EFFECT OF DIFFERENT FEEDING STRATEGIES TO NILE TILAPIA (*OREOCHROMIS NILOTICUS*) PONDS ON FISH, WATER QUALITY AND FISH YIELD.

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ABSTRACT

This trial aimed to find the effect of different feeding strategies; no input (control), compost fertilization; chicken litter fertilization; and artificial feed on microbiological load on fish measured as total microbial count, water quality, and fish production. Eight ponds 200 m^2 area were assigned randomly into four treatment two replicate each. Fish tested was mixed sex tilapia fingerlings stocked at (2 fish/m^2) and reared for 14 weeks. Quantity of fertilizers adjusted to add 10 kg N/ha/week while fed pond treatment offered 25% protein floating feed to visual satiation.

At harvest total microbial count was significantly higher ($P<0.01$) in chicken litter treatment and was in the following increasing order fish feed, no inputs, compost and chicken litter (27.5, 33.5, 33.25 and 48.25 x 10^3, respectively). The result showed that treatments significantly ($P<0.05$) affected on the following water quality parameters (DO, available phosphorus, nitrate-nitrogen). While, the other water quality parameters were not significantly different among treatments.

Fish yield was significantly higher ($P<0.05$) in feed and chicken litter treatments (832 and 771 kg/fed) compared to compost and control treatments (620.5 and 625 kg/fed, respectively). The study concluded that using chicken litter in fish pond fertilization increased microbial load in fish, which may be represent a risk to human health.

Keywords: Total microbial count on fish, Hazards of organic fertilizers, Fish body composition, Pond fertilization. Compost fertilization. Organic fertilizers, Fish yield.

INTRODUCTION

The use of organic fertilizers or animal manures in fertilizing fish ponds is an ancient practice as an economical means of increasing fish production (Knud-Hansen, 1998). However, using animal manures as fertilizer offer many advantages to fish farmers, there is increasing concern of using manures as pond fertilizer due to pathogen found in animal manures (Rice *et al.*, 1987; Xianzhen *et al.*, 1988; Abdel-Rahman *et al.*, 2004; Aly *et al.*, 2009). Fish passively accumulate microbial contaminates on their surfaces, and concentrate disease causes found in water in their guts. Moreover pathogens that are concentrated in the fish gut or that infect the fish tissue can survive until the fish is harvest and eaten (WHO, 2006). Bacterial composition in all fish species reared in one pond appeared to be a reflection of bacterial composition found in pond water (Sivikami *et al.*, 1996). They attributed the presence of *E.coli* bacteria in fish samples to the faecal bacteria received during addition of animal manure that is used to fertilize the ponds for enhancing fish growth. Buras *et al.* (1985) experimentally found critical concentration of standard plate count bacteria to be 5 $\times 10^4$/ml, beyond which microbes appeared in the fish meat. Ali (2003) and Abdel-Rahman *et al.* (2004) reported that using chicken manure to fertilize ponds has an impact on total bacterial load either in water or on fish raised in ponds. Limited information available about the impact of using various nutrient input strategies on microbiological load on fish and their impact on fish yield.

This trial aimed to find out the impact of different feeding input strategies; on microbiological load on fish measured as total microbial count, body composition, water quality and fish production.

MATERIAL AND METHODS

Experimental design.

In order to achieve the aim of the study, the experiment was designed and implemented in Research farm at Abbassa, Abou-Hammad, Sharkia. The current experiment was conducted using randomized block design in eight ponds with similar size (200 m^2 surface area) each. The ponds used were earthen ponds, but their sides/banks made of concrete, without changing the nature of bottom soil.

The experiment consisted of four treatments with two replicate, as follows:

- Treatment 1, control treatment (no inputs).
- Treatment 2, fertilization with compost.
- Treatment 3, fertilization with chicken litter.
- Treatment 4, fed with 25% protein floating fish feed.

Chicken litter used brought from fertilizers supplier while, compost used made in site from poultry litter and mixture of Cat-tails (*Typha* spp.) and Indian goosegrass (*Eleusine indica*) as described by (Ali, 1995). Organic fertilizers and fish feed were analyzed according to AOAC (1990) and the result are summarized in (Table 1 a&b). Nitrogen fertilizers application rate was 10 kg/N/ha/week as recommended by Veverica *et al.* (2001). Amounts of different fertilizers applied to each treatment were adjusted according to nitrogen percentage in relevant fertilizers (10.2 kg and 5.88 kg /pond/week) of compost and chicken litter, respectively. Floating fish feed 25 % protein 2 mm diameter was brought from local commercial producers and fed the fish to visual satiation to the end of trial. Feed ingredient as listed on the feed sack labels were; fish and meat meal, corn gluten, soybean meal, yellow corn, wheat bran, rice bran, calcium die phosphate, and vitamins and minerals premixes.

Table 1 a. Organic fertilizers analysis (dry mater basis).

Sample	Nitrogen %	Phosphorus %	Organic Carbon %
Compost	1.96	0.55	16.6
Chicken litter	3.4	1.05	39.5

Table 1 b. Proximate analysis of fish feed used in the study

Item	Percentage
Protein %	25.2
Energy Kc	2584
Fat %	4.94
Fiber %	5.7
Phosphorus %	0.7

The tested species was Nile tilapia (*Oreochromis niloticus*) mixed sex stocked at rate of 2 fish/m at an average initial weight 10.6 g. Nile tilapia fry were spawned at the Research Farm (Hatchery) and reared in concrete tanks for three months before starting the trial.

Ponds preparation and management.

Trial ponds were drained, cleaned and exposed to sun for one week before the trial. Water 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 fertilizer dose from relevant fertilizers. Two days prior to stocking, ponds water level increased and reached the maximum target depth around 1 m. Trial lasted for 14 weeks started on 11 June, and ended on 20^{th} of September 2006. Compost and chicken litter treatment ponds were fertilized once a week during the trial. Twice a week new water allowed to get into ponds to maintain water level in pond throughout the experiment duration. Fish samples were taken every two weeks where individual weight and length of 20 tilapia fish from each pond recorded.

Analytical procedures.

Total microbial count sampling and analysis.

Tilapia sample were collected from ponds and transferred in sterile plastic bags on ice to the laboratory for bacteriological examination. Total microbial counts were performed using rinsing techniques as described by Perkins (1995). Total bacterial count (TBC) was done on plate count agar (tryptone glucose yeast agar) incubated at 35 °C for 48 h for bacterial enumeration by direct plate count according to Thatcher and Clark (1975).

Water quality measurements.

Biweekly water samples (1 Liter) were collected from each pond (at 9.30 am) and transferred to the laboratory to be analyzed for different water physico-chemical parameters. Water samples were analyzed for pH, alkalinity, total ammonia nitrogen (TAN), nitrate-nitrogen, available phosphorus, chlorophyll a, and Hardness according to APHA, (1998). In addition, Dissolved oxygen (DO) and temperature were measured in pond water (between 6.00 and 6.30 am) twice a week using Thermo Orion (model 835A, Orion Research Inc) oxygen meter. Secchi disk visibility was measured once a week.

Fish body composition.

Proximate analysis of market size fish were carried out according to AOAC (1990) to find out levels of protein, fat, ash, and moisture.

Growth parameters used:

Growth parameters were calculated according to the following equation:

WG (g) = mean final fish wt (g) - mean initial fish wt (g).

ADG (g/ day) = Final fish wt (g) - Initial fish wt. (g)/ time (days).

SGR% = 100 (Ln W2- LnW1) / T

Where W2 is the fish weight at the end and W1 is the weight at the start and Ln is the natural log.

Gross yield of fish: = harvested fish weight (kg)/ unit area

Net yield (kg/feddan) = harvested fish weight (kg) – initial fish stock biomass (kg) / unit area (feddan).

Survival rate % = Nt x 100 / NI

Where: Nt = Number of fish at t days; NI = Number of fish initially stocked.

Condition factor (K) = $(W / L^3) \times 100$

Where: W = Body weight (g) ; L = Body length (cm)

Statistical analysis.

Data were analyzed statistically according to Steel and Torrie (1980) using SPSS, 1999 (version 10.0) statistical software package (SPSS, Inc., Chicago, Illinois, USA). Analysis of variance (ANOVA) and Duncan's Post Hoc Multiple Comparisons Test was performed to evaluate the differences among treatments means (Duncan 1955). Differences were considered significant at probability level of 0.05.

RESULT AND DISCUSSION

Total microbial count on fish:

Total microbial count results are summarised in Table 2 and relative change of TBC for different nutrient inputs compared to control treatment are shown in Figure 1. The obtained result showed that treatments affected significantly ($P<0.001$) on fish sample collected in week 2, 4 and 6. While, in the last two samples week 10 and week 14, treatments effect on TBC were at significant level of ($P<0.01$).

The obtained result agree with the result obtained by Sivikami *et al.* (1996) who reported that in Carp ponds in India, TBC in skin of *Catla catla* reared in manured ponds were ($4.98x10^3$) and total coliforms no was 30. The authors attributed the presence of *E.Coli* in sample to the faecal added to ponds with animal manures. Similarly, Abdel-Rahman *et al.* (2004) stated that using chicken manure to fertilize fish pond water at rate of 15 kg/feddan/day, lead to an increase of most probable number MPN of the total Coliforms from 1.3×10^4 in control to 1.6×10^5 in fish raised in pond received chicken litter. Furthermore Aly *et al.* (2009) examined the shelf life of fish reared in manure treated compared to control ponds and reported low quality meat in fish from manured ponds. However microbiological load on fish during the study were still with the acceptable limits of the Egyptian Standard for the fresh chilled fish. The effect of fertilization was investigated by Xianzhen *et al.* (1988) who reported that the number of total bacteria measure in pond water was the highest in ponds received chicken manure, duck manure, cattle manure, pig manure and the control ponds (11.05×10^8, 6.31×10^8, 5.18×10^8, 4.15×10^8, and 1.7×10^8/ml, respectively).

Table 2. Microbial count (Mean±SER in 10^3)[1] on fish from various treatments during growing period.

Time	Treatment				Sig
	Control	Compost	Chicken litter	Feed	
Initial	13.25±0.479	15.50±0.957	15.25±3.038	14.75±0.854	NS
Week 2	14.00±2.041 c	22.75±2.323 b	31.0±1.826 a	15.75±2.057 bc	***
Week 4	14.25±3.198 c	27.25±3.198 b	42.75±3.172 a	20.00±1.225 bc	***
Week 6	17.00±1.779 c	29.25±4.049 b	46.50±3.428 a	23.50±1.500 bc	***
Week	30.50±1.937 b	31.75±5.072 b	48.00±3.697 a	25.25±2.136 b	**
Week	33.50±1.190 b	35.25±5.573 b	48.25±3.449 a	27.50±1.848 b	**

[1]Values with the same letter within the same row are not significantly different.

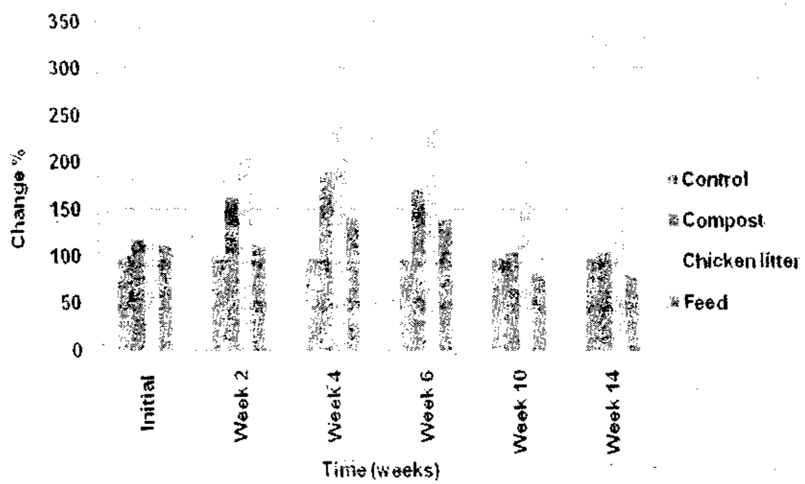

Figure 1 Relative changes in total microbial count on fish sample from different treatments taken during growing period.

Fish body composition

Result of proximate analysis of whole fish at the end of trial are summarised on Table 3. There were a significant effect of nutrient input sources on protein % in harvested tilapia (P<0.05). Protein % was significantly higher in organic fertilizer treatments compost (17%) and chicken litter (16.9%) than either control (15.2%)

or feed (15.0%) treatment. This result agree with what reported by Abdelghany and Ahmed (2002) who found that protein % of whole tilapia body did not vary significantly between ponds fed app-satiation and unfed ponds (15.04 and 14.98% respectively). On the other hand this result disagree with what was reported by Yi *et al.* (2005) who noted that amount of protein in fish grown in organically enriched ponds do not decrease significantly when compared to fish grown on supplementary feeding. There was no significance difference (P<0.05) in moisture among treatments. This result disagrees with what reported by Abdelghany and Ahmed (2002) who found that moisture % was significantly higher in tilapia raised on unfed ponds. However fat was higher in feed treatment (7.82%), compared to control, compost and chicken litter treatments (5.47; 5.38; and 5.48% respectively), there were no significance difference (P<0.05) among treatments. Abdelghany and Ahmed (2002) and Baccarin and Camargo (2004) mentioned that feeding tilapia pelleted and floating diets significantly increased body fat and visceral fat percentages

Ash percentage in fish was notably higher in control treatments but with no significance difference (P<0.05) among treatments. While, Abdelghany and Ahmed (2002) reported that ash was significantly higher in unfed tilapia ponds compared to app-satiation fed ponds. Kang'ombe *et al.* (2006) reported that that *Tilapia rendalli* cultured in either chicken or cattle manure treatments had significantly higher ash contents than those fish reared in unfertilized ponds. They also reported that ash which was higher in chicken manure treatment compared to cattle manure.

Table 3. Proximate analysis of fish reared in different treatments (Mean±SE)[1].

Time	Treatment				Sig
	Control	Compost	Chicken litter	Feed	
Moisture	73.7±1.10	73.15±0.75	72.90±1.70	72.75±1.15	NS
Protein	15.2±0.61 [b]	17.02±0.04 [a]	16.92±0.545 [a]	15.00±0.775 [b]	*
Fat	5.47±0.425	5.38±0.71	5.48±0.59	7.82±0.075	NS
Ash	6.01±0.380	4.65±0.01	4.89±0.145	5.14±0.245	NS

[1]Values with the same letter within the same row are not significantly different.

Water quality

Mean values of water quality parameters of the experimental ponds during the experimental period are summarized in Table (4). Mean water temperature of treatments pond (recorded at 6.30 am) ranged from 27.7 to 27.8 °C with no significant difference among treatments. DO concentration affected significantly ($P<0.05$) with experimental treatments, the lowest was in chicken litter fertilized ponds 1.27 mg/l and the highest (3.26 mg/l) was in compost treatment ponds. The lowest DO level obtained in this experiment is above the minimum required level (1.0 mg/l) DO as the minimum concentration necessary to support fish at rest for long periods recommended by Swingle (1969).

The values of pond water pH were insignificantly affected by experimental treatments (Table 4). Water pH fluctuation pattern showed decline in the beginning of the experiment until week 6, then increased in week 8 and kept fluctuating up and down until the end of trial (Figure 2). Statistical analysis showed that mean soluble phosphorus (SP) concentration in compost treatment were significantly higher ($P<0.001$) than other treatments. SP concentrations fluctuated over the experimental period, showed similar pattern for control and chicken feed, and it was significantly higher in compost treatment (Figure 3). Despite phosphorous is a minor constituent of water, its biological importance is considerable, and it is usually considered to be the element which most frequently limits productivity in aquatic ecosystems (Boyd, 1990).

Overall values of nitrate nitrogen NO_3-N were significantly higher in fertilized treatments compared to control and feed treatments ($P<0.05$; Table 4). Concentrations of nitrogen forms, NO_3-N, NH_4, and NH_3 fluctuated largely throughout the experimental period in all treatments (Figure 4, 5 and 6). Mean values of both NH_4, and NH_3 were not significantly different among treatments. Ali (2003) reported that average of total ammonia in chicken manure fertilized treatment were higher than those receiving the mixed fertilizers. Ammonia is extremely toxic to aquatic animals, and it is capable of inhibiting growth, however the present data are still safe for fish life according to Alabaster and Lioyd (1982).

Total alkalinity showed fluctuating trends over the culture period in all treatments, without significant differences in the mean final values ($P < 0.05$; Figure 7). Liti *et al.* (2001) recorded significantly higher total alkalinity in ponds fertilized with diammonium phosphate and urea and supplemented with pig pellets, than other ponds where rice bran was the supplemental feed. This is almost similar to the current study where mean water total alkalinity in ponds treated with manure where lower than those of the control. Chlorophyll-a value was notably higher in compost treatment 39.8 µg/l followed by chicken litter treatment 38.57 µg/l and the lowest was in control treatment 20.01µg/l without significant difference ($P<0.05$) among treatments ($P<0.05$; Figure 8).

Table 4. Mean (±SE)[1] water quality parameters for different treatments during growing period.

Parameter	N[2]	Treatment				Sig
		Control	Compost	Chicken manure	Feed	
Mean Water Temperature °C at 0630 hr	26	27.7±0.10	27.7±0.00	27.8±0.10	27.8±0.00	NS
DO (mg/l) at 06.30 hr	26	2.29±0.267[ab]	3.15±0.161[a]	1.26±0.131[c]	1.63±0.0.039[bc]	*
pH	8	8.60±0.140	8.94±0.000	8.75±0.005	8.70±0.080	NS
Available phosphorus (mg/l)	8	0.11±0.008[c]	0.71±0.039[a]	0.29±0.006[b]	0.14±0.000[c]	***
Nitrate (mg/l)	7	0.18±0.043[b]	0.78±0.057[a]	0.77±0.075[a]	0.49±0.126[ab]	*
NH_4 (mg/l)	8	0.29±0.022	0.30±0.043	0.39±0.064	0.34±0.007	NS
NH_3 (mg/l)	8	0.09±0.025	0.17±0.000	0.13±0.010	0.11±0.015	NS
Alkalinity (mg/L as $CaCO_3$)	7	194.72±3.29	219.82±8.39	178.57±11.43	201.61±5.54	NS
Chlorophyll a (µg/L)	8	20.01±4.86	39.85±1.305	38.57±2.450	33.38±2.885	NS
Sicch Disk	13	22.6±0.656	23.45±2.198	23.8±0.875	20.27±0.25	NS

[1] Values with the same letter within the same row are not significantly different.

[2] Number of taken samples

In this experiment the mean values of secchi disk were not significantly affected by the treatment (P<0.05). These findings are similar to those of Kumar *et al.* (2005) who found that application of fertilizers in regular intervals caused regular fluctuation of cholorphyll-a in pond water. There was a negative correlation between secchi disk reading and chlorophyll "a" concentration or algal density in pond received chicken manure only or that received both chicken manure and chemical fertilizers (Ali, 2003).

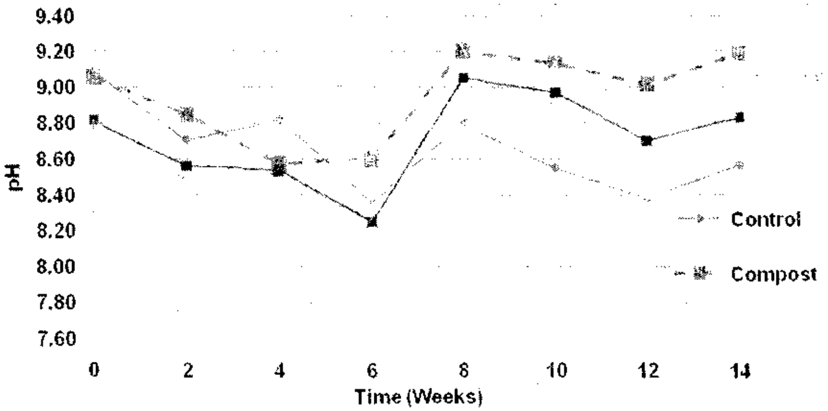

Figure 2. pH variation for ponds under various treatments during the trial.

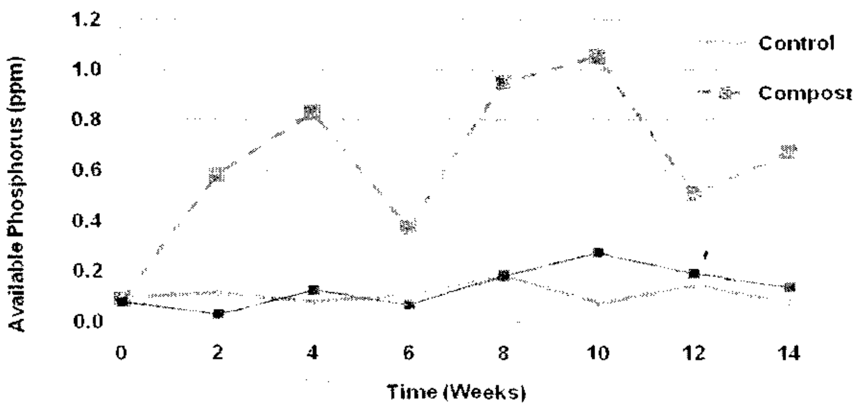

Figure 3. Available phosphorus concentration (mg/l) in ponds for various treatments during the trial.

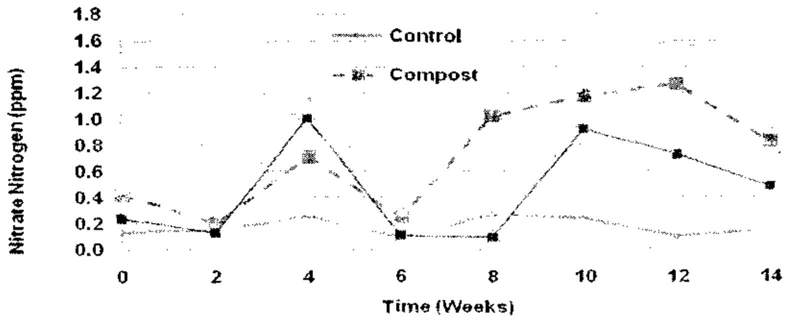

Figure 4. Nitrate nitrogen concentration (mg/l) in pond water for different treatments during the trial.

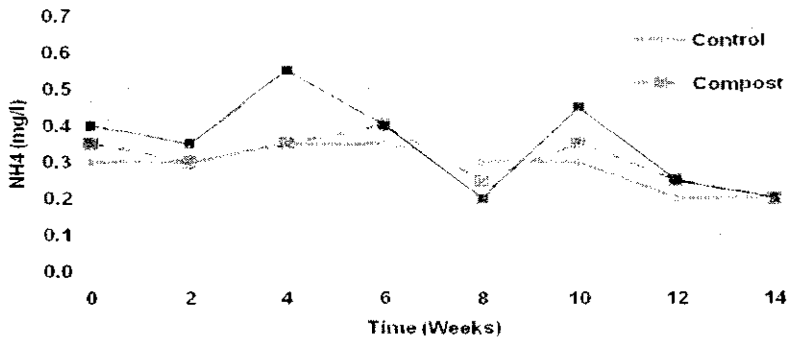

Figure 5. Ammonium nitrogen (NH_4) concentration (mg/l) in pond water for different treatments during the trial.

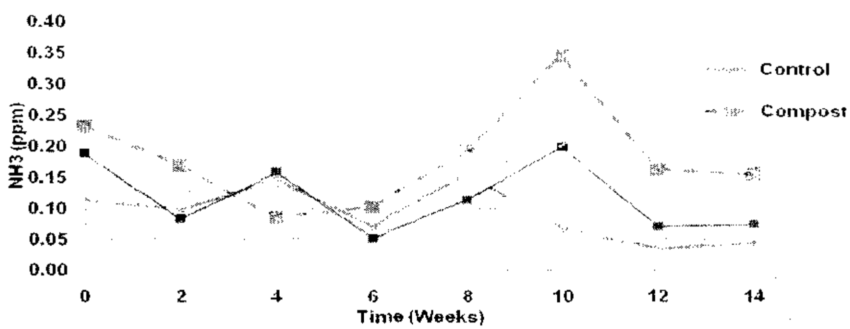

Figure 6. Ammonia (NH_3) concentration (mg/l) in pond water for different treatments during the trial.

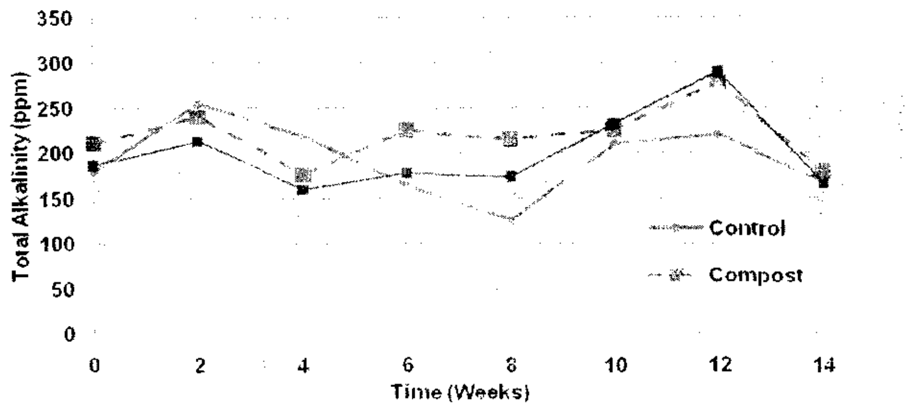

Figure 7. Total alkalinity level (mg/l) in pond water of various treatments during the trial.

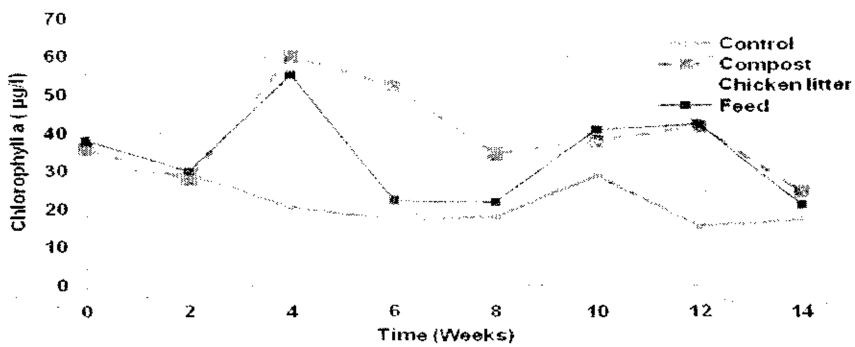

Figure 8. Chlorophyll a concentration (µg/L) in pond water of different treatments during the trial.

Fish growth and yield

The growth performance as affected with nutrient input strategies are summarized in Table 5. The following growth parameters, mean final body weight, net weight gain, average daily gain (ADG) and tilapia survival, were higher in feed treatments compared to the other treatments but with no significance differences among treatments (P>0.05). Similar result was reported by Maluwa and Dickson (1991) who reported that there were no significant different in growth of *O. Karongae* stocked in ponds fertilized with chicken manure, diammonium phosphate and grass compost. While opposite result reported by Sudiarto *et al.* (1990) who stated that during common carp fry rearing survival and fry growth was better in ponds treated with compost than that treated with other fertilizers or used feed alone. On the other hand, the treatments affected significantly (P<0.05) in SGR, the higher was in feed treatments (2.094) and the lowest was in compost treatment (1.93). Mean condition factor was notably higher in feed and chicken litter compared to compost and control, but there were no significance difference among treatments (P>0.05). The obtained result indicates that fish received fish feed and chicken litter treatments showed better growth than control or compost treatment, but with no significant differences among treatments.

Table 5. Growth performance of Nile tilapia in treatments during growing period (Mean±SE)[1].

Time	Treatment				Sig
	Control	Compost	Chicken litter	Feed	
Initial (g / fish)	10.55±0.05	10.75±0.05	10.75±0.15	10.75±0.05	NS
Final (g / fish)	74.6±2.20	71.3±1.40	76.3±2.10	83.7±4.0	NS
NWG (g / fish)	64.05±2.25	60.55±1.45	65.55±1.95	72.95±3.95	NS
ADG (g / fish)	0.65±0.02	0.62±0.02	0.67±0.02	0.75±0.04	NS
SGR	1.996±0.035^{ab}	1.93±0.025^{b}	1.999±0.014^{ab}	2.094±0.044^{a}	*
Recruitment (kg/feddan)	202.7±8.7^{a}	110.3±0.9^{b}	200.1±6.1^{a}	179.2±11.2^{a}	**
Survival %	68.6±4.29	87.2±8.57	90.1±2.86	91.7±4.52	NS
Condition factor	2.05±0.01	2.02±0.050	2.12±0.03	2.18±0.04	NS
Gross Yield (kg/feddan)	713.9±17.6^{b}	710.8±39.4^{b}	861.2±23.25^{a}	922.4±33.5^{a}	*
Net yield (kg/feddan)	625.3±18.02^{b}	620.5±38.99^{b}	770.9±22.01^{a}	832.1± 33.09^{a}	*

[1]Values with the same letter within the same row are not significantly different

Gross and net fish yield affected significantly with the treatment (P<0.05; Table 5). Fish fed artificial diet recorded higher gross yield, followed by chicken litter, then control and finally compost treatment (922.4, 861.2, 713.9 and 710.8 kg/fed, respectively). Sinha (1979), reported that fish yield increased with increasing nutrient inputs in following increasing order (no inputs; fertilized ponds; pond received supplementary feed and then pond received both fertilizers and supplementary feed). Obtained result confirmed what were concluded by (Baccarin and Camargo, 2004) who reported that feeding tilapia pelleted and floating diets increased fish production, while the natural food produced in organically fertilized ponds was not sufficient to meet the growth demands of the fishes when they reached 80 g mean weight.

In conclusion of this trial pond fertilization with chicken litter yield as efficient as artificial fish feed at lower production costs and generate more income to farmers. But, the use of chicken litter in pond fertilization lead to increase bacterial load on fish which could cause public health problem to human either during fish handling after harvest or to end consumers.

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دراسة تأثير أختلاف استراتيجيات التغذية لاحواض البلطى النيللى على جودة الاسماك ومياه الحوض والانتاج السمكى

الملخص العربى

تم اجراء هذه الدراسة فى مزرعة أسماك بحثية بالعباسة ابوحماد شرقية. للتعرف على مخاطر استخدام سبلة الدواجن كسماد مقارنا بالكمبوست والاعلاف التجارية و بدون تسميد او تغذيه. مع مقارنة اثر نظم التغذية على مقاييس جودة مياه الحوض وانتاج الاسماك. تضمنت التجربة ٤ معاملات (تسميد بسبلة الدواجن، تسميد بالكمبوست، تغذيه صناعية بعليقة ٢٥% بروتين للشبع الظاهرى، ثم بدون تسميد او تغذية). واستخدمت لذلك احواض مساحتها ٢٠٠ م لمده ١٤ اسبوع استزرعت باصبعيات بلطى متوسط وزنها (١٠،٦جم) بمعدل ٢ سمكة للمتر.

اظهرت نتائج التجربة ان الحمل الميكروبى كان أعلى على الاسماك فى المعاملات المسمدة بسبلة الدواجن مقارنا بالكمبوست والتغذية الصناعية او بدون تسميد او تغذية وكان مقدار العدد الكلى للميكروبات فى نهاية التجربة كالتالى (٤٨،٢٥ × ١٠^{٣} و ٣٣،٢٥ × ١٠^{٣} و ٣٣،٥ × ١٠^{٣} ثم ٢٧،٥ × ١٠^{٣} على التوالى).

كان المحصول السمكى المتحصل علية فى نهاية مدة (١٤ اسبوع) الدراسة كالتالى (٨٣٢ و ٧٧١ و ٦٢٠،٥ ثم ٦٢٥ كجم / للفدان) من معاملات التغذيه الصناعية يليها التسميد بسبلة الدواجن يليها التسميد بالكمبوست ثم بدون تسميد او تغذية ، على التوالى.

وأظهرت الدراسه ان المعاملات المختلفة اثرت معنويا على كل من تركيز الاكسجين الذائب والفوسفور المتاح والنترات، بينما لم توثر معنويا على كل من درجة الحرارة، الامونيا، الامونيوم، عسر الماء، درجة القلوية، تركيز الكلوروفيل وشفافية المياه.

وخلصت التجربة الاولى الى انه على الرغم من ان التسميد بسبلة الدواجن حقق انتاجية لاتختلف معنويا عن تلك المتحصل عليها عند التغذيه على عليقه صناعية، الا ان الحمل الميكروبى كان اعلى فى احواض المعاملة المسمدة بسبله الدواجن، ويجب الحذر عند استخدام سبلة الدواجن فى برامج التسميد كبديل للاعلاف. وعكس المتوقع لم يظهر الكمبوست كفاءة انتاجية عالية كبديل للتغذية فى هذه التجربة.