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PRODUCTION OF NILE TILAPIA (*Oreochromis niloticus*) AND SILVER CARP (*Hypophthalmichthys molitrix* val.) IN EARTHEN PONDS FERTILIZED BY BLUE GREEN ALGAE AND POULTRY MANURE

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ABSTRACT

This study has been carried out to investigate the growth performance and economic efficiency as well as pond productivity of Nile tilapia (*Oreochromis niloticus*) and silver carp (*Hypophthalmichthys molitrix* val.) reared in polyculture earthen ponds as affected by different fertilizing inputs. Nile tilapia and silver carp fingerlings averaging 0.5 g in weight were assigned randomly to two tested different fertilized inputs. Two treatments were applied in the earthen ponds. (T_1) fresh blue green algae at a rate of one collecting algae pond (3kg) every day/fish pond (5 days / week) and (T_2) fertilization with chicken manure 25 kg / pond every 2 weeks. Four earthen ponds each measuring 20x50 m were used in the experiment. Each treatment was performed in duplicate. All the ponds were stocked with 2500 tilapia plus 500 silver fish / pond (12600/feddan). The study extended 90 days. Results obtained can be summarized in the following: 1- The highest final body weight, average daily gain (ADG) and specific growth rate (SGR), were recorded for Nile tilapia fish group in T_1. While a reverse trend was observed with silver carp which exhipted the highest final body weight, ADG and SGR with T_2. 2- With regard to economic efficiency, the total cost of T_2 was higher than T_1 but a net return of T_1 was higher than T_2.

In conclusion, the use of fresh blue green algae in fish pond culture could be recommended for Nile tilapia and silver carp at a rate of one collecting algae pond (3kg) every day/fish pond (5 days / week) with stocking density 12600/ fedd. Especially with the problems found now for poultry manure.

Keywords: Growth performance, Nile tilapia, Silver carp, Varying fertilizing inputs; Blue green algae; Earthen ponds.

INTRODUCTION

Most fish culture ponds in the tropical region are fertilized to increase phytoplanktonic production, which in turn increases fish yield (Yusoff and McNabb, 1989 and Knud-Hansen and Batterson, 1994). The manure can be used from a direct or indirect integration of fish and livestock. In the direct integration system, fresh manure is added continuously to the ponds, while in the indirect integration system the manure is transported to the ponds and used in fresh or dried forms in different manuring regime (Peker, 1994). Kamal *et al.* (2004) found that the use of dried blue green algae in fish pond culture could be recommended for Nile tilapia at a rate of 5% of fish body weight every week (4g/m^2) plus fertilization with chicken manure, 25 kg every two weeks per pond plus artificial diet (20% protein) at a rate 2% of fish biomass.

Polyculture of Nile tilapia *Oreochromis niloticus* L., common carp *Cyprinus carpio* L. and silver carp *Hypophthalmichthys molitrix* val. is the major aquaculture practice in Egypt and other countries in the world. The combination of the three species may ensure maximum utilization of available natural food in ponds because of their different feeding habits. Silver carp, Nile tilapia, and common carp could be considered as surface, column, and substratum feeders, respectively (Cremer and Smitherman, 1980 and Spataru *et al.*, 1983). The three species are commonly cultured in semi-intensive system with fertilization and supplemental feeding. Artificial feed costs in aquaculture operations account for approximately 50 % of total operational costs (Keenum and Waldrop, 1988 and Ratafia, 1994) and is considered a major constraint for both small fish farms and commercial fish aquaculture ventures. Reducing amount of feed is a means of lowering costs if production is not reduced. In attempts to reduce feed costs, fish farmer provide supplemental feed for part instead of all of the grow-out operation. An on-farm trial, carried out in the Philippines, demonstrated that initiation of feeding of Nile tilapia after 75 days of stocking in ponds produced the same yield as initiation at 45 days (Brown *et al.*, 2000).

The objective of the present study aimed to evaluate the effect of fresh blue green algae, which fish farmer can produce by himself, and comparing with chicken manure fertilization without artificial feeding on the production of Nile tilapia and silver carp fingerlings in the intermediate fish farming for youth project.

MATERIALS AND METHODS

The present study was carried out in Central Laboratory for Aquaculture Research at Abassa, Sharkia governorate, Egypt. Blue green algae, (including the genera *Anabaena*, *Nostoc* and others) were obtained as a dry plant material from Ministry of Agriculture Biofertilizer Unit (G.O.A.E.F) - GIZA - Egypt. The fresh blue green algae was produced in five small ponds for each fish pond, each measured 3 by1m with 40 cm in depth, and covered with plastic sheet. Some soil was added to the algae pond after that water was added and inoculated with dried blue green algae, calcium super phosphate was added to enhance the reproduction and growth of blue green algae. The fresh blue green algae was applied by collecting the surface layer of algae bloom and prodcasting it at a fish pond in amounts of one collecting algae pond (3 kg) every day/fish pond (5 days / week). Before the experimental start, all fish ponds were drained completely and then were exposed to sunrays for 2 weeks till complete dryness. Ponds were then refilled with fresh water coming from Ismailia Nile branch through a canal to the experimental station. Nile tilapia (*Oreochromis niloticus* L.) fish with an average initial weight 0.5 g / fish were obtained at 23 July 2004 from Arabia Company Fish Hatchery, El-Abbassa, Sharkia governorate . Fish were transported in plastic bags and after arrival to the experimental station, fish were adapted to the new conditions for one hour, then distributed randomly into four earthen ponds each measuring 20x50 m. Total water area of each pond was 1000 m^2, water level was maintained at one-meter level throughout the whole experimental period (90 days). After that, silver carp (*Hypophthalmichthys molitrix* val.) fish with an average initial weight 0.5 g / fish were obtained at 3 August 2004 from Central Lab. for Aquaculture Research Hatchery, El-Abbassa, Sharkia governorate. Two treatments were applied in the experimental earthen ponds. These were (T_1) fresh blue green algae at rate of one collecting algae pond (3 kg) every day/fish pond (5 days / week) and (T_2) fertilization with chicken layer manure 25 kg / pond every 2 weeks. Each treatment was performed in duplicate. All ponds were stocked with 2500 tilapia plus 500 silver fish / pond (12600/feddan).

Water temperature, dissolved oxygen and pH were measured daily 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 and ammonia) were carried out every two weeks according to the methods of Boyd (1979). Phytoplankton and zooplankton communities in pond water were determined every month according to the methods described by Boyd (1990) and A.P.H.A (1985). Samples were collected from different sites of the experimental ponds randomly to represent the water of the whole pond. The chemical analyses of blue green algae and chicken manure on basis of dry matter according to the methods of A.O.A.C. (1990) and phosphorus and potassium were determined using spectrophotometer (model LKB, Biochrom 4050 / uv / visble uttras pec П) according to the methods of AOAC (1984) are illustrated in Table (1). Vitamin C was determined by using High Performance Liquid Chromatography (HPLC) according to Wang *et al.* (1988).At the experimental end, 6 fish were taken randomly from each pond, and were exposed to chemical analysis for the whole fish composition according to the methods of A.O.A.C. (1990). Live body weight and length of 150 fish at start and monthly thereafter were recorded till the termination of the experiment. Specific growth rate (SGR) was calculated by using the following equation:-

$$SGR\% = 100 (Ln W_2 - Ln W_1) / T$$

Where W_2 is the fish weight at the end and W_1 is the fish weight at the start and Ln is the natural log. as described by Bagenal and Tesch (1978).

Condition factor (K): K= weight (g) x 100 /length (cm^3) (Hopkins, 1992).

Table (1): The chemical analysis of blue green algae and chicken manure used in the experiment (on dry matter basis).

Analysis % of Blue green algae									
C. P.	Ash	CF	E.E.	NFE	Total	Vitamin C mg/100g		K	P
45.5	20.08.	12.28	3.80	18.34	100	3.5		0.27	0.89
Analysis(%) of chicken manure									
C P	Ash	CF	EE	NFE	Total	N	P	C:N Ratio	N:P Ratio
19.9	31.5	1157	1.92	35.11	100	1.64	0.29	23.41	5.66

Statistical analysis:

A statistical analysis for the experimental results was carried out by using SAS program (SAS Institute, 1990).

RESULTS AND DISCUSSION

Water quality parameters:

Results of water quality parameters of the experimental ponds during the experimental period (90 days) as averages of the monthly samples are summarized in Table (2). In general, averages water temperature, 26.33 and 26.01 °C, DO 6.39 and 6.21 mg / l, pH 8.12 and 8.32 for T_1 and T_2, respectively. The average concentration of unionized ammonia (NH_3) was 0.48 and 1.30 mg/l for T_1 and T_2, respectively. The significantly decrease in the ammonia observed in T_1 (blue green algae) may be due to the consumption of ammonia by blue green algae (Rhyne *et al.*, 1985) . The European Inland Fisheries Advisory Commission (1993) reported that the toxic level of NH_4 to fish is 2 mg/L. The values of the total alkalinity were 350 and 356 mg/L for T_1 and T_2, respectively. The above results showed that all parameters of water quality were in the suitable range (Boyd, 1979).

Table (2): Average water quality parameters during the experimental period (90 days).

Item	T1 Blue green algae	T2 Chicken manure
Temperature(°C)	$26.33^{a} \pm 0.35$	$26.01^{a} \pm 0.24$
Dissolved oxygen (mg/l)	$6.39^{a} \pm 0.68$	$6.21^{a} \pm 0.71$
pH	$8.12^{a} \pm 0.26$	$8.32^{a} \pm 0.43$
NH_3 (mg/l)	$0.48^{b} \pm 0.02$	$1.30^{a} \pm 0.032$
Alkalinity (mg/l)	$350^{a} \pm 51.4$	$356^{a} \pm 55.6$

a,b, Means within the same row with different superscript are significantly different (P<0.05)

Plankton :

As shown in Table (3) the total phytoplankton counts for treatments T_1 and T_2 were on the average, 272000 and 248578 organisms / l, respectively. Table (1) revealed that chicken manure contains 1.64% nitrogen and 0.29% phosphorus and also the blue green algae contain 0.27 % (K) and 0.89% phosphorus which may reflect the better fertilization potential of blue green algae and chicken manure, respectively.

Table (3): Effect of different fertilizer on division plankton

Phytoplankton (organisms / l)				
Treatments	*Cyanophyta*	*Chlorophyta*	*Bacillaphyta*	Total grand
T1 (Blue green algae)	140000	120000	12000	272000
T2 (Chicken manure)	110000	129023	9555	248578

Zooplankton (organisms./l)						
Treatments	Copepoda	Nau	Rotifera	Cole.	Ostracoda	Total grand
T1 (Blue green algae)	77	11	33	66	10	197
T2 (Chicken manure)	53	4	15	50	3	125

Results of the present study indicated that *Cyanophyta* was the dominant group followed by *Chlorophyta* and *Bacillarophyta* in T_1 (Blue green algae) but in T_2. (chicken manure) N:P was 5.66, so *Chlorophyta* was the dominant group followed by *Cyanophyta* and *Bacillarophyta*. This results agree with those of Jensen *et al.* (1994) who found that *Chlorophytes* could be dominant in many shallow eutrophic lakes and ponds with low N:P ratios. Quin and Culver (1996) reported that ponds with organic fertilizer (N:P = 10:1) had significantly less blue-green algae, these results in contrast with those of Smith (1983) who found that blue-green algal blooms became dominant when N:P ratios by weight were below 29:1. The competitive outcome between blue-green algae and green algae for nutrients depends not only on N:P ratio, but also on the rate at which nutrients are supplied (Sommer, 1985). Jensen *et al.* (1994) pointed out that one of the important reasons why *Chlorophytes* were able to out compete blue-green algae in shallow, no stratified lakes was the continuous input of nutrient from the sediment.

Table (3) also showed that the averages numbers of zooplankton organisms per liter were higher in water samples of T_1. The present study indicates that Copepoda is the dominating group followed by Cladocera and Rotifera in all ponds. In general, the community composition of phytoplankton and zooplankton in all treatment ponds fluctuated greatly with temperature, fertilization and feeding habits of fish. In this concern, Riely (1947) reported that there is statistically no strict relationship between the total zooplankton and the total phytoplankton numbers.

Growth performance

The growth responses of fish species in all the treatments were generally satisfactory.

As described in Table (4), the average body weight of Nile tilapia increased from 0.50 g to 46.6 g and 45.62 g for T_1 and T_2, respectively. It is obvious that T_1 (blue green algae) recorded higher ($P > 0.05$) final body weight than T_2 (chicken manure). The same trend was obtained with regard to weight gain, ADG and SGR. These results are in agreement with McDonald (1987) who found that tilapia fish (*Oreochromis aureus*) fed blue green algae (*Anabaena spp.*) gained more weight than the control. Tefei *et al.* (2000) demonstrated that *O. niloticus* was found to be essentially phytoplanktivorous in lake Chamo, the blue green algae contributed over 60% of the total food ingested. Of these, more than 50% was due to *Anabaena*.

Table (4): Growth performance of Nile tilapia and silver carp reared in different fertilized polyculture ponds.

Items	Species	Fertilizer treatment	
		T1 Blue green algae	T2 Chicken manure
Initial weight (g/fish)	NT	$0.50^{a} \pm 0.00$	$0.50^{a} \pm 0.00$
	SC	$0.50^{a} \pm 0.00$	$0.50^{a} \pm 0.00$
Final weight (g/fish)	NT	$46.6^{a} \pm 2.25$	$45.62^{a} \pm 1.43$
	SC	$52.70^{b} \pm 8.30$	$70.70^{a} \pm 1.43$
Weight gain (g/fish)	NT	$46.1^{a} \pm 2.25$	$45.12^{a} \pm 1.43$
	SC	$52.20^{b} \pm 8.31$	$70.20^{a} \pm 1.43$
Average daily gain (mg/d)	NT	$512.2^{a} \pm 27.1$	$501.3^{a} \pm 27.19$
	SC	$644.44^{b} \pm 10.25$	$866.66^{a} \pm 8.65$
Specific growth rate (% / d)	NT	$4.99^{a} \pm 0.72$	$4.96^{a} \pm 0.26$
	SC	$7.72^{b} \pm 0.19$	$8.10^{a} \pm 0.01$
Survival rate %	NT	$91.7^{a} \pm 1.76$	$90^{a} \pm 1.25$
	SC	$96.9^{a} \pm 0.9$	$95^{a} \pm 0.8$
K – factor	NT	$1.95^{a} \pm 0.80$	$1.95^{a} \pm 0.05$
	SC	$1.06^{b} \pm 0.02$	$1.12^{a} \pm 0.05$

a,b, Means within the same row with different superscript are significantly different ($p<0.05$)

NT = Nile tilapia, SC = Silver carp.

With regard to silver carp (Table 4) It is obvious that T_2 (chicken manure) recorded higher ($P < 0.05$) final body weight (70.70 g / fish) than T_1 (blue green algae) 52.70 g/fish. The same trend was obtained with regard to weight gain, ADG and SGR. Fish survival in all treatments exceeded 90% and were not significantly ($P > 0.05$) affected by the fertilization with chicken manure or blue green algae. With regard to condition factor (K), no significant differences ($P > 0.05$) was found between treatment in the case of Nile tilapia but with silver carp, T_2 (chicken manure) was higher ($P < 0.05$) than T_1 (blue green algae). These results showed that fertilization with chicken manure may gave more detritus than blue green algae since the main food items for silver carp are algae and detritus (Herodek *et al.*, 1989). From these data, it can be concluded that fish do not need to be fed immediately after stocking but can be supported by the natural food in the pond ecosystem (Abdelghany *et al.*, 2002).

Proximate Chemical analysis:

Proximate analysis of whole body composition of Nile tilapia and silver carp is shown in Table (5). Crude protein and ash were significantly ($P < 0.05$) higher in both Nile tilpia and silver carp in T_1 (blue green algae) than in T_2 (chicken manure). While a reverse trend was observed with body fat, where it was significant ($P < 0.05$) higher in T_2 (chicken manure) than T_1 (blue green algae). As mentioned previously that pond fertilized with chicken manure may gave more detritus than blue green algae. Getachew and Fernando (1989) stated that the non-protein amino acids and the bacterial cells that are found in association with detritus are the important components that provide the bulk of the essential nutrients in these fish.

Table (5): Chemical analysis (% dry matter) of whole fish body of Nile tilapia and silver carp raised in different fertilized polyculture ponds.

Items	Species	Fertilizer treatment	
		T1Blue green algae	T2Chicken manure
Moisture	NT	$74.63^{b} \pm 1.19$	$75.66^{a} \pm 2.05$
	SC	$75.21^{a} \pm 2.31$	$73.32^{b} \pm 4.12$
Dry matter	NT	$25.37^{a} \pm 0.98$	$24.34^{b} \pm 2.21$
	SC	$24.79^{b} \pm 0.45$	$26.68^{a} \pm 3.17$
Crude protein	NT	$61.21^{a} \pm 2.51$	$55.39^{b} \pm 1.35$
	SC	$46.31^{a} \pm 3.39$	$43.27^{b} \pm 3.39$
Ether extract	NT	$13.11^{b} \pm 1.78$	$18.01^{a} \pm 1.02$
	SC	$13.14^{b} \pm 0.91$	$16.27^{a} \pm 3.09$
Ash	NT	$25.00^{a} \pm 2.23$	$24.13^{b} \pm 1.39$
	SC	$30.95^{a} \pm 1.98$	$28.27^{b} \pm 2.31$

a,b, Means within the same row with different superscript are significantly different ($p<0.05$)
NT = Nile tilapia, SC = Silver carp.

Economic efficiency:

Table (6) shows the results of economical evaluation including the costs and returns for treatments applied in kg / feddan and income in (L.E) for 90 days. All of the treatments in this experiment generated a profit (Table 6).

Total costs were 1500 and 1700 L.E / feddan for $T_1$and T_2, respectively and net returns in L.E per feddan were 2220 and 1850 for T_1 and T_2 and, respectively. Percentages of net return to total cost were 148 % and 108.8 % for T_1 and T_2, respectively. These results revealed that the total cost of T_2 (chicken manure) was higher than T_1 (blue green algae) but a net return of T_1 (blue green algae) was higher than T_2 (chicken manure).

Table (6): Economic efficiency (%) of Nile tilapia (*Oreochromis niloticus*) and silver carp fingerlings production as affected by the applied treatments during the experimental period for 90 days in L.E./ feddan.

Item	T_1	T_2
Stocking data		
Stocking rate of tilapia (fish / feddan)	10000	10000
Stocking rate of silver carp(fish / feddan)	2000	2000
Average size at stoking of tilapia (g)	0.5	0.5
Average size at stoking of silver carp (g)	0.5	0.5
Average size at harvesting (g) of tilapia (g)	46.6	45.62
Average size at harvesting (g) silver carp (g)	52.7	70.7
Survival rate % of tilapia	91.7%	90.0%
Survival rate % of silver carp (g)	96.9%	95%
Production, No./feddan of tilapia	9170	9000
Production, No./feddan of silver carp	1938	1900
Operating costs (L.E)		
Tilapia fry	600	600
Silver carp fry	200	200
Fertilization (manure)	-	300
Blue green algae	100	-
Labor (one / feddan)	300	300
Fixed costs, L.E/ Fedd.		
Depreciation (materials &others)	200	200
Taxes (one feddan)	100	100
Total costs/feddan (L.E)	1500	1700
% of the smallest value of total costs	100%	113.3%
Returns		
Total Returns (L.E)	3720	3550
Net returns (L.E.)	2220	1850
% Net return to total cost	148 %	108.8 %

The economical evaluation of results was carried out according to market prices in 2004 in L.E. where:
1000 tilapia fingerlings (40- 50g each) = 300 L.E.
1000 silver carp fingerlings (50- 100g each) = 500 L.E.

Recommendation

Based on the obtained results and the proplems found with poultry manure now, it can say that, the use of fresh blue green algae in fish pond culture could be recommended for Nile tilapia and silver carp at rate of one collecting algae pond (3kg) every day/fish pond (5 days / week).

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إنتاج البلطى النيلى و المبروك الفضى فى أحـواض ترابيـة مسـمدة بالطحالـب الخضراء المزرقة و زرق الدواجن

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أجريت هذه الدراسة بالمعمل المركزي لبحوث الأسماك بالعباسة مدينـة أبـو حمـاد- محافظة الشرقية -مصر. وكان الهدف من الدراسة التعرف على أداء النمو و الكفاءة الاقتصـادية للبلطي النيلي و المبروك الفضى المرباة في أحواض ترابية فى نظام الاستزراع السمكى متعـدد الأنواع تحت تأثير معاملات تسميدية مختلفة ، وكان متوسط وزن الإصبعيات من أسماك البلطـى النيلى و المبروك الفضى فى البداية ٠,٥ جرام. تم إجراء معاملتين مختلفتـين وهـى كـالآتي: المعاملة الأولى (T_1) التسميد بالطحلب الخضراء المزرقة الطازجة بمعدل محصول حوض طحالب (٣ كجم) كل يوم لكل حوض سمك (٥ أيام / أسبوع) و المعاملة الثانيـة (T_2) التسـميد بـزرق الدواجن بمعدل ٢٥ كجم / حوض و ذلك كل أسبوعين. تم استخدام ٤ أحواض مساحة الحـوض الواحد ١٠٠٠م٢ و تم تخزين الأسماك في الأحواض بمعدل ٢٥٠٠سـمكة بلطـى نيلـى و ٥٠٠ مبروك فضى/ للحوض (١٢ ألف / فدان). وتم تكرار كل معاملة مرتين والدراسة استمرت ٩٠ يوما. و كانت النتائج المتحصل عليها على النحو التالى:-

١- أعلى متوسط جسم نهائي و متوسط النمو اليومى و معدل النمو النوعي تم تسـجلها لأسـماك البلطى النيلى فى المعاملة الأولى (T_1) التسميد بالطحلب الخضراء المزرقة ، بينما كان على العكس المبروك الفضى حيث أظهرأعلى متوسط جسم نهائي و متوسط النمو اليومى و معدل النمو النوعي فى المعاملة الثانية (T_2) التسميد بزرق الدواجن.

٢- بالنسبة للكفاءة الاقتصادية كانت التكاليف الكلية للمعاملة الثانية (T_2) أعلى من المعاملة الأولى (T_1) لكن عائد الربح الصافى كان المعاملة الأولى (T_1) أعلى من المعاملة الثانية (T_2).

وتوصى الدراسة باستخدام الطحالب الخضراء المزرقة الطازجة بمعدل محصول حوض طحالب (٣ كجم) كل يوم لكل حوض سمك (٥ أيام / أسبوع) وكثافة تخزين ١٢ ألف زريعة /فدان من اسماك البلطي النيلي و المبروك الفضى المرباة في الأحواض الترابية وذلك للحصول علـى أعلى إنتاجية و جودة (بروتين عالى و دهن منخفض) للفدان خاصة مع المشاكل الموجـودة الآن لزرق الدواجن.