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RISK ASSESSMENT OF USING POULTRY MANURE ON WATER QUALITY, FISH AS WELL AS THEIR HUMAN HEALTH AND BIOLOGICAL TREATMENT IN AQUACULTURE PONDS

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Abstract

The efficiency of *Scenedesmus dimorphus* as biological treatment to improve water and fish quality in fish farms where poultry manure as fertilizers were studied. Nile tilapia (*Oreochromis niloticus*) fingerlings with an average weight 9.50 ± 0.05. Eight earthen ponds (one feddan each) were used in this study. All ponds were stocked with the same number of fingerlings, being 4000 fish/feddan. The 8 ponds were randomly assigned to four groups with two replicates per each treatment. The first treatment received commercial pelleted fish feed 25% CP and fed at a daily rate of 3 % of fresh fish body weight (T_1).The second treatment received each pond was fertilized by 100 kg poultry manure per week (T_2). The third treatment received each ponds was seeded with *Scenedesmus dimorphus* at initial density $9X10^6$ cells/ml (12 tons acre live algae/feddan) at the beginning of production season (T_3). The fourth treatment received each ponds was seeded the same previous density of live algae (12 m^3/feddan) after one month was fertilized by 100 kg poultry manure per week, after that the fertilizers decreased to 50 kg/feddan (T_4). Artificial pelleted fish feed (25% crude protein) was administrated to ponds (receiving fish feeds T_2, T_3, T_4) 5 days per week at a rate of 3% of fish body weight one time a day during twelve weeks for the rest of the experimental period. The results of examination of water revealed that the use of poultry manure effects on water parameters regarding the pH, dissolved oxygen and unionized ammonia. It was significantly higher in fish group T_2 compared to that of fish group T_1 and T_3. The highest bacteria content was obtained at T_2, while the lowest value was obtained at fish group T_3 ($P< 0.05$). The higher values of heavy metals (Fe, Zn, Cu, Mn and Cd) were accumulated in fish group T_2, while the lowest value was obtained at fish group T_3 ($P< 0.05$). There were significant differences in AWG, ADG and SGR among treatments; the third treatment recorded the highest values for the above parameters, while the lowest levels of these values were observed with second treatment. Body dry matter (%) was not significantly affected by the experimental treatments, while CP%, EE% and ash% significantly differed among treatments. Tilapia fingerlings in T_3 produced lower value of Creatinine, Cholesterol, Glucose and Uric acid while gave higher value of total protein, follicle stimulating hormone (FSH) and gave best value of AST, ALT in plasma.

The results also demonstrated the efficiency of microalgae in reducing the pollutant effect of some heavy metals in water, and decreasing their negative impact, where it gave better water quality and fish safety adverse health human effects.

Key words: Biological treatment, *Scenedesmus dimorphus*, Nile tilapia (*Oreochromis niloticus* poultry manure, heavy metals, bacteriological, Growth performance, AST, ALT

INTRODUCTION

Nile tilapia is by far the most important farmed tilapia species in the world. Tilapia is the most familiar and popular fishes in Egypt, as well as, in the Middle East and warm climate countries (NRC, 2004). In the present years, in Egypt, the efforts were directed to produce more fishes that may be share in covering the shortage in animal protein. In 1999 fish culture in Egypt, added abut 226.000 ton of the total fish production, which constitute about 35% of the total fish production in this year (GAFRD, 2001). Proper nutrition has long been recognized as a critical factor in promoting normal growth and sustaining fish health. Prepared diets not only provide the essential nutrients that are required for normal physiological functioning, but also may serve as the medium by which fish receive other components that may affect their health (Boyd, 1988, Gatlin, 2002). A few years ago, microalgae have been increasingly produced for commercial purposes which include human and animal consumption, bioactive compounds for medicine, fuel production, biofertilizers, and as live feeds for the cultivation of filter feeding organisms (Boyd, 1976, Becker, 1987, Wang *et al*., 2007, Bermejo *et al;* 2008). Currently, microalgal biomass production is economically feasible only when product values are relatively high, such as special chemicals and pigments, or when the microalgae play a critical role in aquaculture production (Bottrill *et al.,* 1970, Boyd, 1973, Badr and Abou-Waly, 1997, Spectorova *et al*., 1997). Algae are important components of aquatic ecosystems and are used as primary source for fish feeding. Tartiel. (2005) found that crude protein content of *Scenedesmus spp* was 52.3% crude protein, 12.20% crude fat, 10.06% Carbohydrate, 14.92 % ash, 8.83% crude fiber, 3.16 RNA and 1.43 DNA , 0.27 B_6, 0.78 B_{12}, 0.01 E, 21.8 C and 1890.0 B-carotene (μg\g dry weight). Algae have attention as a possible alternative protein source for cultured fish, particularly in tropical and subtropical regions where algae production high and their good protein, vitamins and essential fatty acids contents (El-Hindawy *et al*., 2006). The use of microalgae as fish feed inputs has been studied with encouraging results. (Broun, 1980), reported positive growth performance in fish feed diets containing algae cells. Zeinhom (2004) found that fish fed diet containing 15% algae increased significant by the digestibility coefficient of dry matter (92.5%), crude protein (87.63%), ether extract (88.45%) and energy (81.41%). Natural food still remains the major feed for tilapia rearing so a timely supply of microalgae in sufficient quantity ensures the success of a tilapia hatchery (Boyd, 1979; Becker, 1994). The diet of the fish has a great influence on their general chemical composition and particularly on their fatty acid composition. Fillet yield is considered as an important measurement for improving fish production efficiency.

Phytoplankton function is helpful in resisting pollutants in water (Soeder, 1980, Boyd, 1990, El-Fouly *et al.*, 1998). The agriculture drainage water and sewage waste water were appropriate for fish production because it is reached with inorganic nutrient but this fish are not safe for human consumption. Microalgae on environmental safe for fish and its safety for human consumption (Boyd, 1991, Olvera *et al.,* 1998, Lin *et al*., 2008) Potential adverse health effects in such application could be avoided the waste drainage water is sufficiently treated before use with microalgae. Tartiel. (2005) reported that microalgae associated with the utilization as a source of antioxidant vitamins group when occur bioaccumulated in fish tissues and as biocontrol of environmental for biological treatment when absorbed above many heavy metals on cell wall of microalgae and uptake all nitrogen forms , inorganic nitrogen presented at four different forms (nitrate NO_3 , nitrite NO_2 , ammonium NH_4 , ammonia NH_3) as well as concentrations of heavy metals (iron , copper , zinc and lead) decreases in water and thus removal the pollution environmental. Moreover, microalgae were the best for treatment, where it gave better water quality and fish safety adverse health human effects. Elbana and Abd-Elhamid (1999) and Zhao *et al.,* (2001) noted that the fish culture facilities in Egypt, include earthen ponds, concrete ponds, floating cages and galvanized containers but the earthen ponds constitute the main type. Tilapia farms fertilizers may be added to ponds early in the growing season when phytoplankton production normally begins its spring pulse. At the same time periodic fertilization occur through the growing season or sometimes a single application made early in the growing season.

In Egypt, the majority of fish farmers use the organic fertilizers, especially the poultry manure (chicken droppings) not only to encourage the growth of phytoplankton but they use it as a food for fish either alone or mixed with supplemented ration in order to reduce the cost of fish rearing which may have a great drawbacks. Fish production should be increased in Egypt to meet the demand of the increasing population. Several problems face fish production in Egypt. Among these problems are the most tropical species die via low water quality because of pollution with poultry manure.

The aim of this study was to evaluate the use of poultry manure in tilapia farms as fertilizers, as well as evaluation of the use microalgae Scenedesmus *dimorphus* associated with the utilization as biological treatment and thus removal the pollution from the water and the possible metals (heavy metals) bioaccumulation in different organs (muscle, gills and liver) of *Oreochromis niloticus* and the potential effects of a contaminant on fish health and their public health. In this study the use of poultry manure for cultured tilapia was evaluated through determination of their effects on water, fish as well as their human health hazards. At the same time, bacteriological examination of different samples and different combination between these different inputs on growth performance of fish.

MATERIALS AND METHODS

Pond facilities and treatments

The study was carried out for 24 weeks at Abbassa fish farm, Abu-Hammad, Sharkia Governorate, Egypt. Nile tilapia (*Oreochromis niloticus*) fingerlings with an average weight 9.50 ± 0.05 were transferred from Abbassa Hatchery to the wet lab of CLAR and acclimatized in fiberglass indoor tanks for three weeks to laboratory conditions before using in the experiment. The fish were randomly distributed at a rate of 4000 fish in each feddan. Eight earthen ponds were used in this study. The area of each pond was one feddan (4200 m^2) and water depth was 110 cm. The experiment was conducted during the period of six months, from April to September. A feeding regime of 3% body weight per day was employed through out the trial. The amount of feed was calculated and readjusted after weekly weighing. The 8 ponds were randomly assigned to four groups with two replicates per each treatment. The first treatment received commercial pelleted fish feed (artificial diet) containing 25% CP and fed at a daily rate of 3 % of fresh fish body weight from two time daily and 6 days per week (T_1).The second treatment received each pond was fertilized by 100 kg chicken manure per week (T_2). The third treatment received each ponds was seeded with *Scenedesmus dimorphus* at initial density 9X10^6 cells/ml (12 tons acre live algae/feddan) at the beginning of production season (T_3). The fourth treatment received each ponds was seeded the same previous density of live algae after one month was fertilized by 100 kg chicken manure per week, after that the fertilizers decreased to 50 kg/feddan (T_4). Artificial pelleted fish feed (25% crude protein) was administrated to ponds (receiving fish feeds T_2, T_3, T_4) 5 days per week at a rate of 3% of fish body weight one time a day during twelve weeks after the end of the experimental period. Water samples were collected from ponds every month after three days of fertilizer application. The water samples were taken from each corner of the ponds using sampler bottle and mixed together to be ready for analysis. Water temperature and oxygen content were measured daily, the pH was measured weekly by electrode pH meter. Random samples of fish (50 fish from each pond) were taken every month during the whole experimental period 6 months. Individual body weight (g) and body length (cm) were recorded for each fish, the proximate analysis of whole fish bodies of initial and final samples were carried out according to A.O.A.C. (1990) methods. Results of the chemical analysis of poultry manure, *Scenedesmus dimorphus* and artificial diet calculated on dry matter basis are shown in Table 1.

Table 1. Chemical composition of artificial diet, poultry manure and *Scenedesmus dimorphus* (% on dry matter bases).

Chemical analysis (%)	Basal diet	Poultry manure	*Scenedesmus dimorphus*
Dry matter D.M	80.30	84.70	91.50
Crude protein C.P	25.32	26.50	52.80
Ether extract E.E	6.12	2.20	8.62
Crude fiber C.F	8.73	15.90	7.20
Ash	5.68	30.00	13.90
Nitrogen free extract*	54.15	25.40	17.48
Gross energy (Kcal/100g)**	423.15	274.61	451.0

*NFE (nitrogen free extract) = 100 – (protein + lipid + ash + crude fiber).

**GE (gross energy): Calculated according to NRC (1993) as 5.64, 9.44 and 4.11 kcal / g for protein, lipid and NFE, respectively.

Indoor and Outdoor alga mass culture

Stock culture of Scenedesmus *dimorphus* were prepared at National Research Center, Dokki-Cairo. The microalgae were subcultured in Bold's basal medium (BBM) according to Bischoff and Bold (1963). The cultures were allowed to grow in the algae culture room at 25̊C and 14/10 light-dark cycle (5000 lux). Stock culture were transferred from Dokki lab to the wet lab of CLAR in two liters capacity flasks for 5-6 days, then inoculated in carboy cultures at a density of $1x\ 10^5$ cells/ml. The carboy cultures were used as inoculums for two different phases of production in indoor and outdoor in glass aquaria. The aquaria were used to inoculate the fiberglass tanks ($5m^3$), then inoculated in six concrete ponds, the area of each pond was 12 m^3. Commercial or agriculture grade components are used according to Oceanic Institute (OI) Algae culture Medium for outdoor culture (Allen & Nelson 1910). The transfer of the algal cells to fish earthen ponds was achieved at a density of $9X10^6$ cells/ml (12 tons acre live algae/feddan). The following formula was used to compute for the required volume of stock green algae to be added into the ponds (Tendencia *et al.*, 2005).

$$\textbf{Volume to be added} = \frac{\text{(desired density-existing density)x volume of water in pond}}{\text{Density of stock culture}}$$

Physical and chemical parameters of water

Water samples were monthly taken for determination of hydrogen ion concentration was measured with an Accumet pH meter (Model 25, Fisher Scientific). Dissolved oxygen (mg/l) was measured by using a digital oxygen meter (Model YSI 55). Transparency (m) was measured by using a Secki Disk of 20 cm diameter (Boyd and Tucker, 1992). Total hardness (mg/l), calcium hardness (mg/l), total alkalinity (mg/l), nitrogen compounds (NH_3-N, NO_2-N and NO_3-N) (mg/l) and phosphate (mg/l) as well as chlorophyll "a" (µg/l) were determined according to American Public Health Association (APHA, 1985).

Heavy metals

In water samples, heavy metals were extracted with HCL and preserved in a refrigerator till analysis for Fe, Zn, Mn, Cu, Cd, and Pb (Parker, 1972), whereas in fish samples metals were extracted by the method described in Association of Official Analytical Chemists (AOAC, 1990).Atomic Absorption Spectrophotometer (Model Thermo Electron Corporation, S. Series AA Spectrometer with Gravities furnace, UK.) instrument was used to detect the concentration of heavy metals. Also, in fish's tilapia samples; the concentrations of heavy metals were expressed in µg/g. dry weight for tissues (muscle, gills and liver) and µg/l for water.

Bacteriological examinations

Water samples were collected in a sterile glass bottles (500 ml), 30 cm under the water surface, placed into ice-box and examined within 6-8 h of collection in the laboratory. Also, samples of tilapia fishes were taken 20 fish from each group. All samples were analyzed according to the recommendations of APHA (1985).

Growth performance parameters and data calculation:

Weight gain = final weight – initial weight.

Daily weight gain (DWG) = Gain / experimental period.

Feed conversion ratio (FCR) was calculated by using the following equation:

FCR = dry feed ingested / weight gain time of experiment (days).

Relative weight gain (RWG) = Gain / initial weight

Specific growth rate (SGR %) = (In W_1 – In W_0) / T) X 100

Where W_1 is the fish weight at the end (final weight), W_0 is the weight at the start (initial weight), in is the natural log. As described by Bagenal and Tesch (1978) and T is the number of days in the feeding period.

The condition factor (K) = weight / length^3 X 100

Where: W = fish weight "grams", L = fish length "cm"

Biochemical analysis and Analytical methods

The basal diet and fish samples from each treatment were analyzed using the methods of A.O.A.C. (1990) for determination of moisture, crude protein, total lipids and ash. Blood samples were collected from the caudal veins and blood was allowed to set for 30 min. at 4 ̊C to clot, and then centrifuged for 5 min. at 1000 rpm. The serum samples were stored at -20 ̊C until later used to analyze total protein, creatinine, uric acid, glucose and enzymes activity aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were determined colorimetrically according to the method described by Moss (1984). Blood samples were preserved in sodium fluoride for estimating blood glucose. For measuring blood minerals, 0.5 ml plasma was digested with a mixture of concentration. The studied elements were determined using atomic absorption spectrophotometer (Perkin Elmer model 2280). Sodium and potassium were determined by flame photometry (AOAC, 1990).

Statistical analysis of data

Statistical analysis was performed using the Analysis of variance (ANOVA) and Duncan's multiple Range Test, to determine differences between treatments means at significance rate of $P < 0.05$. The standard errors of treatment means were also estimated. All statistics were carried out using Statistical Analysis program (SAS, 2000).

RESULTS AND DISCUSSION

Physical and chemical characteristics of water

Physical and chemical parameters of pond water for the different treatments showed at Table 2. Data showed no significant differences in pond water temperature for the four treatments. Secchi disk value for treatment 3 was significantly lower than that of Treatment 1. No significant differences were found in dissolved oxygen level among treatments except in T_2 compared to T_3. T_2 was also characterized with high pH level compared to T_3. Same trend noticed with total alkalinity. Total hardness showed slight difference where T_4 was lower than T_2 but was not significantly different than T_1 and T_3. T_2 showed the highest level of ammonia and nitrate compared with all other treatments. T_3 showed higher phosphorus and chlorophyll a content compared with other treatments.

Table 2. Mean value of water quality parameters during the experimental period.

Parameters	Treatment			
	T_1 AF*	T_2 PM*	T_3 SC*	T_4 SC+PM*
Temperature °C	29.0±3.02a	29.6±7.21a	29.2±3.04a	29.3±4.50a
Secki Disk (cm)	21.5±16.40a	14.6±12.00ab	12.8±9.01b	14.7±6.30ab
Dissolved oxygen (mg/l)	6.94±2.23ab	6.30±4.24b	8.51±2.04a	7.92±2.10ab
pH	8.68±1.09ab	9.30±9.09a	8.01±6.01b	8.85±2.0ab
Total alkalinity (mg/l)	334.0±76.33ab	413.21±16a	386.7±46.4b	367.2±17.3ab
Total hardness (mg/l)	247.6±83.55ab	261.5±38.7a	252.3±68.6ab	250.8±37.4b
NH_3 (mg/l)	0.26±0.09c	0.94±0.04a	0.17±0.05d	0.22±0.01c
NH_4 (mg/l)	1.40±0.50ac	1.80±0.09a	0.09±0.05c	1.01±0.03bc
NO_3 (mg/l)	0.29±0.06c	0.74±0.09a	0.23±0.08c	0.20±0.01d
Total phosphorus (mg/l)	0.73±0.09c	0.92±0.55b	1.90±0.22a	0.98±0.09b
Chlorophyll "a" content (µg/l)	116.46±74.3c	138.71±81.2bc	195.88±74.3a	172.40±12.4b

Data are represented as mean of three samples replicates ± standard error

Means in the same row with the same letter are not significant difference (P>0.05)

AF* the first treatment artificial diet (control) T1

PM* the second treatment treated by poultry manure T2

SC* the third treatment treated by *Scenedesmus dimorphus* T3

SC+PM* the fourth treatment treated by poultry manure plus *Scenedesmus dimorphus* T_4

Results showed also that the agriculture drainage water is superior to microalgae cultivation because suitable media reached with inorganic elements could improve the prospects for industrial production of this biomass and its ability to derive CO_2 from the atmosphere , considering that the culture medium is an important factor in the production costs of the algal product as well as the unicellular green algae examined play an important role in the treatment of agriculture drainage water in the self purification of streams and natural waters. These results were in accordance with those obtained by Boyd (1991), who stated that the solubility of oxygen decreases to about half as the temperature is raised from the freezing point to 30 ^{o}C demonstrated that saturated dissolved oxygen concentrations in water, at 1 atmosphere of pressure, range from about 9.1 mg/l at 20 ^{o}C to about 7.0 mg/l at 30 ^{o}C. Although not-significant, there was an increase of oxygen content. However this decrease in water temperature causes increase in the solubility of dissolved oxygen. Results obtained in were also in agreement with the findings of Boyd (1988), who found that the water temperature is one of the most influential environmental factors affecting both the metabolism and growth of fish and their body composition. Also, Chen *et al.* (2001) observed that the amount of, dissolved oxygen required by aquatic animals is variable and depends on species, size, activity, water temperature, dissolved oxygen concentration. Appreciable amounts of oxygen are produced by photosynthesis process of algae in fish ponds during day light hours, which are used continuously by the pond (fish, plankton and benthos) in respiration. In this connection, Knud-Hansen *et al.* (1998) reported that the important role of temperature in phytoplankton flourish, they advocated that algal productivity is primarily a function of nutrients, light availability and temperature , an adequate basis or do the different physiological indicators . In this respect, De Pauw *et al*. (1998) who stated that a microalgal system can be employed as an alternative secondary treatment process for simultaneous removal of nutrients and organic matter from water. The quest-ion of what limits phytoplankton production is central to freshwater ecology. But it is a question fraught with difficulties and suffused with generalization. Also, results obtained in this work in partial agreement with the Vechtel *et al*. (1992) who concluded that the photosynthesis measured as oxygen release or carbon uptake; the net rate of incorporation of carbon; the rate of cell division; or the net accumulation of cell material. Factors which limit production can be grouped as rate-limiting factors for the first three of these and yield-limiting factors for the last. In turn, the potential yield, determined by yield-limiting factors, may not be achieved because crop-limiting factors prevent accumulation of biomass.

The stress associated with the use of poultry manure, including change of water parameters The low level of dissolved oxygen and high level of unionized ammonia in case of water received poultry manure specially in the presence of high pH levels may constitute a great danger on fish which may inducing mortalities, because the high levels of unionized ammonia inducing severe irritation on gills leading to hyperplasia of gill filaments, which in turn affecting the ability of gills to take the dissolved oxygen from water (Rasmussen and Korsgaard, 1996).Which could be encouraged by the low levels of dissolved oxygen in water, Also, the addition of poultry manure (high organic matter) to ponds increase decomposition of organic matter by microorganisms, resulting in oxygen depletion which alone may leads to high mortalities unless counter measures are taken? The results showed that the addition of poultry manure affecting drastically the health condition of cultured tilapia, mortalities were recoded after each meal of poultry manure and showing that many died fish, some fish with eroded fins and gills, at the same time, the majority of fish showing signs of asphyxia after addition of poultry manure like accumulation near the water inlet, surfacing and gasping of air. The signs of asphyxia disappear after introduction of new water to the ponds. The signs of asphyxia may attributed to the effects of poultry manure on water parameters, which associated with low dissolved oxygen, high ammonia and high pH, eroded fins and gills may be due to the different bacterial pathogens and increase the bacterial content which either enter to the water.

Growth performance and survival rates

Data in Table 3 is showing the growth performance and feed conversion ratio (FCR) of Nile tilapia under the four different feeding treatments. It is obvious that fish of T_3 had the highest body weigh gain (BWG) among all treatments. T_1 ranked in the second place followed by T_4 while T_2 was ranked last in terms of BGW. Same trend was found in total weight gain (kg/pond) where T_3 had the highest total weight gain (1145.92 kg/pond) while T_2 had the lowest one (697.48 kg/pond). The best FCR rate was obtained in T_3 compared with the other three treatments which reflects the benefit of using *Scenedesmus dimorphus* in ponds stocked with Nile tilapia. Data in Table 4 illustrate the effect of different feeding strategies on the daily weight gain (DWG) and relative weight gain (RWG) of Nile tilapia in earthen ponds. It is clear enough that T_3 (use of *Scenedesmus dimorphus*) showed positive effect on the DWG and RWG of fish at the end of the experimental period after six months. T_3 showed significant increase of the two mentioned parameters compared with those of the other three treatments. Data in Table 5 illustrate the effect of different feeding strategies on the body length and condition factor of Nile tilapia in earthen ponds. Data showed that the best condition factor was obtained in fish treated with *Scenedesmus dimorphus* (T_3). That table reflects the effect of *Scenedesmus dimorphus* in producing bigger size fish compared with those of the other treatments. The highest specific growth rate (1.62) was obtained in T_3 while the lowest one was obtained in T_2 (Table 6)

Table 3. Effect of different treatments on body weight performances of Nile tilapia (*Oreochromis niloticus*).

Exp. Period		Treatment			
Months	Weeks	T_1 AF*	T_2 PM*	T_3 SC*	T_4 SC+PM*
		Daily weight gain (DWG) Mean ±S.E			
April	(4 weeks)	0.53±0.01b	0.53±1.22b	0.73±2.04a	0.46±0.05c
May	(8 weeks)	0.58±0.09b	0.58±3.05b	0.72±1.61a	0.76±1.07a
June	(12 weeks)	0.35±0.06b	0.35±6.03b	0.42±0.07a	0.45±0.09a
July	(16 weeks)	0.90±1.02c	0.90±1.01c	2.08±0.03a	1.32±1.07b
August	(20 weeks)	1.91±0.06ab	1.91±0.07ab	2.47±4.11a	1.56±0.08b
September	(24 weeks)	1.95±0.09c	1.95±0.09c	3.81±5.52a	2.34±3.04b
		Relative weight gain (RWG)			
April	(4 weeks)	2.81±1.02a	1.64±0.75c	2.12±0.90b	1.39±0.07d
May	(8 weeks)	0.57±0.035c	0.68±0.06b	0.67±0.08b	0.95±0.02a
June	(12 weeks)	0.24±0.011ab	0.25±0.02ab	0.23±0.04b	0.29±0.02a
July	(16 weeks)	0.59±0.018c	0.50±0.01c	0.95±0.077a	0.66±0.07b
August	(20 weeks)	0.49±0.053c	0.71±0.09a	0.57±0.051b	0.47±0.088c
September	(24 weeks)	0.50±0.014b	0.42±0.03d	0.56±0.033a	0.48±0.040c
Avg.	0 - 24 weeks	25.50±0.40b	19.22±0.07d	29.71±0.03a	20.65±0.09c

Data are represented as mean of three samples replicates ± standard error

Means in the same row with the same letter are not significant difference (P>0.05)

There were significant differences in SGR among all treatments except between T_1 and T_4 which did not show significant differences. Results of daily gain followed almost the same pattern as the body weight. These results are in partial agreement with results obtained by Green (2006), who

Table 4. Effect of different treatments 0n daily weight gain of Nile tilapia (*Oreochromis niloticus*) .

Exp. Period		Treatment			
Months	Weeks	T_1 AF*	T_2 PM*	T_3 SC*	T_4 SC+PM*
		Body weight (ABW) Mean ±S.E			
Initial biomass (kg/pond)		38.2±1.47a	36.28±1.33a	38.56±1.72a	37.52±0.66a
Initial (g/f)	(0 week)	9.55±0.09a	9.07±0.09a	9.64±0.09a	9.38±0.12a
April	(4 weeks)	36.40±0.06a	24.01±5.13a	30.06±7.13b	22.40±6.33c
May	(8 weeks)	57.12±0.18a	39.36±6.01bc	50.16±8.09b	43.76±7.2bc
June	(12 weeks)	70.82±0.65a	50.09±1.52c	61.83±9.11b	56.52±1.4bc
July	(16 weeks)	112.74±1.51b	75.34±1.37c	120.31±7.20a	93.66±6.7bc
August	(20 weeks)	168.93±6.42b	128.80±1.98c	189.29±2.25a	137.5±6.3bc
September	(24 weeks)	253.07±5.32b	183.44±5.58d	296.12±4.89a	203.1±1.85c
		Body weight gain (BWG)			
April	(4 weeks)	26.85±0.82a	14.94±0.64bc	20.42±4.53b	13.02±0.08c
May	(8 weeks)	20.72±7.69a	16.35±5.58b	20.10±9.22a	21.36±0.23a
June	(12 weeks)	13.70±13.42a	9.73±1.88c	11.67±1.19b	12.76±4.02a
July	(16 weeks)	41.92±6.61b	25.25±5.44d	58.48±2.08a	37.14±6.08c
August	(20 weeks)	56.19±8.66b	53.46±6.61c	68.98±4.55a	43.84±28.3d
September	(24 weeks)	84.14±6.42b	54.64±7.11d	106.83±8.09a	65.60±61.2c
	0-24 weeks	243.52±34.2b	174.37±12d	286.48±18.61a	193.72±12.5c
Total weight gain (kg/pond)		974.08±254.1	697.48±94.31	1145.92±87.32	774.88±35.40
Total feed consumed (kg/pond)		1843.65±61.9	871.85±34.21	831.74±67.22	844.75±34.6
Feed conversion ratio (FCR)		1.89±6.35	1.25±1.02	0.72±0.08	1.09±1.06

Data are represented as mean of three samples replicates ± standard error

Means in the same row with the same letter are not significant difference (P>0.05) reported that the addition of feed to ponds of common was necessary to maintain fast growth in addition to organic fertilization. In this respect, Chang (1998) reported that fertilization was commonly used to enrich pond water in order to increase natural food production and to provide additional organic matter as fish food. The same author reported also that fish growth rate was found to be directly related to the amount of enrichment when ponds were low in nutrients.

Table 5. Effect of different treatments on body length (cm) and condition factor (K) of Nile tilapia (*Oreochromis*

Exp. Period		Treatment			
Months	**Weeks**	T_1 AF*	T_2 PM*	T_3 SC*	T_4 SC+PM*
		Body length (L) Mean ±S.E			
Initial	(0 week)	4.61±1.02a	4.57±2.02a	4.55±3.01a	4.60±2.41a
April	(4 weeks)	10.31±3.42a	9.35±3.45a	8.97±5.01b	8.80±3.02b
May	(8 weeks)	14.28±2.02a	11.02±1.55b	13.70±0.55a	12.56±6.2ab
June	(12 weeks)	15.12±7.31a	12.08±2.84b	16.93±9.07a	13.71±3.2ab
July	(16 weeks)	21.39±6.04a	17.66±3.22b	23.67±4.41a	18.48±5.2ab
August	(20 weeks)	24.59±9.11ab	21.39±6.08c	26.45±3.33a	23.77±4.01b
September	(24 weeks)	28.12±4.22ab	25.05±3.11c	30.78±1.22a	26.89±1.09b
		Condition factor (K)			
April	(4 weeks)	0.88±0.05b	1.12±0.24ab	1.34±0.35a	1.38±0.32a
May	(8 weeks)	1.25±0.03ab	1.80±0.36a	1.17±0.13b	1.13±0.14b
June	(12 weeks)	1.65±0.09c	2.23±0.17a	1.03±0.04d	1.79±0.17b
July	(16 weeks)	0.72±0.04c	0.91±0.05a	0.47±0.03d	0.90±0.01a
August	(20 weeks)	0.76±0.04a	0.77±0.01a	0.65±0.07c	0.70±0.09b
September	(24 weeks)	0.75±0.08 ab	0.82±0.01a	0.64±0.012c	0.71±0.03b

Data are represented as mean of three samples replicates ± standard error

Table 6. Effect of different treatments on specific growth rate (SGR) of Nile tilapia (*Oreochromis niloticus*) .

Exp. Period		Treatment			
		T_1	T_2	T_3	T_4
Months	Weeks	**Specific growth rate (SGR)** Mean ±S.E			
April	(4 weeks)	4.75±15.62a	3.51±10.25b	4.04±12.88a	3.10±3.01b
May	(8 weeks)	1.63±17.02b	1.75±22.7b	1.86±14.60b	2.40±5.77a
June	(12 weeks)	0.77±3.02b	0.86±36.01a	0.71±7.05b	0.89±1.46a
July	(16 weeks)	1.68±4.82b	1.46±23.04c	2.39±16.02a	1.78±3.21b
August	(20 weeks)	1.43±19.22ab	1.92±0.49a	1.61±0.06ab	1.39±8.41b
September	(24 weeks)	1.46±14.03b	1.25±0.54c	1.62±12.10a	1.40±0.09b

Data are represented as mean of three samples replicates ± standard error

Heavy metals concentration in water and fish

In a part of the study, some heavy metals (Iron, Zinc, Copper, Manganese, Cadmium, and Lead) were detected in both water and some tissues of fish body. Table 7 illustrates these data which showed that the average concentrations of the studied heavy metals in pond water were always lower than the permissible limits in all treatments. Among treatments, all studied heavy metals were lower in T_3 pond water with the exception on lead which showed its lowest level in T_1. Lowest levels of iron were obtained in T_3 followed by T_4 then T_1 while the highest level was obtained in T_2. Same trend was found with both copper manganese and cadmium. Heavy metals levels in different organs of fish body are illustrated in Table 8. Data showed that all studied heavy metals, except manganese and cadmium, were accumulated in liver more than in gills while the lowest levels of metals were detected in the muscles. Manganese and cadmium levels were, however, higher in gills than muscles and liver. The lowest accumulation rate off all studied metals in muscles, gills and liver were detected in fish organs from T_3 followed by T_4 and T_1 while T_2 ranked in the last in regard to the accumulation rate of meals. Liver is the site of high bioaccumulation especially for Fe, Zn and Cu, while muscle tissues had the lowest concentration. The high Fe concentrations in the liver tissue may be due to iron-containing enzymes and the extensive vascular system of the liver, as the hemoglobin in the blood binds approximately three quarters of the Fe in the body, This may be attributed to the complex formation between both metal ions and the protein structure in gills which contain nitrogen, oxygen and sulfur as previously reported by Cotton and Wilkinson (1980). The reason for the high accumulation of Zn and Cu in the liver could be related to the specific metabolism process and enzyme catalyzed reaction involving Zn and Cu taking place in the liver, the high metal concentrations in liver reflect its multifunctional role in detoxification and storage. These findings reflect the effect of the treatment with *Scenedesmus dimorphus* in reducing the accumulation rate of heavy metals in the organs of fish, Tartiel (2005). However, all metals concentrations on average below the maximum tolerance levels for human consumption established by the FAO/WHO, (1999). In regard to the accumulation rate in fish tissues of all treatments, studied heavy metals could be arranged on a descending manner as follows: Fe > Cu > Zn > Mn > Pb ≥ Cd.

Table 7. Average concentrations of heavy metals (µg/l) in water samples.

Metals	**Treatments**				**PL*** (µg/l)
	T_1 (AF*)	T_2 (PM*)	T_3 (SC*)	T_4 (SC+PM*)	
Iron (Fe)	99.70±0.93	142.01±0.45	57.03±0.52	81.06±0.3	300.0
Zinc (Zn)	7.01±1.8	13.82±2.04	5.34±0.22	9.23±1.65	120.0
Copper (Cu)	5.22±12.3	6.38±1.55	2.75±0.85	3.12±1.33	13.0
Manganese (Mn)	31.40±0.35	38.67±0.74	25.09±3.25	26.0±14.2	170.0
Cadmium (Cd)	1.04±10.2	2.03±4.03	1.00±0.09	1.02±0.02	4.30
Lead (Pb)	0.85±0.01	3.08±0.06	1.04±0.07	1.57±0.07	2.50

*PL: permissible limits (µg/l) according to **US EPA, 1999**.

Table 8. Average concentrations of heavy metals (µg/g dry wt.) in tissue/organs of Nile tilapia (*Oreochromis niloticus*) after experimental period.

Metals		Treatments			
		T_1 AF*	**T_2 PM***	**T_3 SC***	**T_4 SC+PM***
Fe	**Muscle**	72.20±0.05	93.30±0.12	34.02±0.84	77.94±0.16
	Gills	187.80±14.3	486.17±36.2	153.40±54.12	174.30±51.0
	Liver	428.05±96.5	625.30±77.4	237.61±92.3	341.00±87.1
Zn	**Muscle**	30.95±2.14	42.81±65.8	26.12±3.21	34.70±4.51
	Gills	75.90±16.3	134.02±22.6	35.77±15.6	45.08±12.70
	Liver	121.00±45.2	157.11±17.3	41.22±35.4	66.50±18.90
Cu	**Muscle**	6.43±0.09	8.40±0.12	2.54±0.18	2.90±0.012
	Gills	7.14±0.08	10.76±3.20	3.92±5.41	4.67±2.55
	Liver	381.06±33.6	562.70±76.4	151.13±55.6	227.00±67.5
Mn	**Muscle**	3.04±0.04	3.96±0.23	1.04±0.74	1.69±0.22
	Gills	70.40±12.71	82.73±13.45	20.30±5.62	29.80±7.31
	Liver	28.22±12.6	44.38±7.61	7.51±16.3	8.59±5.83
Cd	**Muscle**	0.051±0.007	0.054±0.002	0.023±0.008	0.031±0.004
	Gills	0.210±0.006	0.395±0.001	0.56±0.002	0.62±0.007
	Liver	0.205±0.001	0.297±0.006	0.037±0.009	0.052±0.005
Pb	**Muscle**	0.312±0.02	0.503±0.06	0.020±0.005	0.087±0.08
	Gills	0.163±0.09	0.426±0.04	0.026±0.005	0.049±0.08
	Liver	0.126±0.03	0.213±0.04	0.060±0.002	0.096±0.06

Bacteriological examination

Data of the bacterial count in the water of the four different treatments are shown in Table 9.

Table 9. Average of bacteriological examination of water samples.

Type of bacteria	Treatments								
	T_1 AF*		T_2 PM*		T_3 SC*		T_4 SC+PM*		
	No.	%	No.	%	No.	%	No.	%	Tot.
Aeromonas	2	3.2	6	9.7	4	6.5	6	9.7	18
Pseudomonas	2	3.2	4	6.5	0	0	1	1.6	7
Salmonella	0	0	4	6.5	0	0	1	1.6	5
Staphylococcus	1	1.6	6	9.7	2	3.2	2	3.2	11
Shigella sp.	2	3.2	4	6.5	2	3.2	2	3.2	10
Campylobacter	1	1.6	6	9.7	2	3.2	2	3.2	11
Total	8	--	30	--	10	--	14	--	62
Percentage (%)	12.9	--	48.4	--	16.13	--	22.6	--	100

It is clear that T_1 showed the lowest water bacterial content (8) while the highest content (30) was found with T_2 where poultry manure was used as pond fertilizer. Water of T_3 and T_4 ponds showed moderate bacterial content (10 and 14, respectively).

Table 10. Average of bacteriological examination in different organs of Nile tilapia (*Oreochromis niloticus*) .

Type of bacteria		Treatments								
		T_1 AF*		T_2 PM*		T_3 SC*		T_4 SC+PM*		
		No.	%	No.	%	No.	%	No.	%	Tot.
Aeromonas	Muscle	0	0	1	1.3	0	0	0	0	11
	Gills	1	1.3	2	2.6	1	1.3	2	2.6	
	Liver	1	1.3	2	2.6	0	0	1	1.3	
Pseudomonas	Muscle	1	1.3	4	5.2	0	0	0	0	20
	Gills	2	2.6	3	3.9	0	0	2	2.6	
	Liver	1	1.3	5	6.5	1	1.3	1	1.3	
Salmonella	Muscle	0	0	2	2.6	0	0	0	0	11
	Gills	1	1.3	4	5.2	1	1.3	1	1.3	
	Liver	0	0	2	2.6	0	0	0	0	
Staphylococcus	Muscle	0	0	0	0	1	1.3	1	1.3	10
	Gills	0	0	2	2.6	2	2.6	1	1.3	
	Liver	0	0	2	2.6	0	0	1	1.3	
Shigella sp.	Muscle	0	0	1	1.3	0	0	1	1.3	13
	Gills	0	0	2	2.6	1	1.3	2	2.6	
	Liver	1	1.3	3	3.9	1	1.3	1	1.3	
Campylobacter	Muscle	0	0	1	1.3	0	0	1	1.3	12
	Gills	0	0	3	3.9	2	2.6	2	2.6	
	Liver	1	1.3	1	1.3	0	0	1	1.3	
Total	--	9	--	40	--	10	--	18	--	77
Percentage (%)	--	11.7	--	52.0	--	13.0	--	23.4	--	100

Data in Table 10 show the bacterial count of different species of bacteria in different fish tissues of fish from ponds of the four treatments. Data showed that the total bacterial count of different species of bacteria was, however, higher in the gills and liver tissues than in muscles. Among treatments, and as what was found in water, T_1 and T_3 fish tissues had the lowest total bacterial content (9 and 10 respectively) while the highest (40) were found in T_2 moderate bacterial count (18) was found in tissues of T_4. The obtained results could be of great public health significance for human consuming such fish, because presence of members of the enter-bacteria group (*Salmonella sp.* and *Shigella sp.*) in muscles of tilapia fish fed on poultry manure. Also, presence of *Salmonella sp.*, *Shigella sp. and Campylobacter sp.* in muscles of fish fed on poultry manure of public health significance and may inducing food poisoning (Heinitz *et al.,* 2003 and Maria *et al.,* 2006). Also, the presence of such bacteria in muscles, kidney and intestine of examined fish not agree with the data reported by Hayes, (2007), that the flesh of newly caught fish generally accepted to be sterile but bacteria were found in variable numbers in three sites on the fish including gills and intestine. So the fish produced in ponds fertilized by domestic animal, could conceivably be marketed for human consumption if it could be demonstrated that there are no pathogenic organisms associated with the production, as a means of assuring a sanitary product and also to reduce the aesthetic stigma surrounding such product.

Body chemical composition and biochemical analysis

Table 11 is showing the data of fish body chemical composition; moisture, crude protein, total lipids and ash content.

Table 11. Proximate chemical analysis (% on dry matter basis) of whole body of Nile tilapia (*Oreochromis niloticus*) as affected by different treatments.

Items (%)	Treatments			
	T_1 AF*	T_2 PM*	T_3 SC*	T_4 SC+PM*
Moisture	75.84±0.45a	75.50±0.56a	76.40±0.61a	75.53±0.82a
Crude protein	63.51±0.65ab	55.82±0.22c	65.17±0.22a	62.70±0.34b
Total lipids	17.77±0.23ab	23.84±0.47a	12.90±0.10b	17.50±0.36ab
Ash	18.72±0.44b	20.34±0.12ab	21.93±0.11a	19.80±0.14ab

No significant variations were noticed among treatments in regard to body moisture content which ranged between 75.5 and 75.84%. Crude protein content was higher in fish body of T_1 and T_3 than that of T_2 and T_4. T_3 showed the lowest lipids content in fish body while T_2 showed the highest one. No significant differences were found in ash content of T_2, T_3 and T_4. It is obvious that T_3, where *Scenedesmus dimorphus* were used, showed the highest protein content and the lowest lipids content in fish body. Table 12 is showing the data of some blood constituent (Creatinine, Cholesterol, Glucose, Uric acid and total protein) in plasma of Nile tilapia (*Oreochromis niloticus*) as affected by different treatments of feeding and fertilization. Slight variations were noticed among treatment in regard to the content of different blood parameters.

Table 12. Some blood constituent (in plasma) of Nile tilapia (*Oreochromis niloticus*) as affected by different treatments

Items	Treatments			
	T_1 AF*	T_2 PM*	T_3 SC*	T_4 SC+PM*
Creatinine (mg/100 ml)	2.21±0.74c	2.95±0.21a	1.80±0.06d	2.40±0.09b
Cholesterol (mg/100ml)	114.0±0.29b	127.0±0.47a	99.0±0.77d	110.0±0.52c
Glucose (mg/100ml)	103±0.45b	129.02±0.33a	84.73±0.65c	96.23±0.97bc
Uric acid (mg/100ml)	1.99±0.11c	2.37±0.55a	1.94±0.93d	2.06±0.28b
**ALT	19.00±0.23c	17.67±0.62d	22.30±0.37a	19.74±0.39b
**AST	56.62±0.94b	45.33±0.29d	62.55±0.32a	57.01±0.22b
Total protein (g/L)	24.95±0.64ab	21.50±0.38c	26.71±0.12a	24.25±0.44b
**FSH (g/ml)	0.18±0.37c	0.15±0.01d	0.24±0.10a	0.20±0.02b

**ALT alanine aminotransferase enzyme **AST aspartate aminotransferase enzyme
**F.S.H. Follicle stimulating hormone.

However, treatment 3, where *Scenedesmus dimorphus* were used, showed the lowest content of creatinine, cholesterol, glucose and uric acid and the highest content of alanine aminotransferase and aspartate aminotransferase (ALT and AST), total protein and FSH. Treatment 2 (fertilizing with poultry manure) showed reverse trend compared with T_3, highest content of creatinine, cholesterol, glucose and uric acid and lowest content of aminotranferases (ALT and AST), total protein and FSH. Blood parameters content in fish of both T_1 and T_4 had moderate vacillating values and fall between the values of T_2 and T_3. Hematological tests and analyses of serum constituents have proved useful in the detection and diagnosis of metabolic disturbances, such tests should be supplemented with clinical and biochemical analysis for diagnostic purposes. Also, determination of AST and ALT have proved useful in the diagnosis of liver and kidney diseases in fish, Creatinine and uric aci are considered as good indicators of glomular filtration rate and kidney dysfunction (Racicot *et al.*, 2000 and Maita *et al.,* 2004). Results of FSH are in agreement with those obtained by Mecdowell *et al.,* (1990) who found that egg production and fertility were higher due to algae diet than fish meal diet. It could be concluded that the use of poultry manure affected water parameters regarding the pH, dissolved oxygen and unionized ammonia; there levels were significantly higher in T_2 compared with T_1 and T_3. The highest bacterial content was observed in T_2, while the lowest value was obtained in fish of T_3. The higher values of heavy metals (Fe, Zn, Cu, Mn and Cd) were accumulated in fish of T_2, while the lowest value was observed in T_3. There were significant differences in AWG, ADG and SGR among treatments; the third treatment recorded the highest values for the above parameters, while the lowest level of these values was observed with second treatment. Body dry matter (percentage) was not significantly affected by the experimental treatments, while CP%, EE% and ash% significantly differed among treatments. Tilapia fingerlings in T_3 produced lower value of creatinine, cholesterol, glucose and uric acid while gave higher value of total protein, follicle-stimulating hormone (FSH) and gave best value of AST, ALT in plasma. Results also demonstrate the efficiency of microalgae in reducing the negative impact of some heavy metals in water, where it gave better water and fish quality. The findings of this study showed different trends in water quality parameters in the ponds of the four treatments. But the treatment of *Scenedesmus dimorphus* showed the best water quality conditions compared with the other three treatments. These findings agree with those of Tartiel (2005) who reported that microalgae associated with the utilization as a source of antioxidant vitamins group when accumulated in fish tissues and as biocontrol of environmental for biological treatment when many heavy metals absorbed on the cell wall of microalgae and uptake all nitrogen forms, inorganic nitrogen presented at four different forms (nitrate, nitrite, ammonium, ammonia) as well as concentrations of heavy metals (iron, copper, zinc and lead) decreases in water and thus removal the environmental pollution. Moreover, microalgae were the best for treatment, where it gave better water quality and fish safety adverse health human effects. The use of *Scenedesmus dimorphus* showed better growth performance parameters (BGW, DWG, RWG) and the feed conversion ratio (FCR) compared with the other treatments. This is in agree with Zeinhom (2004) who found that fish fed diet containing 15% algae increased significant by the digestibility coefficient of dry matter (92.5%), crude protein (87.63%), ether extract (88.45%) and energy (81.41%). The diet of the fish has a great influence on their general chemical composition and particularly on their fatty acid composition.

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السيطرة على مخاطر استخدام زرق الـدواجـن فى جودة المياة والأسماك فى المزارع السمكية.

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أجريت هذه الدراسة لتقييم لمدى خطورة أستخدام زرق الدواجن فى احواض المزارع السمكية على جودة المياة والاسماك وخطورة ذلك على صحة الانسان ومعالجة ذلك بيولوجيا باستخدام الطحلب الاخضر سندزمس بعد تنميته خارج المعمل بصورة مكثفة. تم استخدام ثمانية أحواض ترابية قسمت الى أربع مجموعات متساوية مساحة الحوض واحد فدان، وعمق المياة 110سم ، وأستخدمت أصبعيات البلطى النيلى بمتوسط وزن 9.5 ±0.05 جم/سمكة بمعدل4000 سمكة لكل حوض فى مكررين لكل معاملة واستمرت التجربة لمدة ستة أشهر. أشتملت الدراسة على اربعة معاملات مختلفة وهى كالاتى: المعاملة الاولى (T_1) التغذية على عليقة صناعية والمعاملة الثانية (T_2) التسميد بزرق الدواجن بمعدل 100كجم/ فدان/ أسبوع والمعاملة الثالثة (T_3) حيث تم استخدام طحلب السيندزمس بكثافة 9×10^6 خلية /مللتر (12 طن طحالب حية/فدان) فى بداية الموسم والمعاملة الرابعة (T_4) حيث تم استخدام طحلب السندزمس بعد مرورشهرمن التسميد بزرق الدواجن بمعدل 100كجم/ فدان/اسبوع ثم تناقصت كمية السماد فى الشهر الثانى بمعدل 50 كجم/فدان /اسبوع الى نهاية التجربة، مع مراعاة انه قد تم التغذية الصناعية للاسماك فى المعاملات الثانية والثالثة والرابعة لمدة 12 أسبوع قبل نهاية التجربة، وقد اسفرت نتائج هذه الدراسة عن :-

1- أظهرت النتائج أن أستخدام زرق الدواجن أدى الى زيادة معدلات الامونيا الغير متأينة (السامة) وكذلك انخفاض معدل الاكسجين الذائب مما ادى الى زيادة معدل نفوق الاسماك وظهور علامات الاختناق عليها، وظهور انواع من البكتريا المسببة لبعض امراض الاسماك والضارة للانسان.

2- أوضحت النتائج بعد اجراء الفحص البكتيرى على الاسماك فروق معنوية حيث سجلت المعاملة الاولى أدنى القيم بينما ظهرت فى أسماك المعاملة الثانية أنواع من البكتريا المسببة لبعض أمراض الاسماك لم تظهر فى المعاملات الاخرى وكذلك تم عزل بعض البكتريا المعوية الضارة للانسان وسجلت هذه المعاملة أعلى القيم.

3- أظهرت الدراسة ان تركيزالعناصر الثقيلة (الحديد- الزنك- النحاس- المنجنيز) فى اسماك المعاملة الثانية كان اعلى عن مثيلاتها فى باقى المعاملات، بينما اسماك المعاملة الثالثة (استخدام طحلب السندزمس) سجلت ادنى القيم.

4- تأثرت معنويا قيم كل من الزيادة فى الوزن (AWG) ومعدل النمو اليومى (ADG) ومعدل النمو النوعى(SGR) حيث سجلت المعاملة الثالثة أعلى قيم لهذه المقاييس.

5- لم يتأثر معنويا محتوى الاسماك من المادة الجافة باختلاف المعاملات بينما تأثر محتوى الجسم من البروتين والمستخلص الاثيرى والرماد باختلاف المعاملات وكان هناك فروق معنوية.

6- أظهرت النتائج أن أسماك المعاملة الثالثة أعطت أقل قيم للكرياتين، والكوليسترول والجلوكوز وحمض اليوريك فى بلازما الاسماك بينما أظهرت نتائج تلك المعاملة أعلى قيم لانزيمات الترانسى أمين AST ,ALT والبروتين الكلى وكذلك الهرمون المشجع لنمو الحويصلات FSH فى بلازما الدم.

لذلك نستخلص من هذه الدراسة ان استخدام زرق الدواجن فى المزارع السمكية يمثل خطورة ومشكلة كبيرة لما تحدثه من تأثيرات ضارة على المياة والاسماك وايضا لما يمثله تناول تلك الاسماك من خطورة على صحة الانسان، وان المعالجة البيولوجية باستخدام طحلب السندزمس أدت الى التوازن البيئى فى الوسط المحيط بالأسماك والى تحسين جودة ونوعية المياة وصحة وسلامة الأسماك للأستهلاك الآدمى.