The potential effect of biofloc system and pro-pac on water quality and growth performance of nile tilapia (*oreochromis niloticus*)

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ABSTRACT

This study was conducted over a period of 90 days to examine the impact of varying concentrations of Biofloc (with C/N ratios of 10/1 and 15/1) and Pro-Pac (at concentrations of 250 and 500 mg/l) on the water quality, feed utilization and productive parameters of Nile tilapia (*Oreochromis niloticus*) fingerlings. The fingerlings in this study were rearing in 27 plastic tanks in nine treatments (triplicate per each) , each containing 100 liters of water. Sub-zero water exchange with addition of molasses excluding control tanks. The fingerlings were nourished a commertial diet containing 25% crude protein at a rate of 2% of their live weight daily. The outcomes of this study indicated that, the water quality parameters were improved significantly compared to the control. Moreover, the using of Biofloc and Pro-Pac at varying concentrations significantly improved the final body weight and specific growth rate (SGR) for different groups compared with control. Additionally, the feed conversion rate, along with the efficiency of protein utilization, was found to be greater in the fish tanks administered with Biofloc and Pro-pac, as compared to the control. The addition of Biofloc and Pro-Pac caused an increase in the crude protein percentage in the fish body, and the etheric extract percentage also increased and ash was reduced. The beneficial Accordingly, it could be concluded that the growth performance was increased by increasing the Biofloc and/ or Pro-pac concentration.

Keywords: Nile tilapia; Biofloc system and Pro-pac; water quality; feed utilization; productive parameters.

INTRODUCTION

Global aquaculture industry has experienced substantial growth in the past few years and has become a financially significant sector (Subasinghe *et al*., 2009). Currently, it's the swiftest expanding industry for producing aquatic food worldwide, with great capability to fulfil the escalating requirement for aquatic products. In 2014, the FAO has estimates that world aquaculture production of food fish increased by 5.8% from 66.6 to 70.5 million metric tons (FAO, 2016), and Egypt produced approximately 2,010,579 metric tons (GAFRD, 2020). In 2016, Egypt ranked first among African nations in terms of fish production, producing 259,006 tons, which represents one-tenth of the continent's overall production and is the tenth highest in the world (FAO 2016).

The prohibition of Antibiotic Growth Promoters (AGP) has led to the adoption of novel approaches to feeding and managing fish health in aquaculture applications, which has drawn a lot of attention from researchers and practitioners alike (Balcázar *et al*., 2006). Furthermore, the rising worldwide need for secure and healthy food has sparked an interest in discovering eco-friendly replacements to AGPs that can be incorporated into fish diets. Consequently, considerable research efforts have focused on developing novel strategies for feed additives and functional nutritional enrichment, such as pre-probiotics, aquamimicry, acidifiers, and other complements, which have demonstrated potential for stimulating growth and enhancing health (Denev, 2008). In recent times, there has been a surge in the study of functional nutrients in aquatic diets. This can be attributed to the growing demand for eco-consumer-friendly aquaculture, as observed by Denev (2008). A multitude of published studies have provided evidence of the advantageous effects of pre-probiotics on the various fish species, such as *Oncorhynchus mykiss* (rainbow trout), as demonstrated in research by Dugenci *et al*. (2003), Aubin *et al*. (2005), Brunt and Austin (2005), Panigrahi *et al*. (2005), Staykov *et al*. (2006), and Bagheri *et al*. (2008). The previous studies have shown that a diet supplemented with probiotics has a superior favorable impact on the viability, growth, and feed conversion of young-old *Channa striata* fish in contrast to prebiotic supplementation.

A current priority of the Egyptian government is the implementation of state-sponsored projects that bridge scientific investigations with practical field utilization to promote the advancement of fish farming.

Additionally, there is a focus on the drafting of novel statutes and regulations aimed at facilitating investment in the sector, as indicated by Hassan et al. (2014). The aim of this investigation was to examine how various levels of Biofloc and/ or Pro-pac, and their interplay, affect the physicochemical properties of water, as well as the growth and feed efficiency of Nile tilapia (*Oreochromis niloticus*) fingerlings.

MATERIAL AND METHODS

The current experiment was conducted in the summer of 2021 (90 days) at the aquaculture experimental station, Department of Fish Production, Faculty of Agriculture, Al-Azhar University, Cairo, Egypt. The experimental system was made up of (27), plastic PVC tanks, each of which held 100 litres of water. The tanks were aerated before using for about 24 hours to remove chlorine. Different concentrations of Biofloc (Biofloc C/N ratio 10/1 and 15/1) and Pro-pac (Pro-pac 250 and 500 mg/l) were added in tanks with molasses except for control water. Water quality parameters were assessed both during and at the end of this experiment.

Experimental Fish:

A group of (270) fingerlings of Nile tilapia at average of initial weight and length of (about 16 gm & 9.8 cm) were chosen in this experiment. the fingerlings were kept in plastic experimental tanks for one month prior to the start of the experiment for acclimatization and fed commercial sinking diet at a rate of 3% of biomass daily (during acclimatation period). The fish were subsequently distributed at a rate of 10 fish were stocking per tank (100 fish/m3); the experimental treatments were examined in three replicates for each.

Experimental Diets and Treatments:

Nine isonitrogenous and isocaloric diets were formulated to provide 25% protein and 4050 kcal/kg diet. The chemical analysis of basal diet is presented in Table (1). Two concentrations for both Biofloc (Biofloc C/N ratio 10/1 and 15/1), and Pro-pac (Pro-pac 250 and 500 mg/l) were tested Long *et al*., (2015) and Elkady *et al.*, (2016) as follow:

T1: control

T2: PRO-PAC 250 mg/l

T3: PRO-PAC 500 mg/l

T4: Biofloc C/N ratio 10/1

T5: Biofloc C/N ratio 15/1

T6: PRO-PAC 250 mg/l and Biofloc C/N ratio 10/1

T7: PRO-PAC 250 mg/l and Biofloc C/N ratio 15/1

T8: PRO-PAC 500 mg/l and Biofloc C/N ratio 10/1

T9: PRO-PAC 500 mg/l and Biofloc C/N ratio 15/1.

(1) nitrogen free extract (NFE) calculated as : 100 - % (Protein + Lipid + Ash + Crude fiber).

(2) gross energy(GE) calculated using the values 4.1 , 5.6 and 9.44 Kcal GE/g DM of carbohydrate , protein and fat , respectively (NRC, 2012). (3) Digestibility energy(DE) calculated as : 75 × Gross energy(GE) / 100.

Experimental Design:

In this experiment, the fingerlings were fed twice at a daily rate 2% of body weight on the same diet as a described in Table (1). The amount of food consumed was changed on a weekly basis based on the actual body weight gained. Weekly water samples were taken from each tank to measure the water quality parameters. The Biofloc tanks started with a sedimentation of bacteria estimated at 4 ml / liter.

Adding Molasses for Biofloc:

The adding of molasses depends on the amount of feed added daily and the percentage of protein in the diet as follows: (A) in the case of feeding rate 2% of body weight; (B) the output is 20 grams of ration to be served per kg weight of fish in ponds;(C) in the event that the percentage of protein in the diet is 25%;(D) the result is 5 grams of protein to be served per kg weight of fish in ponds;(E) it is known that 16% of protein is nitrogen;(F) the yield is 0.8 grams of nitrogen served per kilogram of fish weight in ponds;(G) it is known that 25% of the total nitrogen is retained by the body and the rest is excreted in the aquatic environment; (H) the output is 0.6 grams of nitrogen released into the aquatic environment per kg weight of fish in ponds; (I) it is known that the heterotrophic bacteria need to activate a carbon / nitrogen ratio of 10/1 in aquatic environment, so we multiply by 10; (K) the result is the addition of 6 grams of carbon / kilo gram of fish weight in the ponds; (l) and molasses has 50% carbon and to add 6 grams of carbon, we multiply by 2 add 12 grams of molasses;(m) and the ratio of carbon/ nitrogen is 15/1 in the surrounding aquatic environment, so we multiply by 15;(N) the result is the addition of 9 grams of carbon / kilogram of fish weight in the ponds;(O) and molasses has 50% carbon and to add 9 grams of carbon, we multiply by 2 add 18 grams of molasses.

Calculation and preparing of Pro-pac and Molasses:

Calculation and preparing of Pro-pac and molasses were done as follows: (a) Concentration of 250 mg Pro-pac / litre; 25gm Pro-Pac + 50gm molasses; (b) Concentration of 500 mg Pro-pac / liter; 50 gm Pro-Pac + 50gm molasses. Molasses was added according to of the amount of feeding ration introduced to fish to maintain the optimal C/N ratio, (>10- 25: 1) to activate heterotrophic bacteria growth (Avnimelech, 1999). molasses had been completely dissolved in water at plastic tank and spread over the pond surfaces at morning (10 a.m.). Adding molasses as a carbohydrate source, shading ponds, and strong aeration condition are the main circumstances that cause Floc growth and development (Azim and little, 2008).

Analytical Methods of Water Quality and Fish Growth:

Samples of water from each tank were taken to determine the physic chemical characteristics of water. Determination of water parameters were measured as follows: water temperature(T), Conductivity and TDS in degree centigrade was recorded every day using Instrument, WTW, Model, cond. 720 , U.S.A. pH values of water was measured daily using Instrument, WTW, Model, pH 7110, U.S.A. Dissolved Oxygen(Do) was determined using an oxygen meter Dissolved Oxygen Meter EXTECH Instruments. NH4, NO2 and NO3 values of water was measured daily using Instrument, Ionic Chromatography, Dionex, Model, Ultimate 3000, U.S.A.

Fish samples were taken from each group and dried on 60 Cº for 48 hours before being ground in an electrical mill and stored at 4 Cº for chemical analysis.

Analysis of Experimental Diets and Fish Body:

Determination of Dry matter (DM), Crude protein (CP), Ether extract (EE), Crude fiber (CF) and ash in the basal diet and in fish body in the different groups were carried out according to the methods of A.O. A.C. (1990). The fish growth performance and feed utilization parameters were calculated according to the following equations: total weight gain (TWG):TWG (g) = final weight (FW) (g) - initial weight (IW) (g);average daily gain (ADG):ADG (g) = TWG (g) / Time (days);survival rate (SR %):SR % = Total number of fish at the end of the experimental × 100 / total number of fish at the start of the experiment; specific growth rate (SGR, % / day):SGR = 100 × [In wt1- In wt0/T] whereas: In: Natural log,Wt1: Final weight (g),Wt0: Initial weight (g),T: Time in days; feed conversion ratio (FCR):FCR = Total feed consumption (g) / Weight gain (g);protein efficiency ratio (PER):PER = Body weight gain (g) / protein intake (g); Relative growth rate (RGR):RGR= Average weight gain (g) / Average initial weight (g).

Statistical Analysis:

SPSS 20.0 INC., Chicago, IL, Statistics were computed using USA (SPSS, 2011). A one-way analysis of variance (ANOVA) was performed on all data, and Duncan's post hoc multiple tests was then performed at a 5% level of probability (Duncan, 1955).

RESULTS AND DISSCUSION

Water Quality Indicators:

The essential chemical and physical characteristics of the water that used for fish raising in the trial are depicted in Figures (1-2). Generally, all tested water quality criteria were suitable and within the acceptable limits for rearing Nile tilapia (*O. niloticus*).

The water temperature in all experimental groups was kept within the range of 29-29.5°C, which is considered desired for Nile tilapia rearing as recommended by Ibrahim *et al*. (2008). The experiment revealed notable variations in pH and NH_3 levels across the different treatments. Specifically, trial groups from T2 to T9, ascending sequence, were exhibited lower levels of pH and NH_3, ranging from 5.77 to 6.07, while T1 had higher level, extending to 8.07. These findings indicating a decrease in pH resulting from the activity of organic matter-degrading bacteria that emit carbon dioxide into the water volume. This observation aligns with the results of Wasielesky *et al*. (2006). Conversely, the elevation of pH levels could be attributed to stimulated photosynthesis.

The dissolved oxygen (DO.) levels were suitable during the experimental period, ensuring optimal conditions for tilapia growth. The mean DO levels were sustained at levels higher than 5 mg/L through oxygen supply, which is in accordance with the desirable DO values for tilapia growth as suggested by

Bergheim (2007). The high depletion of DO by heterotrophic microbiota in the starch group could potentially explain these findings. However, Total Dissolved Solid (TDS) ranges between 235.3 Mg/L in control (T1) compared to other treatments (T2 – T9). Conductivity values (ms/cm) ranged between 393.3 ms/cm in control (T1) compared to other treatment (T2 – T9). The results of the nitrogen content, including NH_3, NO_2, and NO_3, which were observed and analyzed to evaluate their impact on the experimental conditions. The occurrences of decreased total nitrogen ammonium (TNA) (NH_3, NH_4), nitrite (NO_2), and nitrate (NO_3) were found lower in the (T2 – T9) compared to (T1), which were relatively higher TNA (0.42 Mg/l) concentrations. Variations in TNA values among the trial groups were anticipated due to the elevated activity of organic matter-degrading bacteria in the experimental molasses group, which contributed to the reduction of TNA through nitrogen transformation.

In all the tested groups of the Biofloc approach, NO3, there was a steady reduction in N levels, which could be attributed to the limited nitrogen supply administered in the system, as suggested by Nieuwenhuize (2000). In a 56-day study conducted by Long *et al*. (2015), the potential benefits of Biofloc technology (BFT) on the growth and weight gain of fish, gastrointestinal function, blood analysis, and improved farmed tilapia (GIFT) were investigated in zero-water exchange systems. The investigated work comprised of a singular Biofloc Technology tested and a control treatment subjected to water supply. In order to achieve a carbon/nitrogen (C/N) ratio of 15, glucose was incorporated into the BFT group. Subsequently, it was found that the levels of NO_2 and NO_3 were markedly reduced in the BFT group as compared to the control, with statistical significance at $P \leq 0.05$.

Growth Performance:

In Table (2) and Figure (3), the performance parameters of Nile tilapia growth were recorded for the nine different trial groups (T1-T9) implemented in the investigation. Significant differences in the initial body weight of the fish among treatments were observed indicating the homogenizing procedure of individual.

Rearing system factor levels effected FW. (T1) were significantly lower (45.11 g) compared to the other treatments (T2 – T9) (50.04 g- 50.88 g). However, no significant differences were found between (T2, T3, T4, T5, T6, T7, T8, and T9) (50.04, 49.45, 50, 50.32, 51.22, 51.88, 51.55, and 50.88 g). There were no significant differences in SGR, FBW, ADG, TWG, and SR resulting from the interaction between the Biofloc and/ or Pro-pac systems. However, the maximum observations were noted in treatments (T6, T7, and T9) with weights of 51.22, 51.88, and 50.88 g respectively, whereas the minimum observations were showed in treatments (T1 and T3) with weights of 45.11 and 49.45 g respectively. Similarly, the differences in ADG, SGR, and SR were observed between (T1) control and the remaining trial groups (T2 – T9), while no significant differences were found among the other systems (T2 – T9). Various experiments have also demonstrated that fish growth, health, and survival rates are improved in in aquatic environments with significant levels of biological status in naturally occurring biotic communities, bacterial aggregations, and photosynthetic organisms (Burford *et al.,* 2004). Although the mechanism by which microbial communities' promote fish-growth is still unclear, Izquierdo *et al*. (2006) proposed that the fat content of microbiota may play a vital role. According to Avnimelech (1999), the microbial-origin protein provided by the fish stock was sufficient to complement the protein from the formulated fish feedstuff.

In addition to serving as a food source, bioflocs also play an important ecological action in aquaculture ecosystems. They act as aquatic conditioners, helping to mitigate retrogradation of physicochemical characteristics of the rearing water caused by leftover food, excreta, and other decaying bio-compounds in aquaculture systems. By controlling superfluous nitrogen contents, biofloc can neutralize the negative effects of these pollutants (Long *et al.,* 2015). The utilization of nitrogen by microbes to produce protein in the aquaculture system is enabled by the absorption of N-molecules from the water. Therefore, the incorporation of a containing starch feed could potentially be used in a self-contained recirculating culture technique. This is in line with the findings of Avnimelech (2007).

Several studies in the past have indicated that incorporating Biofloc and/ or Pro-pac systems in the cultivation of *O. niloticus* can lead to improved growth efficiency and reduce the mortality levels of tilapia, as opposed to utilizing traditional farming water (Without bioflock), as shown by Mishra *et al*. (2008). A trial performed by Long *et al*. (2015) for a period of 56 day`s aimed to study the impact of BFT on the weight gain, gastro-intestinal status, blood biochemistry parameters, and overall health and immunity of GIFT in a tank system without water supplying. The investigations comprised of two groups: one using BFT and the other using a recirculating method as a reference. The BFT group was supplemented with glucose to maintain a C/N ratio of 15, resulting in a 0.0% mortality rate at the end of the trial. The SGR and total fish biomass were exhibited a significant increase in the BFT group compared to the control group. In addition, the FBG of specimens and TWG were 12.54% and 9.46% greater, respectively, in the BFT group. Through the study in the Biofloc system and Pro-pac, it is clear to us the growth of bacterial cells with protein, as shown in the Table (3) and Figure (4) . Ekasari *et al*. (2015) conducted a study to evaluate the impact of the BFT approach on feed utilization and mortality rates of young-old *O. niloticus* during the production and cultivation phase. Through their study, molasses with a carbon content of 53% was incorporated per day to the BFT to maintain an estimated balance between C and N ratio of 10. The mortality percentages of the early life stages of fish from the BFT group were found to be less 2% than those of the fish from the reference group 33%. The origin or housing of the young fish had no discernible impact their growth efficiency, but the fish body weight appeared to be more consistent when the fish were kept in BFT system. In a study on the impact of BFT on larval survival and resistance, Ekasari *et al*. (2015) found that after being inoculated with the disease-causing *Streptococcus agalactiae* bacteria, fish cultured in the biofloc group exhibited significantly lower mortality (20-25%) compared to control fish stocked in regular water (approximately 45%). Additionally, when the control group was stocked in BFT, they demonstrated high resistance to bacterial pathogenicity, with survival rates approximately 70%. To evaluate resilience to hypertonic stress, a saltwater stress test was conducted, where fish from the BFT group exhibited 28% and 58% mortality rates at 1 hour and 24 hours subsequent to stress, markedly lower than the mortality rates of fish from the control group, which were 67% and 95% at the same experimental period. These results indicate that BFT may enhance the survival and resistance of fish to pathogenic bacteria and salinity stress.

Feed Intake and Feed Utilization:

Feed intake (FI) increased significantly ($P \leq 0.05$) in treatments (T6, T7, T8, and T9) and protein intake (PI) in (T6, T7, T8, and T9). Table (4) and Figure (5) showed that Feed Conversion Ratio (FCR) and Protein Efficiency Ratio (PER), and Relative Growth Rate (RGR) were improved in trial groups (T2 – T9) compared to (T1).

In this study, the findings related to FCR, PER, and RGR were consistent with the results reported by Avnimelech (2007), who suggested that the Biofloc in aquatic environment give rise nearly half of the fish necessity amino acids. The presence of a large population of protozoa and rotifers in the BFT communities had a positive effect on the growth of the crustaceans in BFT trial groups than to the reference group, according to Thompson *et al*. (2002). It is possible to raise the retrieval of nitrogenous matter from *O. niloticus* farming systems by up to 50% with water supplying accompanied by starch reinforcement. This finding is significant because it suggests a more sustainable approach to aquaculture, as it reduces the need for water exchange, which can be costly and environmentally damaging, as shown by Avnimelech (2006). Long *et al*., (2015) investigated the effects of Biofloc technology (BFT) on the growth, digestive activity, hematology, and improved the farmed tilapia (GIFT) in restricted light with zero exchange of water sources in tanks. In the investigation, a BFT and control treatments with recirculating water were applied. To establish a C/N ratio of 15, glucose was introduced to the BFT tested group. In opposite to the control treatment, the fish in the BFT exhibited a 22.2% increase in PER, and a 17.5% decrease in FCR.

Body Chemical Compositions:

The carcass composition results for Nile tilapia are presented in Table (5) and Figure (6). Dry matter and ash exhibited significant decreases in treatments T2 to T9, whereas crude protein (CP) and Ether extract increased significantly in the same treatments compared to T1. The protein concentration in Biofloc treatments could potentially be attributed to the chemical composition of heterotrophic bacteria and other organisms present in Biofloc and biofilms, as noted by Fernandes *et al*. (2008). The dry matter and ash content showed significant differences among the treatments, with the highest dry matter content being recorded in groups T3, T4, T5, T7, T8, and T9 (98.41, 98.43, 98.50, 98.42, 98.59, and 98.28, respectively) as compared to other groups. Treatment T5 had the highest amount of crude protein content (64.22), while treatments T2, T5, T7, and T8 had the highest values of ether extract or lipid content (25.60, 22.27, 22.91, and 25.83, respectively). Fish groups in treatments showed ash content ranging from 24.01 to 26.50. In their study, Zhao *et al*. (2014) investigated the impact of a feed C/N ratio-enhanced biofloc system on water quality and production performance of carp in a minimum-water exchanged pond polyculture system. The results showed that bioflocs had a significant effect on muscle composition in terms of crude protein, crude fat, and ash of the mirror carp ($P \leq 0.05$). Similarly, our study demonstrates that an increase in the feed C/N ratio can enhance production performance and feed utilization in mirror, silver, and bighead carp while also improving water quality.

CONCLUSION

From this study, it is clear that cultivator under biofloc system and pro-pack is one of the best types of modern cultivator. Therefore, I advise farmers to cultivator it, due to its importance, especially with fish that depend on algae and micro-plants for their food, such as tilapia, some types of carp, shrimp, and others.

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Table 1: Chemical Analysis of Experimental Diet (Basal Diet).

Analysis	%
Dry matter (DM %)	97.56 %
Crude protein (CP %)	25 %
Ether extract (EE %)	6.88 %
Ash	6.90 %
Crude fiber (CF %)	5.11 %
Nitrogen free extract(NFE) (1)	56.11%
Gross energy(GE) Kcal/Kg (2)	4050
Digestibility energy (DE) (3)	3037.5

Table 2: Growth Performances Parameters plastic tanks as affected by rearing systems (water additives) by some bacterial Probiotic and Biofloc condition.

Parameters Variable	IW gm	FW gm	TWG gm	ADG gm	SGR %	SR %
Control (T1)	16.09±0.01	45.11±0.71^{b}	29.02±0.72^{b}	0.32±0.008^{b}	1.14±0.01^{b}	95±2.88^{b}
Effect of Pro-Pac levels						
250 mg/l (T2)	16.04±0.07	50.04±0.10^{a}	34.00±0.03^{a}	0.37±0.00^{a}	1.26±0.003^{a}	100±0.00^{a}
500 mg/l (T3)	15.98±0.12	49.45±1.80^{a}	33.47±1.93^{a}	0.37±0.02^{a}	1.25±0.05^{a}	100±0.00^{a}
Effect of Biofloc levels						
C/N ratio 10/1 (T4)	15.84±0.005	50.00±0.79^{a}	34.16±0.79^{a}	0.37±0.008^{a}	1.27±0.01^{a}	100±0.00^{a}
C/N ratio 15/1 (T5)	15.96±0.10	50.32±0.46^{a}	34.36±0.35^{a}	0.38±0.003^{a}	1.26±0.00^{a}	100±0.00^{a}
Interaction between Pro-Pac levels and Biofloc levels						
PRO-PAC 250 mg/l and Biofloc C/N ratio 10/1 (T6)	16.10±0.05	51.22±1.02^{a}	35.12±1.07^{a}	0.39±0.01^{a}	1.28±0.02^{a}	100±0.00^{a}
PRO-PAC 250 mg/l and Biofloc C/N ratio 15/1 (T7)	15.86±0.02	51.88±0.88^{a}	36.02±0.86^{a}	0.40±0.008^{a}	1.31±0.02^{a}	100±0.00^{a}
PRO-PAC 500 mg/l and Biofloc C/N ratio 10/1 (T8)	16.25±0.03	51.55±0.62^{a}	35.30±0.65^{a}	0.39±0.008^{a}	1.28±0.01^{a}	100±0.00^{a}
PRO-PAC 500 mg/l and Biofloc C/N ratio 15/1 (T9)	16.11±0.03	50.88±0.33^{a}	34.77±0.36^{a}	0.38±0.005^{a}	1.27±0.01^{a}	100±0.00^{a}

a, b, and c, mean in the same column having different letters are significantly ($P \leq 0.05$) different.

Table 3: Effect of Biofloc System and Pro-pac on Total Protein Content in Water.

Parameters Variable	Protein in Water %
Control (T1)	-
Effect of Pro-Pac levels	
250 mg/l (T2)	39.46 %
500 mg/l (T3)	39.79 %
Effect of Biofloc levels	
C/N ratio 10/1 (T4)	22.65 %
C/N ratio 15/1 (T5)	23.68 %
Interaction between Pro-Pac levels and Biofloc levels	
PRO-PAC 250 mg/l and Biofloc C/N ratio 10/1 (T6)	44.00 %
PRO-PAC 250 mg/l and Biofloc C/N ratio 15/1 (T7)	27.49 %
PRO-PAC 500 mg/l and Biofloc C/N ratio 10/1 (T8)	34.96 %
PRO-PAC 500 mg/l and Biofloc C/N ratio 15/1 (T9)	42.35 %

Table 4: Feed intake and feed utilization parameters plastic ponds as affected by rearing system (water additions) by some pacterial Probiotic and Biofloc condition.

Parameters Variable	FI gm	PI gm	FCR %	PER %	RGR %
Control (T1)	32.41±0.32^{d}	8.10±0.08^{d}	1.11±0.01^{a}	3.58±0.05^{b}	180.36±4.66^{b}
Effect of Pro-Pac levels					
250 mg/l (T2)	32.76±0.28^{d}	8.19±0.06^{d}	0.96±0.008^{b}	4.15±0.03^{a}	211.97±0.75^{a}
500 mg/l (T3)	33.23±0.84^{cd}	8.30±0.20^{cd}	0.99±0.03^{b}	4.03±0.13^{a}	209.44±13.84^{a}
Effect of Biofloc levels					
C/N ratio 10/1 (T4)	33.18±0.78^{cd}	8.29±0.19^{cd}	0.97±0.00^{b}	4.12±0.00^{a}	215.65±5.10^{a}
C/N ratio 15/1 (T5)	33.49±0.23^{bcd}	8.37±0.05^{bcd}	0.97±0.003^{b}	4.10±0.01^{a}	215.28±0.76^{a}
Interaction between Pro-Pac levels and Biofloc levels					
PRO-PAC 250 mg/l and Biofloc C/N ratio 10/1 (T6)	34.71±0.38^{ab}	8.67±0.09^{ab}	0.98±0.01^{b}	4.05±0.08^{a}	218.13±7.43^{a}
PRO-PAC 250 mg/l and Biofloc C/N ratio 15/1 (T7)	34.49±0.25^{abc}	8.62±0.06^{abc}	0.95±0.01^{b}	4.17±0.06^{a}	227.11±5.09^{a}
PRO-PAC 500 mg/l and Biofloc C/N ratio 10/1 (T8)	35.08±0.15^{a}	8.77±0.03^{a}	0.99±0.01^{b}	4.02±0.06^{a}	217.23±4.49^{a}
PRO-PAC 500 mg/l and Biofloc C/N ratio 15/1 (T9)	34.29±0.06^{abc}	8.57±0.01^{abc}	0.98±0.008^{b}	4.05±0.03^{a}	215.82±2.75^{a}

a, b, c, and d, mean in the same column having different letters are significantly (P≤0.05) different.

Table 5: Body Chemical Composition (%) plastic ponds as affected by rearing tanks (water additives) by some Bacterial Probiotic and Biofloc systems.

Parameters Variable	Dry matter %	Crude Protein %	Ether extract %	Ash %
Initial	97.43±0.11^{d}	46.23±0.79^{d}	12.59±0.03^{d}	30.26±0.02^{a}
Control (T1)	97.93±0.23^{c}	59.12±0.62^{c}	12.75±1.19^{d}	26.04±0.52^{b}
Effect of Pro-Pac levels				
250 mg/l (T2)	98.003±0.03^{c}	63.71±0.41^{a}	25.60±3.22^{a}	25.40±1.48^{b}
500 mg/l (T3)	98.41±0.00^{ab}	62.57±0.06^{ab}	19.42±0.81^{bc}	24.39±1.12^{b}
Effect of Biofloc levels				
C/N ratio 10/1 (T4)	98.43±0.06^{ab}	63.11±0.60^{ab}	19.56±1.24^{bc}	26.50±0.28^{b}
C/N ratio 15/1 (T5)	98.50±0.09^{a}	64.22±0.87^{a}	22.27±0.57^{abc}	24.52±0.43^{b}
Interaction between Pro-Pac levels and Biofloc levels				
PRO-PAC 250 mg/l and Biofloc C/N ratio 10/1 (T6)	98.07±0.02^{bc}	61.56±0.06^{b}	19.42±0.61^{bc}	26.45±0.80^{b}
PRO-PAC 250 mg/l and Biofloc C/N ratio 15/1 (T7)	98.42±0.18^{ab}	62.82±0.52^{ab}	22.91±0.35^{ab}	25.59±0.49^{b}
PRO-PAC 500 mg/l and Biofloc C/N ratio 10/1 (T8)	98.59±0.02^{a}	63.39±0.13^{a}	25.83±2.60^{a}	24.01±0.79^{b}
PRO-PAC 500 mg/l and Biofloc C/N ratio 15/1 (T9)	98.28±0.02^{abc}	64.02±0.51^{a}	17.56±0.38^{c}	26.19±1.25^{b}

a, b, c, and d, mean in the same column having different letters are significantly (P≤0.05) different.

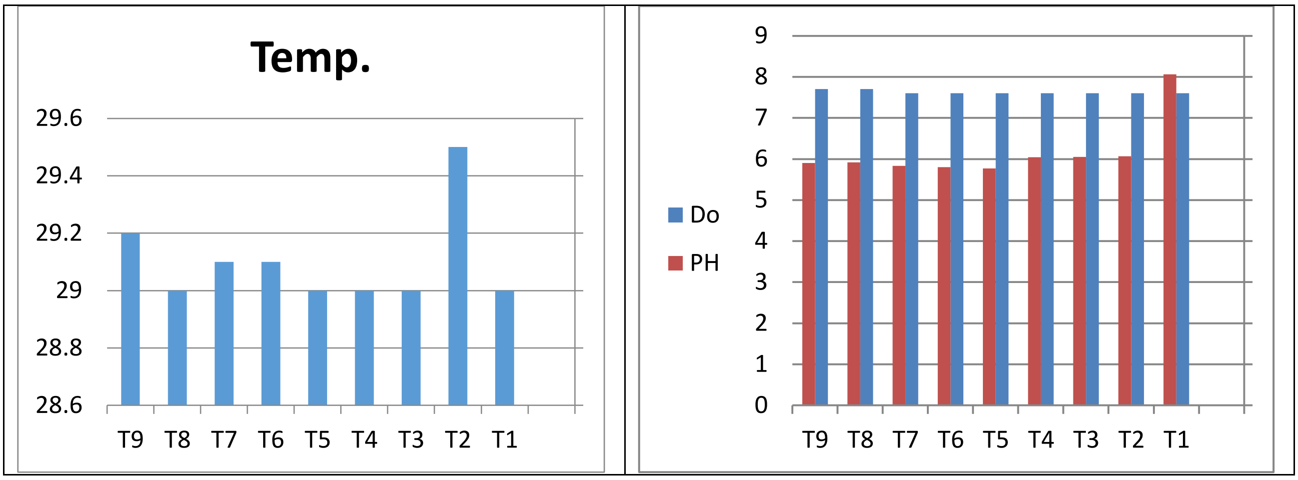

Figure 1: Temperature, pH, and dissolved Oxygen (DO) values for control, Biofloc and/ or pro-pac treatments.

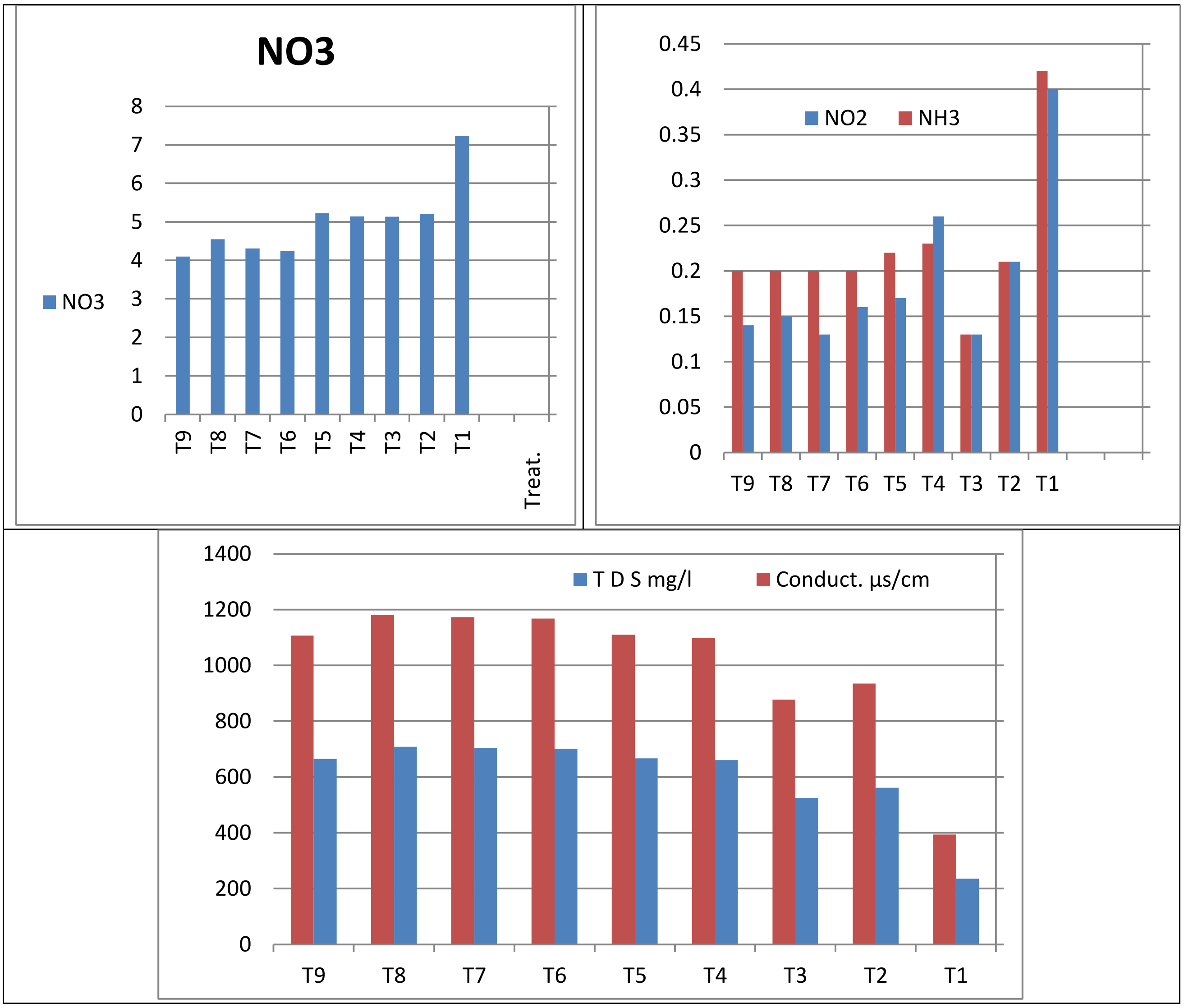

Figure 2: Conductivity, TDS, NH3, NO2 and NO3 values for control, Biofloc and/ or Pro-pac treatments.

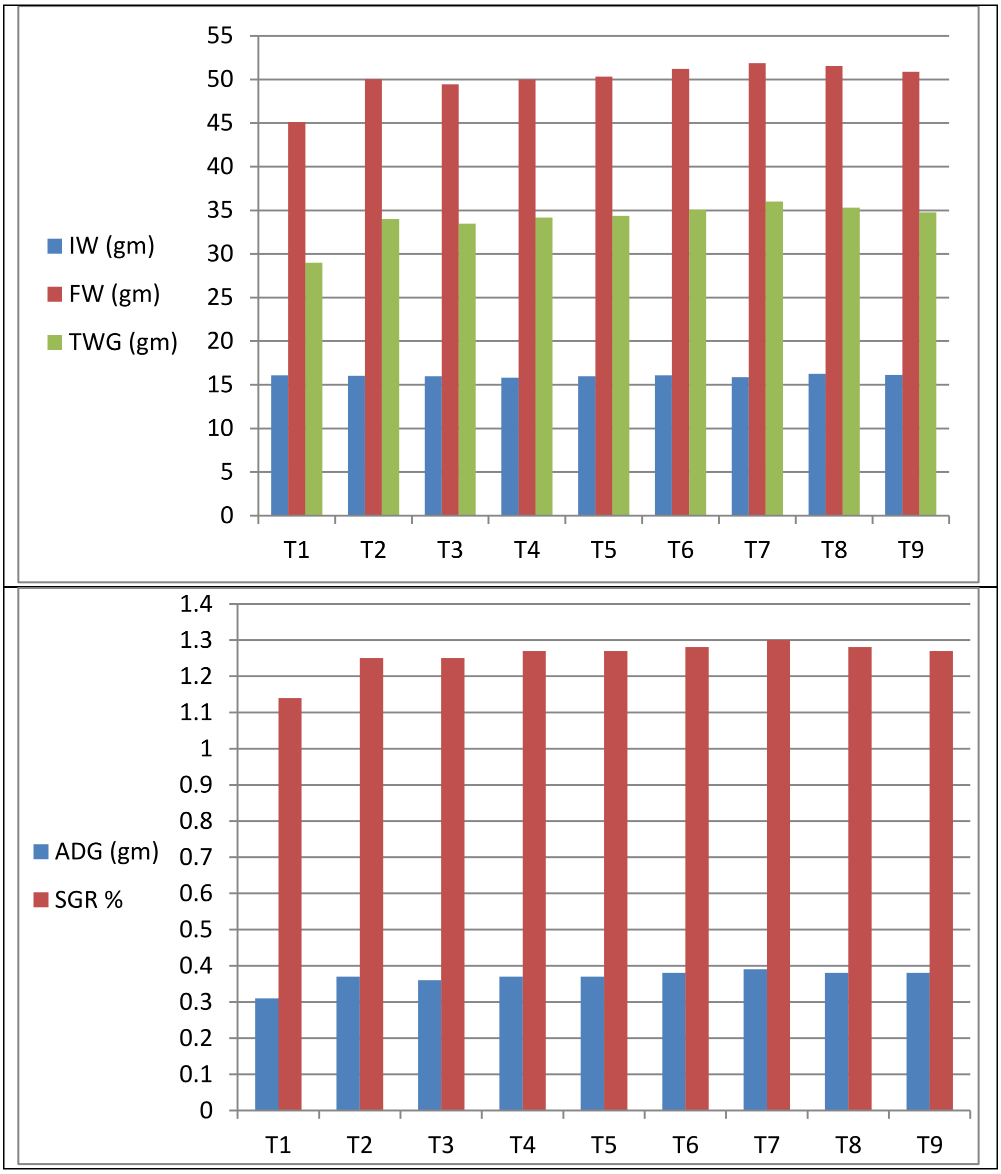

Figure 3: IW, FW, TWG, ADG, SGR and SR values for control, Biofloc and/ or Pro-pac treatments.

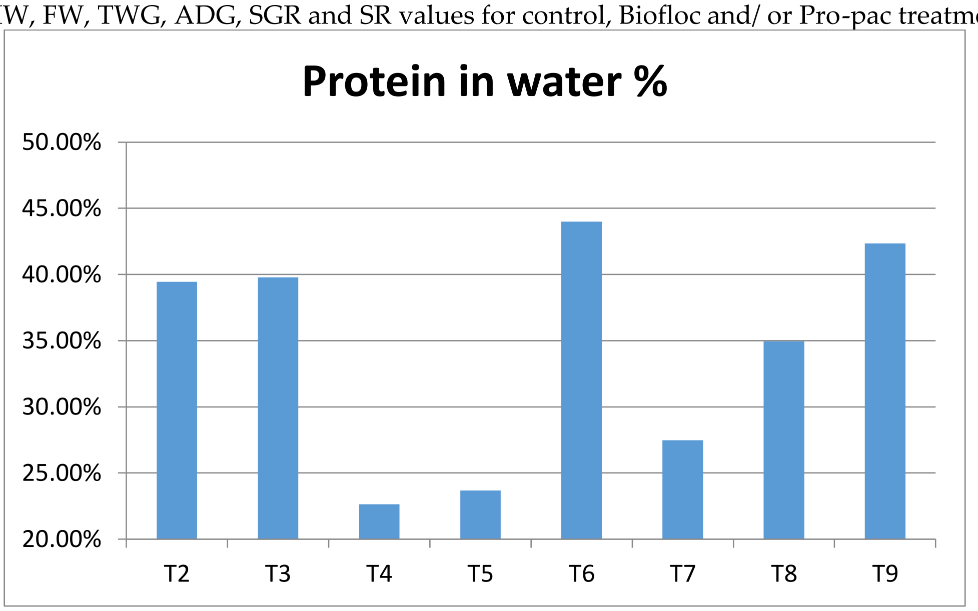

Figure 4: Protein in water values for control, Biofloc and Pro-pac treatments.

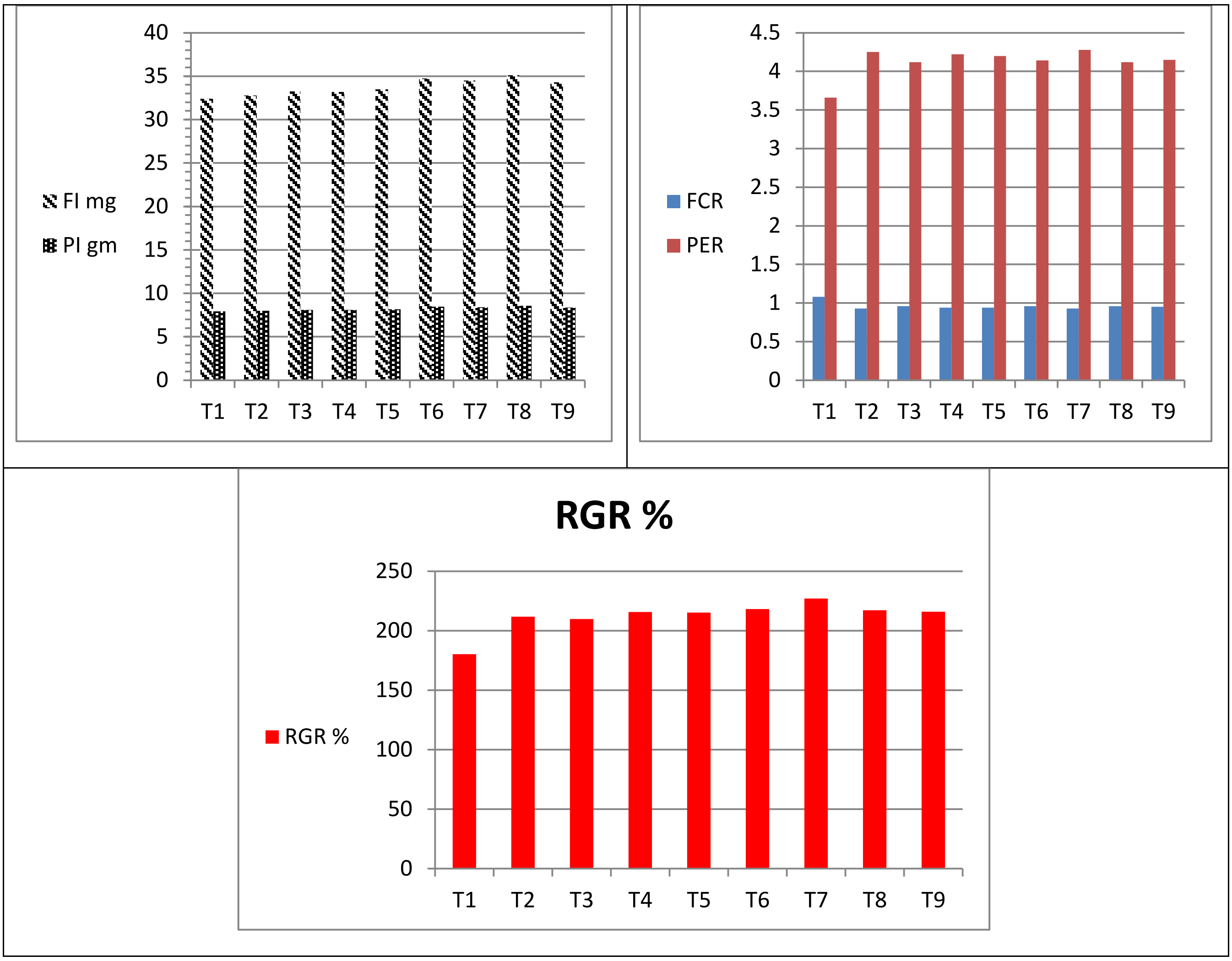

Figure 5: FI, PI, FCR, PER and RGR values for control, Biofloc and/ or pro-pac treatments.

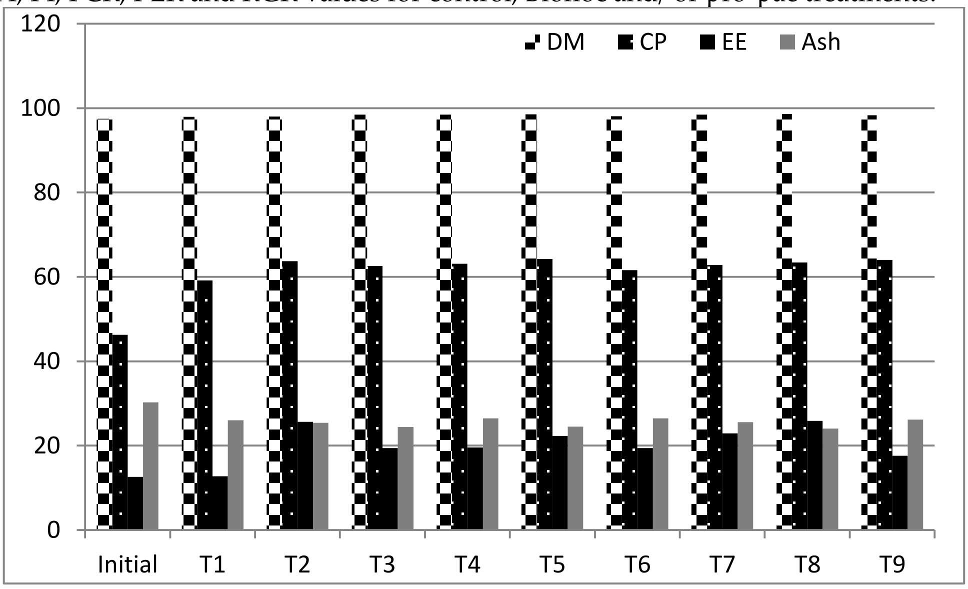

Figure 6: DM, CP, EE and ASH values for control, biofloc and pro-pac treatments.

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التأثير المحتمل لنظام البيوفلوك والبرو- باك على جودة مياة الأحواض ومعدلات النمو لأسماك البلطى النيلى

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الملخص العربى

تم إجراء تجربة لمدة 90 يوم لدراسة تأثير تركيزات مختلفة من البيوفلوك (نسبة C /N 10/1 ونسبة C / N 15/1) والبرو- باك (250 مجم / لتر & 500 مجم / لتر) على جودة المياه واستخدام الغذاء والمعايير الإنتاجية لأسماك البلطي النيلي. تم خلال التجربة وضع أصبعيات أسماك البلطي ذات أوزان متماثلة في أحواض بلاستيكية في ثلاث مكررات تحتوي كل منها على 100 لتر من المياه. تم إضافة المولاس للأحواض، مع عدم تغيير المياه خلال مدة التجربة، باستثناء أحواض المقارنة. تم تغذية الأسماك يومياً بنظام غذائي يحتوي على 25٪ من البروتين الخام بمعدل 2٪ من الوزن الحي. أظهرت النتائج أن معايير جودة المياه تغيرت للأفضل عن أحواض المقارنة. أدت إضافة البيوفلوك والبرو- باك إلى زيادة ملحوظة في متوسط وزن الأسماك ومعدل النمو عند مقارنتها بالأسماك في أحواض المقارنة. وجد كذلك أن معدل التحويل الغذائي وكفاءة استخدام البروتين أعلى في أحواض الأسماك المعالجة بالبيوفلوك والبروباك مقارنة بالأسماك في أحواض المقارنة، سبب إضافة البيوفلوك والبرو- باك زيادة فى نسبة البروتين الخام فى جسم الأسماك وزادت أيضا نسبة المستخلص الإيثيرى وقل الرماد، وأن تأثيرالبيوفلوك والبرو- باك إزداد كلما زاد مستوى تركيز هذه المواد.

الكلمات الاسترشادية: البلطى النيلى، نظام البيوفلوك والبرو- باك، جودة المياه، الإستفادة من الغذاء، المعايير الإنتاجية.