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EVALUATION OF THREE COMMERCIAL FEEDING REGIMES FOR NILE TILAPIA, *Oreochromis Niloticus* L., REARED IN EARTHEN PONDS

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SUMMARY

Nile tilapia, *Oreochromis niloticus* L., fingerlings averaging 38gm in weight were assigned randomly to three treatments, two 3-faddan earthen ponds/ each, 4000 fish/faddan. The first treatment concerned fertilizers regime (F) where 35kg chicken litter, 3kg urea and 15kg tri-super phosphate/faddan/ wk were applied. The second dealt with concentrate mixture regimen (CM) which was fed 6 days a week at a rate of 3% of fish fresh body weight. The third was a combination between F and CM regimes at the same rate. The CM was fed once daily and adjusted periodically after each weighing. The duration of the study was 126 days. Water was supplied from one of Nile canal endings. Data on growth performance, carcass traits, body chemical composition, production efficiency and economic efficiency were obtained .

The F+CM regime responded better than CM alone than F alone regarding fish growth performance, production efficiency and economic efficiency. Fertilizers tended to have a potentiality equivalent to about 2/3 of MC, about 2% of fish body weight. Carcass traits and body chemical composition were not altered greatly due to the regimes studied, but their absolute figures were affected by fish weight at harvesting. Net returns of F+CM regime was the best (LE 2960/faddan/126 days) compared to the other regimes. Studying the effect of decreasing fertilizers, concentrate mixture or both of them on fish performance reared in earthen ponds may be needed aiming to improve the economic efficiency.

Keywords: Nile tilapia, growth performance, carcass traits, body chemical composition, production efficiency , economic efficiency

INTRODUCTION

Nile tilapia is a popular fish species among Cichilidae family. They characterized by their tolerance to poor water quality , their ability to utilize a wide range of food items including phyto- and zoo-plankton and grow well in fertilized earthen ponds (Broussard , 1985).

Rakocy and McGinty (1989) and AOAD (1995) pointed out to the significant production of tilapia when fertilizers were used, but they stated that such production is not as high as that with formulated feeds. However, Green (1992) found insignificant differences between the regime contained pelleted feed and that contained both organic manure (chicken manure) and pelleted feed. Lock *et al.*(1986) determind feeding costs to be more than 50% of variable costs and AOAD (1995) cited that feeding costs represent from 35 to 70% of total costs. In this respect, Rakocy & McGinty (1989) postulated that fertilizers can help in reducing the quantity of expense of supplemental feeds. Lim (1989) suggested that the nutritionally balanced feeds are not necessary in fertilized ponds and 24% crude protein diet would be sufficient.

At Fayoum Governorate, in fish farms, there are different feeding regimes among them fertilizers, manufactured concentrates and fertilizers plus concentrates regimes. On the other hand, in different cases the economical returns recommend regimes of lower fish body weight at harvesting than others. Fertilizers are not expensive as manufactured concentrates and their major benefit goes toward their action on increasing the availability of natural feeds for fish in ponds. Moreover, manufactured concentrates are expensive and are not available at different periods in certain areas .

Such findings may draw the attention to a periodical evaluation of different feeding regimes at different areas to produce good quality fish with the possible lowest costs of production. Accordingly, the present study aimed to gain information on the production and costs of Nile tilapia reared in earthen ponds under three feeding regimes (fertilizers only , concentrate mixture only and their combinations) with the same levels used in fish farms at Fayuom.

MATERIALS AND METHODS

The present work was conducted in a commercial fish farm near Shakshouk village at El-Fayoum Governorate, ARE. Nile tilapia, *Oreochromis niloticus* L., fingerlings were obtained from El-Abbassa Station , Sharkeya Governorate , ARE . Fingerlings were acclimated in ¼ faddan (fad.) pond for 4 wk. Acclimated fingerlings of 38±0.43 gm fresh body weight in average were assigned randomly to 3-fad. earthen ponds (1.2 meter water height) at a rate of 4000 fish/fad. In such ponds, water turnover rate was 1/24 of water volume/month (5 cm column of water/pond/month). Three dietary regimes (2 ponds/each) were used to form 3 treatments as follows:

I. Fertilizers regime treatment, F: it contained chicken litter (35kg/fad./wk., soaked in 5kg cases in ponds and replaced weekly), urea (3kg/fad./wk., dissolved in water and sprayed in ponds at 0900h) and tri-super phosphate (15kg/fad./wk., soaked for 24h in water and sprayed in ponds at 0900h).

II. Concentrate mixture regime treatment, CM : it was introduced to fish at a rate of 3% of their fresh body weight/ day, with the assumption of no mortality. The CM was prepared using ground materials which were mixed well in the fish farm. Such feed was soaked in water for 1 ½ h before use to be sediment in suspended feeders (small pools, 1/2 m depth) beside pond banks. The ingredients of concentrate mixture and its chemical composition are presented in Table 1.

Table 1. Concentrate mixture ingredients and its chemical composition

Ingredients	%	Chemical composition*	
Fish meal.	15	% CP	23.77
Sunflower meal.	17	% EE	5.37
Cotton seed meal.	8	% CF	8.90
Wheat bran.	23	% NFE	53.78
Rice bran.	20	% Ash	8.18
Yellow corn.	16	Mcal GE/kg**	4.36
Dicalcium phosphate.	1	Mcal DE/kg***	4.00

*Dry matter basis, **Calculated after Omer (1984), *** After excluding CF energy as a simple prediction of digestible energy.

III. Fertilizers and concentrate mixture regime treatment, F+CM: it is a combination between F and CM. It was fed at the same levels cleared above in I and II and as introduced in fish farms at Fayoum Gavornerate .

In both II and III regimes, the CM was introduced once daily at 1000h , 6 days a week. The duration of the study was 126 days from 6 May to harvesting date,10 September 1994.

Water at canal endings (Nile water) was used . Water temperature, pH , dissolved oxygen and ammonia were monitored periodically at noon (Table 2). Offspring were collected periodically and prior to harvesting by proper nets after scattering some food on ponds surface , beside banks at noon. Fish body weight was obtained at the start and at two- week intervals until harvesting at the day of off feeding (50 fish were weighed as a group/ pond). Feeding rate of fish received the CM was adjusted after each weighing of fish.

Samples of fish were killed at the start of the experiment and at harvesting, weighed, minced, mixed well and kept at -20 °C until sub-samples were taken for chemical analysis. the only exception is that, at harvesting, before mincing, carcass parts and fish fillet were obtained, weighed and recombined with the same fish samples taken .

The AOAC (1980) methods were used for determining dry matter (DM), ash, crude protein (CP) and ether extract (EE) for both CM and fish samples as well as crude fiber (CF) for CM used. Nitrogen free extract (NFE) for CM was obtained by difference (Organic matter-CP-EE-CF). Water temperature, pH, dissolved oxygen and total ammonia were obtained through centigrade thermometer, Orion digital pH meter (model 57) and Hanna instruments ammonia test kit (HI 4829) respectively .

Table 2 . Monthly water quality in earthen ponds throughout the experimental period

Months	pH		O^2,mg/l		Temperature °C		Ammonia, mg/l	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
May	8.0	8.5	4.0	6.0	22	25	0.2	0.3
June	8.0	8.5	4.0	5.0	24	27	0.2	0.4
July	8.5	9.0	3.0	4.0	26	30	0.3	0.5
Aug.	8.5	9.0	3.0	5.0	28	30	0.4	0.5
Sep.	8.0	8.5	4.0	6.0	24	26	0.2	0.4
Range*	8.0	9.0	3.0	6.0	22	30	0.2	0.5

* All over the tested period.

Gross energy of CM was calculated using the values reported by Omar (1984), 5.5, 9.08 and 4.10 k cal/gm for CP, EE and carbohydrates respectively. Energy values for fish were calculated after Viola *et al.* (1981), 5.5 and 9.5 k cal/gm for protein and fat respectively . The other calculations were as follows:,

1. Total gain = live fresh body weight at harvesting - that at the start .
2. % specific growth rate (%SGR) = 100(ln W_t - ln W_o)/t , where ln is the natural log, W_t is the final fish fresh weight in gm , W_o is the initial fresh body weight in gm ," t" is the total period used in days.
3. Fish number at harvesting = (Total weight of fish per fad. at harvesting in kg) (No of fish in samples obtained)/ weight of such samples in kg.
4. Fish survival rate, % = 100(No of fish survived per fad. till harvesting / No of fish at the start) .
5. Net fish production, kg = Fish fresh weight at harvesting per fad. - Fish fresh weight at the start per fad.
6. Fillet steak number/kg fish = Weight of fish fillet produced per kg/weight of one steak of fillet.
7. Total production costs/ fad., LE = Sum of costs of CM (LE 555 / fad.), fertilizers (LE 173/fad.), fingerlings used at the start (LE 180 / fad.) and other production costs (LE 800/ fad.). Such costs differ according to the dietary regime used.
8. Production costs /kg fish sold , LE = Total production costs per fad., LE /kg fish harvested per fad.

9. Production costs / kg fillet sold , LE = production costs per kg fish sold ,LE / fillet weight production per kg fish , kg .
10. Net returns/ fad., LE = Fish selling price per fad., LE / total production costs per fad., LE.

Any relative percentage was made assuming that the lowest value is 100%.

Statistical analysis was carried out after Steel and Torrie (1980) using completely random design and LSD whenever possible , using Duncan-Waller minimum-average-risk-t values (K 100) to test mean differences (for growth performance and body composition data). Also, coefficient of variability,%CV, was used for carcass traits .

RESULTS AND DISCUSSION

In the present study CM was fed at a rate of 3% of fish fresh weight as used in commercial farms. Also, it would be expected that the third regime is more advantageous than the others tested , but questions existing are, can CM at the used level withstand against natural feeds and what is the most economic regime for fish production .

1. Concentrate mixture

As evident in Table 1, the CM contained 23% CP. Such level was lower than that mentioned by NRC (1983) and nearly similar to that cited by Lim (1989). In the present study, the CM was similar to that used in different fish farms at Fayoum. It seems that such CM is commercially acceptable as a supplementary feed to improve fish performance.

2. Water quality

Water quality (Table 2) in the earthen ponds used was in the range reported by Broussard (1985) and Rakocy and McGinty (1989) for water temperature (26-30) and in the safety levels reported by Johnson (1986) for water pH (6.5- 9.0), O_2 (around 5 mg/l) and ammonia (tolerable level is 1 mg/l).

3. Growth performance

Growth performance data especially those of fish fresh weight at harvesting, total gain and %SGR (Table 3) showed better response to CM regime when compared with fertilizers one . Moreover the F+CM regime had more favorite effect than the CM one. The increase in growth performance by artificial diets than fertilizers was also reported by AOAD (1995) who summarized the work of Abou-Akkada in Alexandria . The better growth with F+CM regime reflect the increase in feeding materials due to the presence of CM at similar rate to CM in the second regime beside fertilizers at similar rate to the first regime.

It seems that fertilization is equivalent to the effect of 2% CM of fish body weight when compared to CM that fed at a rate of 3% of fish body weight considering the total gain[(75x 3)/123.5 = 1.8] and %SGR [(0.86x 3) / 1.15= 2.2, with average = (1.8+2.2)/2 = 2%]. Accordingly, the third feeding regime (F+CM) seemed to be equivalent. to 5% of fish fresh body weight . Even though the growth performance of fish raised on F+CM regime was not parallel to the proposed 5%. Such result may need further investigation , as it may lower F and /or CM levels in F + CM regime to reduce feeding costs. This is because of the 1% loss [(165.3 x 3) /123.5 =4% regarding total gain, and (1.32 x 3)/1.15=3.4 % regarding %SGR] in the third feeding regime, where the CM feeding rate was 3% of fish fresh weight.

Table 3 . Growth performance of Nile tilapia as affected by feeding regime

Items	Feeding regime treatments			SED
	F	CM	F+CM	
Live fresh body weight/ fish ,gm.				
At the start.	38.25	37.75	38.45	0.43
At harvesting.	113.25^{C}	161.25^{B}	203.75^{A}	5.51
Total gain / fish , gm.	75.00^{C}	123.50^{B}	165.30^{A}	2.02
% SGR.	00.86^{C}	1.15^{B}	1.32^{A}	0.01
Relative % of SGR .	100.00	134.00	153.00	

F, fertilizers ; CM , manufactured concentrate.
Averages in the same row / each item having different superscripts are significant.
SGR , specific growth rate ; SED , standard error for difference.

4. Carcass traits

As evident in Table 4, on obvious differences were found regarding carcass traits when expressed as percentages. The absolute figures tended to be parallel to the final fish fresh body weight.

Table 4. Carcass traits of Nile tilapia as affected by feeding regime, on fresh basis

Items	F		CM		F+CM		% CV
	gm.	%	gm.	%	gm.	%	
Fresh body weight/ fish	113.2	100.0	161.3	100.0	203.8	100.0	28.4
Fillet / fish	49.0	43.3	70.0	43.4	89.8	44.1	29.3
Head / fish	32.0	28.3	45.0	27.9	56.0	27.5	27.1
Fins and scales/fish	11.3	9.9	15.3	9.5	18.0	8.8	22.9
Bones / fish	10.0	8.8	16.0	9.9	19.0	9.3	30.6
Viscera / fish.	7.0	6.2	10.0	6.2	14.0	6.9	34.0
Skin / fish.	4.0	3.5	5.0	3.1	7.0	3.4	28.6
Total byproducts/fish*	64.3	56.7	91.3	56.6	114.0	56.0	27.7

F, fertilizers ;CM, concentrate mixture ; %CV, %coefficient of variability.
* Head, fins & scales , bones , viscera and skin.

Dietary regimes did not affect fish body chemical composition greatly (Table 5). In this connection, Winfree and Stickney (1981) indicated no obvious trend with carcass protein. Even though El-Bedawey *et al.* (1985) work on *Tilapia zilli* showed an improvement in body protein with artificial feeds compared with natural feeds.

Table 5. Body chemical composition of Nile tilapia as affected by feeding regime

Items	At the start	Feeding regime treatments			SED
		F	CM	F+CM	
%DM .	25.23	26.34	26.53	26.71	
On DM basis .					
%CP .	50.91	53.82	53.01	54.26	0.32
%EE .	31.81	27.45	27.83	26.91	0.36
%Ash .	17.28	18.73	19.16	18.83	0.23
Kcal / gm.	5.82	5.57	5.60	5.56	0.05

F, fertilizers; CM, concentrate mixture; DM, dry matter; EE, ether extract; SED, standard error of difference.

5. Production efficiency

As evident in Table 6, fish survival rate was 95% or more and net fish production was parallel to fresh body weight at harvesting. Also fish fillet produced followed similar trend to harvested fish fillet weight, so that fillet steak number / kg fish decreased as fish fresh body weight increased .

Table 6. Effect of feeding regime tested on production efficiency of Nile tilapia

Items	Feeding regime treatments		
	F	CM	F+CM
Fish No / fad.			
At the start.	4000	4000	4000
At harvesting.	3800	3850	3820
Survival rate %.	95.00	96.25	95.50
Fresh body weight / fad., kg.			
At the start.	153	151	154
At harvesting.			
a)Total	445	642	795
b)Marketable size.	430	621	778
c)Non marketable size.*	15	21	17
Net production / fad., kg.[1,2]	277	470	624
Relative % of net production.[1]	100	170	225
Fillet production / kg fish.[1]	433	434	441
Weight of one steak of fillet , gm.[1]	24.5	35.5	44.9
Fillet steak number / kg fish.[1,2]	17.7	12.2	9.8

*Small fish including other mainly *T. zilli* .

1- For marketable size fish. 2- Fish body weight at harvesting / fad. - Fish body weight at the start/ fad. 3- Fish fillet production per kg fish / Weight of one steak of fillet.

It seems that survival rates obtained were in the normal range. Coddington & Green (1993) and Hansen& Batterson (1994) reported values ranged between 87-91% and 71.2-93.7% for survival rate, respectively. The tested dietary regimes had no effect on survival rates as reported by Stickney & McGeachin (1984), Fineman & Camacho (1987) Kalio & Camacho (1987) and Osman (1991).

6. Economic efficiency

Table 7 showed that the cost of fertilizers added were lower than that of CM. Production costs were the lowest with fertilizer regime and the highest with F+CM treatment (the third regime). Even though , the net returns were greater with F+CM than CM and F regimes respectively . This is due to the selling prices of fish which governed by harvested fish weight as well as the net production (Table 6). Fertilizers, CM, F+CM represented 15% [(100 x 173)/ 1153], 36% [(100 x 555) /1535], and 43% [(100 x 728) /1708] of the total costs respectively.

Table 7. Effect of feeding regime on the economic efficiency of Nile tilapia

Items	Feeding regime treatments		
	F	CM	F+CM
Offered CM/fad.,kg.	000	957	957
Fertilizers added/fad.,kg.			
a) Urea.	54	000	54
b) Tri super phosphate.	270	000	270
c) Chicken manure.	630	000	630
Cost of offered CM/fad.,LE.	000	555	555
Cost of fertilizers added/fad., LE.	173	000	173
Fish cost at the start /fad., LE.	180	180	180
Other production costs /fad., LE*.	800	800	800
Total production costs/fad., LE.	1153	1535	1708
Production costs /kg fish sold, LE.	2.68	2.47	2.19
Production costs /kg fillet sold, LE.	6.19	5.70	4.98
Relative % of production costs/kg fish sold.	122	113	100
Fish selling price/fad., LE.			
a) Marketable size.	2150	3415.5	4668
b) Non marketable size.	8	5	8
Net returns/fad., LE.			
a) Total.	1005	1886	2964
b) Marketable size fish.	997	1880.5	2960
Relative % of total net returns /fad.	100	188	295

* Labor, renting, transportation, maintenance of banks, equipment and buildings.
Selling price of 1000 fingerlings of fish is LE 45 and that of one kg fish harvested is LE 5.0, 5.5 and 6.0 for F, CM, F+CM treatments respectively. The price of non marketable fish was LE 0.5/kg., cost of CM is LE 580/ton.

Green (1992) work on Nile tilapia reported that net returns with chicken litter plus feed was greater than feed only . AOAD (1995) reported that feed cost represents 35 to 70 % of the total costs . The obtained results are in the same direction to that reported by these authors for the second and the third regimes. In the present study the highest net returns / fad. was with F+CM regime (LE 2964). Such results were lower than that reported by Green (1992) by about 10% [100(3300-2964) /3300].

CONCLUSION

Results obtained may suggest the use of fertilizers beside concentrate mixture as a supplementary feed regarding fish performance and net returns . Also further work may be needed to find the level of fertilizers , concentrate mixture or both of them on fish final weight and net returns as it was observed that fish total gain in the third regime (F+CM) was not linear with the sum of those obtained with F and CM regimes .

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تقييم ثلاث نظم غذائيه للبلطى النيلى المربى فى أحواض أرضيه

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أجريت هذه التجربة فى إحدى المزارع التجارية بمحافظة الفيوم ، وفيها وزعت اصبعيات البلطى النيلى (تزن فى المتوسط ٣٨جم) فى ثلاث معاملات غذائية ، حيث وزعت كل معامله فى حوضين أرضيين (٣ فدان للحوض، بواقع ٤ آلاف إصبعيه للفدان) . واعتمد النظام الغذائى فى المعاملة الأولى على الاسمده فقط (٣٥كجم زرق دجاج + ٣كجم يوريا + ١٥ كجم ثلاثى سوبر فوسفات/ فدان/أسبوع)، وفى الثانيه استخدم علف مركز والذى غذى ٦ أيام فى الأسبوع بمعدل ٣٪ من وزن السمكه الطازج، وفى الثالثة استخدمت الاسمده السابقه مع العلف المركز بنفس تركيزات المعاملتين الاوليتين. وغذى العلف المركز مرة واحدة يومياً، والذى عدل دوريا تبعا للوزن الدورى للاسماك. واستغرقت التجربه ١٢٦ يوماً، واستخدمت مياه نهايات الترع العذبه فى الاحواض المستخدمه. وجمعت بيانات عن مظاهر النمو وصفات الذبيحه ومكونات الجسم والكفاءه الانتاجيه والكفاءه الإقتصاديه.

واوضحت النتائج افضليه النظام الغذائى الثالث عن الثانى عن الاول عند النظر الى مظاهر النمو والكفاءه الانتاجيه والكفاءه الاقتصاديه. ووجد ان معدلات التسميد المستخدمه تكافئ تقريبا العلف المركز اذا اضيفت بنسبه ٢٪ من وزن الجسم الطازج. ولم تتاثر النسب المئويه لصفات الذبيحه ومكونات الجسم بدرجه كبيره بالنظم الغذائيه المستخدمه ، وتاثرت القيم المطلقه لها بمعدل نمو الاسماك. وكان أعلى صافى للعائد المادى ٢٩٦٠ جنيها مصريا للنظام الغذائى الثالث بالمقارنه بالنظامين الاولين. وبمقارنه معدل التغذيه فى النظام الثالث بالنظامين الاولين وجد ان معدل التغذيه لهذا النظام ربما يحتاج مزيد من الدراسه لخفضه دون التاثير على الكفاءه الإنتاجيه لرفع الكفاءه الإقتصادية.