranged from 26.48 to 27.63°C during the experiment period (15^{th}April – 15^{th} October). Gui *et al*. (1989) and Kamal *et al*, (2008) indicated that an average temperature of 28 °C was considered the most sutible temperature for growth of Nile tilapia fry. In the same respect, Dissolved oxygen ranged between 4.21 and 6.89 mg / l. Many authors (Denser 1968, AIT 1986, and Hassan *et al*. 1997) indicated that 2.3 mg DO /l is above the normal tolerance level of tilapia. In the same trend, pH ranged in our study, between 8.12 and 8.80. pH range of 6.5 - 9 are the most suitable for fish production (Boyd, 1998).

The average concentration of unionized ammonia (NH_3) was 0.35, 0.32, 0.29, 0.28 and 0.26 mg/l for T1, T2, T3, T4 and T5, respectively. Diana and Lin (1998) found that, ammonia concentration ranged between 0.374 and 0.410 mg/l in ponds fertilized with a combination of chicken manure and inorganic fertilizers in

The concentration of nitrite ranged between (0.033 to 0.040 mg/l) during the whole experimental period. The concentration of nitrate seems to be

constant among treatments (0.110 to 0.117 mg/l). Diana and Lin (1998) showed that nitrite and nitrate concentration ranging between 0.374 – 0.410 mg/l and 0.438 – 0.461 mg/l, respectively, in ponds fertilized with both chicken manure and inorganic fertilizers. Kamal *et al.* (2008) indicated that, the values of nitrite ranged between 0.02 and 0.03 mg/L.

The average values of seechi disk readings were 18.28, 19.16, 22.06, 21.52 and 23.39 cm for T1, T2, T3, T4 and T5, respectively. The values of the total alkalinity ranged between 384.76 and 422.97 mg/l, and total hardness ranged between 191.16 to 212.36 mg/l. Kamal *et al.* (2008) reported that, the values of the total alkalinity ranged between 392.50 and 434.34 mg/l, and. The obtained results showed that all water quality parameters were in the suitable range (Boyd, 1979).

Table 3. Some water quality parameters of earthen ponds stocked with Nile tilapia and Grey mullet fry treated with organic fertilizers and artificial feed for 182 days culture period.

Variable	NO.	T1	T2	T3	T4	T5
Temperature (C°)	6	27.63 ±0.50^{a}	27.18 ±0.50^{a}	26.48 ±0.50^{b}	27.132 ±0.50^{a}	26.52 ±0.50^{b}
DO oxygen	6	5.48 ±0.15^{ab}	6.89 ±0.15^{a}	5.50 ±0.15^{ab}	5.42 ±0.15^{ab}	4.21 ±0.15^{b}
PH	6	8.80 ±0.12^{a}	8.56 ±0.12^{a}	8.52 ±0.12^{ab}	8.37 ±0.12^{b}	8.12 ±0.12^{b}
Seechi disk (cm)	6	18.28 ±0.15^{a}	19.16 ±0.15^{a}	22.06 ±0.15^{ab}	21.52 ±0.15^{b}	23.39 ±0.15^{b}
NH_3 mg/l	6	0.35 ±0.008^{b}	0.32 ±0.008^{b}	0.29 ±0.008^{a}	0.28 ±0.008^{a}	0.26 ±0.008^{a}
NO_2 mg/l	6	0.033 ±0.001^{c}	0.040 ±0.001^{a}	0.036± 0.001^{b}	0.03 8±0.00^{a}	0.035 ±0.001^{b}
NO_3 mg/l	6	0.112 ±0.003^{a}	0.110 ±0.003^{a}	0.117 ±0.003^{a}	0.115 ±0.003^{a}	0.115 ±0.003^{a}
Total alkalinity (mg/l)	6	422.97 ±14.06^{a}	413.55 ±14.06^{a}	402.63 ±14.06^{ab}	392.96 ±14.06^{ab}	384.76 ±14.06^{b}

$^{a-c}$ Means with the same letter in each column are not significantly different (P≥0.05).

Body weight:

The averages of initial weights of *Oreochromus niloticus* (ON) and Grey mullet *Mugil cephalus* (GM) were 47.11 and 36.87g respectively; while at the end of the experiment, the means of body weight for fish species were 307.90 and 235.45g, respectively (Table 4). These results indicate that, the body weight for (ON) was higher than obtained in (GM).

The initial body weight was 47.10, 47.95, 46.33, 45.89 and 48.30g for the different treatments T1 (control): artificial feeding during the experimental period, T2: fertilized with rigirs during the first month of the experimental period, followed by pelleted artificial feed until the end of experiment, T3: fertilized with rigirs for the first two months of the experimental period, followed by pelleted artificial feed until the end of experiment, T4: fertilized by rigirs for the first three monthes of the experimental period, followed by artificial feed until end of experiment, and T5: fertilized with rigirs till the end of the experimental period, respectively. While at the end of experiment, the means of tilapia body weight for treatments were 366.20, 351.40, 338.77, 288.80 and 194.40g for the five treatments, respectively. These results indicate that, the average body weight for first and second treatment was higher than other treatments. Osman *et al*. (2008) found that, fish groups fed the artificial diet only (treatment 1) showed the highest significant final body weights ($P<0.01$) followed in descending order by treatments 3, 4, 5 and 2 (308.8, 292.4, 234.1, 202.3 and 178.8 g), respectively.

Table 4. Effect of fertilization and artificial feeding on body weight (g) of Nile tilapia and grey mullet.

Treatments	No.	Nile tilapia		Grey mullet	
		Initial weight	Final weight	Initial weight	Final weight
T1	30	47.10 ± 0.92^{a}	366.20 ± 1.29^{a}	36.31 ± 0.92^{b}	278.68 ± 1.29^{a}
T2	30	47.95 ± 0.92^{a}	351.40 ± 1.29^{ab}	38.12 ± 0.92^{a}	268.13 ± 1.29^{a}
T3	30	46.33 ± 0.92^{a}	338.77 ± 1.29^{b}	37.24 ± 0.92^{a}	256.57 ± 1.29^{ab}
T4	30	45.89 ± 0.92^{a}	288.80 ± 1.29^{c}	35.14 ± 0.92^{b}	227.40 ± 1.29^{b}
T5	30	48.3 ± 0.92^{a}	194.40 ± 1.29^{d}	37.55 ± 0.92^{b}	146.45 ± 1.29^{c}

[a-c] Means with the same letter in each column are not significantly different ($P\geq0.05$).

Green (1992) concluded that the chicken manure can replace 100% of pelleted supplemental feed without significant effects on the growth of tilapia during the first 60 days of the culture. This is in agreement with the results obtained in the present study. Fath El-bab *et al.* (2011) studied the effect of fertilization and artificial feed on productivity of earthen ponds stoked under polyculture system and found that, the differences between fish species were significant. These results may be attributed to the feeding habits of species as tilapia fish is an efficient converter of phytoplankton and can utilize a wide variety of food, especially artificial feeds.

Concerning body weight of grey mullet (Table 4), the initial body weight was 36.31, 38.12, 37.24, 35.14 and 37.55g for the different treatments, respectively. While at the end of experiment, the means of body weight for treatments were 278.68, 268.13, 256.57, 227.40 and 146.45g for the five treatments, respectively. These results indicate that, the average body weight for first treatment was higher than other treatments and the differences among treatments were significant ($P<0.05$).

El -Ebiary (1998) when studied the use of organic manures in polyculture system for tilapia, mullet and carp, he found that, the average of final weight influenced by an increase of the period of organic fertilization. He referred that, organic fertilizer is not enough to rely upon as a staple food for Fish.

Jasmin *et al*. (2011) found that, average gain in body weight of all the fish species together was less in the pond without fertilizer than that in the pond with fertilizer. The fertilizer increased the primary productivity and finally caused a significant increase in fish yield in ponds.

Body length:

Table 5 shows means of total body length, at the start and the end of experiment. As described in this Table the initial averages of ON and GM were 16.87 and 17.22cm, respectively while at the end of experiment, the means of

total body length for fish species were 26.94 and 29.98cm, respectively. These results indicate that body length for GM was significantly higher than ON.

Concerning the effect of treatments on body length for Nile tilapia (Table 5), the initial body length was 16.00, 17.80, 15.80, 16.50 and 18.20cm for five treatments T1, T2, T3, T4 and T5 respectively. While at the end of the experiment, the means of body length for treatments were 28.10, 27.90, 27.40, 26.10 and 25.20cm for five treatments, respectively. These results indicate that the total body length for first treatment (control) was higher than other treatments. Analysis of variance of results indicated that the differences among treatments were significant ($P<0.05$).

Osman *et al.* (2008) reported that, average fish final length at the end of the experimental period was found to follow the same order ($P<0.01$) of finale body weight and being 31.20, 30.80, 30.50, 29.95 and 27.38cm, respectively. These results are in accordance with those obtained by Hafez (1991), who found a strong correlation between body weight and body length for tilapia, mullet and carp fish.

Table 5. Effect of fertilization and artificial feeding on body length (cm) of Nile tilapia and grey mullet.

Treatments	No.	Nile tilapia		Grey mullet	
		Initial length	Final length	Initial length	Final length
T1	30	16.00 ± 0.09^{a}	28.10 ± 0.78^{a}	17.10 ± 0.09^{b}	31.30 ± 0.78^{a}
T2	30	17.80 ± 0.09^{a}	27.90 ± 0.78^{a}	17.70 ± 0.09^{a}	30.70 ± 0.78^{b}
T3	30	15.80 ± 0.09^{a}	27.40 ± 0.78^{b}	18.00 ± 0.09^{a}	31.60 ± 0.78^{b}
T4	30	16.50 ± 0.09^{a}	26.10 ± 0.78^{c}	16.80 ± 0.09^{b}	30.80 ± 0.78^{b}
T5	30	18.20 ± 0.09^{a}	25.20 ± 0.78^{d}	16.50 ± 0.09^{b}	26.50 ± 0.78^{c}

$^{a-c}$ Means with the same letter in each column are not significantly different ($P\geq0.05$).

Averages mullet body length at the start of this experiment were 17.10, 17.70, 18.00, 16.80 and 16.50cm for five treatments, respectively. While at the end of experiment the means of body length for treatments were 31.30, 30.70, 31.60, 30.80 and 26.50cm for the five treatments, respectively. These results

indicate that, the average body length for first treatment was higher than other treatments. Prabahar and Murugan (2012) found increasing body length when mullet and major carp, fed on artificial feed after 2 months of fertilization by organic and inorganic fertilizers.

Condition factor (K):

Condition factor (K) was considered to be a sufficient measure of shape, although shape is usually not considered as a character of interest to breeding programs, since it has no obvious economic value (Nilsson, 1992).

Table 6. Effect of fertilization and artificial feeding on condition factor (K) of Nile tilapia and grey mullet.

Treatments	No.	Nile tilapia		Grey mullet	
		Initial K	Final K	Initial K	Final K
T1	30	1.43±0.04[a]	1.97±0.18[a]	0.75±0.04[a]	1.05±0.18[a]
T2	30	1.00±0.04[b]	1.95±0.18[a]	0.70±0.04[a]	1.07±0.18[a]
T3	30	1.47±0.04[b]	2.00±0.18[a]	0.66±0.04[a]	1.04±0.18[a]
T4	30	1.04±0.04[a]	1.89±0.18[a]	0.77±0.04[a]	1.00±0.18[b]
T5	30	0.94±0.04[a]	1.61±0.18[b]	0.81±0.04[a]	0.95±0.18[c]

[a-c] Means with the same letter in each column are not significantly different (P≥0.05).

Table 6 presents means of K at the start and the end of the experiment as affected by treatments and fish species. As described in this Table, the averages of K values at the start for ON and GM were 1.17 and 0.74, respectively while at the end of experiment the means of K for fish species were 1.83 and 1.02, respectively.

With regard to the effect of treatments on condition factor for Nile tilapia, Table 6 showed that, the initial condition factor was 1.43, 1.00, 1.47, 1.04 and 0.94 for five treatments T1, T2, T3, T4 and T5 respectively. While at the experimental end, the averages of condition factor for treatments were 1.97, 1.95, 2.00, 1.89 and 1.61, respectively. These results indicate that, the condition factor for T3 was higher than other treatments. Analysis of variance of results

indicates that, the differences among treatments were significant (P<0.05). Oren (1981) revealed that fluctuations in ponds for fish growth (length, weight and condition factor) are affected by different factors such as feeding regime, population density and environmental conditions. Osman *et al*. (2008) when studied the effect of different combinations between organic, inorganic fertilizers and artificial diets on the growth performance, feed efficiency and production cost of *Oreochromis niloticus* reared in earthen ponds, found that the average of condition factor values for treatments (Treatment1, artificial diet only), (Treatment2, fertilization only), (Treatment3, 1month fertilization + 3 months artificial diet), (Treatment4, 2months fertilization + 2 months artificial diet) and (Treatment5, 3 months fertilization + 1 month artificial diet) were 2.38, 2.34, 2.4, 2.26 and 2.18, respectively.

Results presented in Table 6 show that, the average of condition factor values for treatments (1, 2, 3, 4 and 5) For grey mullet at the beginning of this experiment were 0.75, 0.70, 0.66, 0.77 and 0.81, respectively. While at the of this experimental period the average of condition factor values were 1.05, 1.07, 1.04, 1.00 and 0.95 for five treatments, respectively , the differences among treatments were significant (P<0.05).

Fath El-bab *et al.* (2011) found that, feeding treatment in adequate quantities and the increase in feeding rate resulted in higher condition factor since the fish grow well when the supply of food is adequate. Similar results in which condition factors increased with the feeding rate have been reported by Chua and Teng (1982)

Daily weight gain (DWG):

Table 7 shows means of daily weight gain, throughout the experiment as affected by treatments and fish species. As described in this Table the averages between each of ON and GM were 1.43 and 1.11g/fish, respectively. These results indicate the daily weight gain for ON was higher than obtained for GM.

Concerning the effect of treatments on daily weight gain for Nile tilapia Table 6 showed that, the daily weight gain was 1.75, 1.67, 1.61, 1.33 and

0.80g/fish for five treatments T1, T2, T3, T4 and T5, respectively. These results indicate that, the daily weight gain for treatments T1 and T2 were higher than other treatments. Analysis of variance of results indicates that the differences among treatments were significant (P<0.05). Osman *et al*. (2008) found that, the highest averages daily gain and SGR were recorded by treatment 1 (2.54 and 3.62%/ day, respectively) followed by treatments 3,4 and 5, while the lowest values (1.46 and 3.16%/day, respectively) were found in the group fed no artificial feed (treatment 2).

Hassan *et al.* (2008) revealed that artificial feed application to blue tilapia improved specific growth rate values as compared with other treatments in fertilized ponds at lower stocking densities. Increasing was recorded in the growth performance by using supplemental feeding compared with other treatments (fertilized ponds). They found also that, blue tilapia was the fastest growing fish under these conditions while growth performance of grass carp was higher in fertilized ponds.

Table 7. Effect of fertilization and artificial feeding on DWG and SGR of Nile tilapia and grey mullet.

Treatments	No.	Nile tilapia		Grey mullet	
		DWG, g/fish	SGR, %/d	DWG, g/fish	SGR, %/day
T1	30	1.75±0.07^{a}	1.13±0.12^{a}	1.33±0.07^{a}	1.12±0.12^{a}
T2	30	1.67±0.07^{ab}	1.10±0.12^{ab}	1.26±0.07^{a}	1.07±0.12^{ab}
T3	30	1.61±0.07^{ab}	1.09±0.12^{b}	1.20±0.07^{b}	1.06±0.12^{b}
T4	30	1.33±0.07^{c}	1.00±0.12^{c}	1.17±0.07^{bc}	0.97±0.12^{c}
T5	30	0.80±0.07^{d}	0.77±0.12^{d}	0.61±0.07^{c}	0.78±0.12^{d}

$^{a-c}$ Means with the same letter in each column are not significantly different (P≥0.05).

With regard to the effect of treatments on daily weight gain for grey mullet, it was 1.33, 1.26, 1.20, 1.17 and 0.61,g/fish for five treatments, respectively. The obtained results indicate that, the daily weight gain for treatments T1 and T2 were higher than other treatments. Analysis of variance of

results indicates that the differences among treatments were significant ($P<0.05$). El -Ebiary (1998) when studied the use of organic manures in polyculture system for tilapia, mullet and carp, he found that the average of daily weight gain Influenced by an increase of the period of organic fertilization. He referred that, organic fertilizer is not enough to rely upon as a staple food for Fish. Kstmont (1995) showed that, growth and yield of each species may be increased in polyculture than in monoculture because of the positive interactions among species.

Specific growth rate (SGR):

Table 7 shows means of SGR, at the end of experiment as affected by treatments and fish specie. As described in this Table, the averages of ON and GM were 1.68 and 1.48%/day, respectively. These results indicate that SGR for ON was higher than that obtained for GM.

With regard to the effect of treatments on SGR for Nile tilapia, Table 7 showed that, the specific growth rate during the whole experimental period were 1.13, 1.10, 1.09, 1.00 and 0.77 for treatments T1, T2, T3, T4 and T5, respectively. These results indicate that, the Specific growth rate for T1 and T2 were higher than those obtained with other treatments. Analysis of variance indicates that the differences among treatments were significant ($P<0.05$). Abdel- Rahman *et al.* (2003) reported that SGR for *O. niloticus* during the fortnight periods of the experiment were significantly higher for pelleted and mash treatments rather than chicken manure and cow manure treatments.

Hassan *et al.* (2008) reported that, the SGR values of blue tilapia influenced by supplementary feed which increased the availability of all nutrients to fish when stocked in un-fertilized ponds; the lowest value was obtained by grass carp with high stocking density in un-fertilized ponds.

The average of SGR values for treatments (1, 2, 3, 4 and 5) For grey mullet during the whole experimental period were 1.12, 1.07, 1.06, 0.97 and 0.78, respectively. These results indicate that, the SGR for treatments T1 was higher than other treatments. Analysis of variance of results indicates that the

differences among treatments were significant (P<0.05). Sarig (1981) observed that mass development of algae frequently appears in the fertilized ponds where supplementary food is added. He added that these algae are not fully utilized by common carp or tilapia, but serve as excellent food for grey mullet. Essa *et al*. (1989) and Hussein (1995) reported that, the highest growth of mullet (*M. cephalus*) was recorded in polyculture conditions with organic fertilizers and supplementary feeding.

Chemical composition:

Moisture %:

Table 8 showed averages of moisture% for whole body at the end of this experiment found to be 67.31 and 63.90% for ON and GM, respectively. These results indicated that, the moisture% for ON was higher than that obtained for GM. The differences between fish species were significant (P<0.05).

With regard to the effect of treatments on moisture% for Nile tilapia, Table 8 showed that, the values at the end of this experiment were 67.18, 69.36, 67.75, 66.22 and 66.04% for five treatments T1, T2, T3, T4 and T5, respectively. The obtaine results indicate the dry matter for T2 was higher than obtained for other treatments. Analysis of variance of results indicates that the differences among treatments were significant (P<0.05). Osman *et al*. (2008) reported that, moisture content of tilapia fish in treatment2 (only organic and inorganic fertilizers) decreased significantly (P<0.01) compared with the other treatments.

Table 8. Effect of fertilization and artificial feeding on chemical composition % DM basis of Nile tilapia and grey mullet.

Treatments	No.	Moisture	Protein	E. ext.	Ash
Nile tilapia					
T1	**6**	67.18±1.29^{b}	58.37±1.05^{d}	28.75±0.79^{a}	11.68±0.64^{a}
T2	**6**	69.36±1.29^{a}	64.54±1.05^{b}	26.53±0.79^{c}	10.12±0.64^{ab}
T3	**6**	67.75±1.29^{b}	62.33±1.05^{c}	27.95±0.79^{b}	10.47±0.64^{ab}
T4	**6**	66.22±1.29^{c}	65.80±1.05^{a}	26.25±0.79^{c}	10.03±0.64^{ab}
T5	**6**	66.04±1.29^{c}	65.73±1.05^{a}	24.52±0.79^{d}	9.95±0.64^{b}
Grey mullet					
T1	**6**	64.31±1.68^{a}	63.92±1.38^{c}	29.52±1.02^{a}	11.69±0.83^{b}
T2	**6**	64.25±1.68^{a}	63.97±1.38^{c}	25.85±1.02^{b}	12.60±0.83^{a}
T3	**6**	62.44±1.68^{c}	64.29±1.38^{b}	25.69±1.02^{b}	12.48±0.83^{a}
T4	**6**	64.73±1.68^{a}	64.99±1.38^{b}	23.75±1.02^{c}	10.37±0.83^{c}
T5	**6**	63.79±1.68^{b}	64.22±1.38^{a}	20.69±1.02^{d}	10.16±0.83^{d}

$^{a-c}$ Means with the same letter in each column are not significantly different (P≥0.05).

Concerning the effect of treatments on moisture% for grey mullet, Table 8 showed also that, the moisture% was 64.31, 64.25, 62.44, 64.73 and 63.79%/fish for five treatments T1, T2, T3, T4 and T5 respectively. oure results indicate that, the moisture% for treatments 4 was higher than other treatments. Analysis of variance of results indicates that the differences among treatments were significant (P<0.05).

Protein %:

The averages of protein content of ON and GM were found to be 63.21 and 64.48%, respectively. These results indicate that, the protein % for GM was higher than obtained in ON. The differences between fish species were significant (P<0.05).

With regard to the effect of treatments for Nile tilapia on protein %, Table 8 showed that, protein content was found to be 58.37, 64.54, 62.33, 65.08 and 65.73% for five treatments T1, T2, T3, T4 and T5, respectively. These results indicated that, protein % for T5 was higher than obtained with other treatments. Analysis of variance of results indicates that the differences among treatments were significant (P<0.05).

Hafez *et al*. (2001) indicated that, fish carcasses of fish reared in organic fertilization ponds had higher percentages of protein, ash and lower percentages of fat compared with fish carcasses obtained from fish fed supplementary feeds.

The average of protein % values for treatments (1, 2, 3, 4 and 5) For grey mullet at the end of the experimental period were 63.92, 63.97, 64.29, 64.99 and 65.22%, respectively. These results indicate that, the % protein for treatments T5 was higher than other treatments. Analysis of variance of results indicates that the differences among treatments were significant ($P<0.05$).

Ether extract %:

As described in Table (8), the averages fat content of ON and GM were 26.80 and 24.95%, respectively. These results indicate the ether extract for ON was higher than that obtained for Gm and the differences between fish species were significant ($P<0.05$).

With regard to the effect of treatments for Nile tilapia on ether extract %Table 8 showed that, ether extract at the end of this experiment was 28.75, 26.53, 27.95, 26.25 and 24.52% for treatments T1, T2, T3, T4 and T5, respectively. Our results indicate that ether extract for first treatment was higher than obtained for other treatments, and by increasing fat percentage there was decreasing protein percentage. Analysis of variance indicates that the differences between treatments were significant ($P>0.05$). Barash and Schroeder (1984) indicated that tilapia fat content was higher in fish fed pelleted feed when compared by those raised with fermented manure

The average of ether extract% values for treatments (1, 2, 3, 4 and 5) For grey mullet during the whole experimental period was found to be 29.52, 25.85, 25.69, 23.75 and 19.69%, respectively. These results indicate that, the ether extract% for first treatments was higher than other treatments. Analysis of variance of results indicates that the differences among treatments were significant ($P<0.05$).

Ash %:

The averages Ash content of ON and GM were found to be 10.45 and 11.66%, respectively. These results indicated that the ash for GM was higher than obtained for ON. The differences among fish species were significant ($P<0.05$).

With regard to the effect of treatments for Nile tilapia on ash%, Table 8 showed that ash content was found to be 11.68, 10.12, 10.47, 10.03 and 9.95% for treatments T1, T2, T3, T4 and T5, respectively. These results indicate that ash for first treatment (T1) was higher than obtained for other treatments, and the differences among treatments were significant ($P>0.05$). Brown and Murphy (1991) concluded that larger size fish class (as treatment 1 in the present experiment) usually had lower ash and higher fat content than smaller size (treatment 2).

The average of ash% values for treatments (1, 2, 3, 4 and 5) For grey mullet during the whole experimental period were 11.69, 12.60, 12.48, 10.37 and 10.16%, respectively. These results indicate that, ash% for second treatment (T2) was higher than other treatments. Analysis of variance of results indicates that the differences among treatments were significant ($P<0.05$). It is obvious to notice that the rest in fish body composition was high in groups treated with fertilizers, this my due to the increase of natural food in fish gut.

Total yield:

Averages of total yield at the end of the experiment were listed in Table (9). As described in this Table, *Oreochromis niloticus* gained the highest yield 8806.93kg compared with 2234.55kg gained by grey mullet. These results may be attributed to the feeding habits of the two species as described previously. The total fish production (tilapia fish + grey mullet) for all feeding treatments was 12693.22 kg. Fath El-Bab *et al*. (2011) found that,this increase may be due to the dietary habits of each speices.

Table 9. Total yield of different fish species as affected by feeding treatments.

Treatments	Nile tilapia		Grey mullet	
	Yield (kg)	%total yield	Yield (kg)	%total yield
T1	1614.94	24.30%	405.48	24.19%
T2	1518.05	22.84%	382.09	22.80%
T3	1463.49	22.03%	365.61	21.82%
T4	1234.62	18.58%	320.63	19.13%
T5	813.56	12.24%	202.10	12.06%
Total yield	6644.66	100%	1675.91	100
% of the biggest value	100%		25.22	

*The fish catch attributed to the highest value for the same variable.

As in this Table, Nile tilapia (T1) gained the highest yield (2219.46kg), compared with (T2) (2117.63kg), (T3) (2030.74kg), (T4) (1486.94kg) and (T5) (952.16kg). While total yield of grey mullet, (T1) gained the highest yield (540.64 kg), compared with (T2) (509.45kg), (T3) (4.87.48kg), (T4) (427.51kg) and (T5) (269.47kg)These results indicated that, the low of gain in rigir ponds compared with control (fed diet) reported in similar studies (Green, 1992; Diana *et al*., 1994; 1996 and Brown *et al*., 2000) indicates that either phytoplankton may not be enough to meet protein requirement of fish or that fish could not efficiently assimilate the produced phytoplankton in these ponds. Collis and Smitherman (1978) found that hybrid tilapia when fed on manure, grew 62% compared to hybrids fed on a high protein diet. Barash and Schroeder (1984) found that the substitution of 46% of the pellets by fermented cow manure did not reduce the total fish yield but the complete substitution of the pellets by fermented cow manure caused 47% decrease in the total yield.

Economic evaluation:

Results of costs including variable, fixed and interest on working capital for the treatments applied are shown in Table (10). Results of this Table revealed that costs of fish fingerlings are similar in all treatments applied, however, the feed costs differed according to rigir and artificial food, the net return was the lowest for treatment 5, rigir (1124.85LE) and increased to

5554.45, 5177.92, 5633.33 and 7259.05 LE for other diets treatment 1, treatment 2, treatment 3 and treatment 4, respectively.

Table 10. The effect of the experimental diets on economic efficiency (LE/Feddan)

Items		Treatments				
		T1	**T2**	**T3**	**T3**	**T5**
1- Variable costs (LE/Feddan)						
a. costs of fish fingerlings:						
O. niloticus		1980	1980	1980	1980	1980
G. Mullet		5100	5100	5100	5100	5100
b. Feeds		30618.2	28475.0	25089.7	13562.3	0
c. rigir		0	780	1560	2340	5070
Total variable costs (LE/Feddan)		37698.24	35555.03	32169.72	20642.29	1215
2- Fixed costs (LE/Feddan)						
a. Depreciation (materials&others) 10%		300	300	300	300	300
b. Taxes		250	250	250	250	250
Total fixed costs (LE/Feddan)		550	550	550	550	550
Total operating costs (variable & fixed)		38248.24	36105.03	32719.72	21192.29	12700
Interest on working capital*		2860.76	2700.46	2447.26	1585.07	949.89
Total costs		41109.00	38805.49	35166.97	22777.35	13649.89
% of the smallest value		3.01	2.84	2.58	1.67	1.00
Returns						
Total return (LE) **	ON	25745.69	24246.89	23840.86	16133.34	9571.70
	GM	23626.24	22445.01	19667.93	16611.54	7352.63
	Total	49371.93	46691.90	43508.78	32744.88	16924.33
Net return (LE/Feddan)		8262.93	7886.41	8341.81	9967.53	3274.44
% of the smallest value of net return		252.35%	240.85%	254.76%	304.40%	100%
% Net returns to total costs		20.10%	20.32%	23.72%	43.76%	23.99%

* 15% × total operating costs × 140/365 days.

** The economical evaluation of results was carried out according to market prices in 2013 in LE.

O. niloticus = LE 260 /1000 fry. G. mullet = LE 1750 /1000 fry

Rigir = LE 1950/1000 Kg

Fish feed (25% protein) = LE 3200 /1000 Kg

Total costs per feddan increased from 15799.48LE (100%) for treatment 5 to 43258.59 (274%), 40955.08 (259%), 37316.56 (236%) and 24926.94 (158%), respectively. Differences in total costs were attributed to the differences in feed costs and rigir.

Total return in LE/feddan for treatment 1, treatment 2, treatment 3, treatment 4 and treatment 5 were 49371.93, 46691.9, 43508.78, 32744.88 and 16924.33 LE, respectively (Table 10). Net returns/feddan in LE were found to be. 5554.45, 5177.92, 5633.33, 7259.05 and 1124.85LE for the five treatments T1, T2, T3, T4 and T5, respectively. The percentage of net return to total costs 14.13, 14.07, 16.59, 31.36 and 7.12%% for treatments T1, T2, T3, T4 and T5, respectively.

These results indicated that feeding of *Oreochromis niloticus* in polyculture with grey mullet in earthen ponds on organic fertilizer (rigir) for 3 months followed by feeding on an artificial feed containing 25% crude protein resulted in best economic efficiency compared to the other treatments. These results are in complete agreement with results of Kamal *et al*. (2008).

CONCLUSION

Based on results obtained in this study and on the economical evaluation, it could be concluded that, the use of rigir at the first three months of culture tilapia and grey mullet at rate of 100 kg / feddan / week (as safe organic matter), after that use artificial feed containing 25% crude protein at rate of 3 % of total biomass of Nile tilapia and grey mullet in erthen fish ponds culture at last three months could be recommended for producing Nile tilapia and grey mullet. From the economical point of view, this treatment seemed to be the best in terms of ratio of returns to total costs.

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خفض الغذاء الصناعى بإستخدام البدائل العضوية الامنة تحت نظام الإستزراع المتعدد

أحمد فاروق فتح الباب

المعمل المركزى لبحوث الثروة السمكية ، مركز البحوث الزراعية ، وزارة الزراعة ، مصر.

الملخـــص العربـــى

تم إجراء هذه الدراسة لمعرفة تأثير خفض الغذاء الصناعى بإستخدام البدائل العضوية الامنة (ريجر) ١٠٠كجم/ أسبوع/ الفدان على أداء النمو والكفاءة الاقتصادية لأسماك البلطي والبوري في ألأحواض الترابية تحت نظام الاستزراع السمكى متعدد النوع، تم تخزين أسماك البلطي النيلى والبوري فى عشرة أحواض (٠.٥ فدان). تم تصميم العشرة أحواض لتشمل خمسة معاملات (مكررين لكل معاملة) ، وتم تخزين أسماك البلطي النيلي (٤٥٠٠سمكة / حوض) مع أسماك البوري (١٥٠٠سمكة / حوض)، وكانت الأحواض الترابية التجريبية التي استخدمت في الدراسة المعاملة الاولى (الكنترول): التغذية الصناعية طوال فترة التجربة (٢٦ أسبوعا)، المعاملة الثانية: تم التسميد بواسطة ريجر بمعدل٥٠كجم/أسبوع/حوض طوال الشهر الأول من بداية التجربة، تلاها التغذية الصناعية حتى نهاية فترة التجربة، المعاملة الثالثة: تم التسميد بواسطة ريجر بمعدل٥٠كجم/أسبوع/حوض لمدة شهرين من بداية التجربة، تلاها التغذية الصناعية حتى نهاية فترة التجربة، المعاملة الرابعة: تم التسميد بواسطة ريجر بمعدل٥٠كجم/أسبوع/حوض طوال ثلاثة شهور من بداية التجربة، تلاها التغذية الصناعية حتى نهاية فترة التجربة والمعاملة الخامسة: تم التسميد بواسطة ريجر بمعدل٥٠كجم/أسبوع/حوض طوال فترة التجربة (٢٦ أسبوعا). ويمكن تلخيص النتائج المتحصل عليها فيما يلي:

قياسات النمو:

أسماك البلطى: سجلت المعاملة الأولى أعلى معدل من وزن الجسم الحى، طول الجسم، زيادة اليومية فى الوزن و معدل النمو النوعى، وسجلت المعاملة الثالثة أعلى معدل لمعامل الحالة.

أسماك البورى: سجلت المعاملة الأولى أعلى معدل من وزن الجسم الحى، طول الجسم، زيادة اليومية فى الوزن و معدل النمو النوعى، وسجلت المعاملة الثانية أعلى معدل لمعامل الحالة.

التركيب الكيميائي:

أسماك البلطى: سجلت المعاملة الأولى أعلى معدل لنسبة الدهن والرماد، وسجلت المعاملة الرابعة أعلى معدل لنسبة الروتين، وسجلت المعاملة الثانية أعلى معدل لنسبة الرطوبة.

أسماك البورى: سجلت المعاملة الرابعة أعلى معدل لنسبة الرطوبة ولنسبة الروتين وسجلت المعاملة الأولى أعلى معدل لنسبة الدهن وسجلت المعاملة الثانية أعلى معدل لنسبة الرماد.

إستنادا إلى النتائج التي تم الحصول عليها في هذه الدراسة وعلى التقييم الاقتصادي، يمكن أن نخلص إلى أن (المعاملة الرابعة) استخدام زرق الدواجن المعامل حراريا ومكبوس كسماد عضوي آمن (ريجر) بمعدل ١٠٠كجم/أسبوع/فدان في الأشهرالثلاثة الأولى من استزراع أسماك البلطي النيلى والبوري يليها استخدام الأعلاف الصناعية التي تحتوي على البروتين الخام ٢٥٪ بمعدل ٣٪ من إجمالي وزن الجسم لأسماك البلطي النيلي و البوري في الاحواض الترابية في الأشهر الثلاثة الأخيرة يمكن أن يوصى بها لإنتاج البلطي النيلي و البوري. من وجهة النظر الإقتصادية تعتبر هذه المعاملة هى الأفضل من حيث نسبة العائد إلى إجمالي التكاليف.