

## **EFFECT OF REUSE BIOFLOC WATER ON GROWTH PERFORMANCE, FEED UTILIZATION OF NILE TILAPIA FINGERLINGS (*OREOCHROMIS NILOTICUS*)**

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### **SUMMARY**

**N**ile tilapia (*Oreochromis niloticus*) fingerlings (average weight and length:  $20.20 \pm 0.20$  g,  $10 \pm 0.25$  cm) cultivated at reusing water from systems with biofloc technology (BFT) under three treatments: T1: Control, T2: tilapia cultured in reused water biofloc (RW) with adding carbohydrate and T3: tilapia cultured in reused water biofloc (RW) without adding carbohydrate. Nine rectangular tanks (66 x 47 x 44 cm, 75L) were used with stocking densities (400 Fish/m<sup>3</sup>) for 60 days to investigate fish growth performance, feed utilization, body composition, survival, water quality and also economic evaluation was done. Fish were fed a commercial diet containing 30% crude protein. Growth performance of tilapia was recorded biweekly. Water temperature, dissolved oxygen and pH, were recorded daily, while NO<sub>2</sub><sup>-</sup>, NO<sub>3</sub><sup>-</sup>-N; total hardness, carbonate hardness and total suspended solids were recorded biweekly. The body composition of the whole fish was determined at the end of the experiment. Results showed that the best water quality parameters, final body weight, weight gain, daily weight gain, specific growth rate, final biomass, net yield, PER, FCR, FE, feed intake and economic evaluation were significantly ( $P < 0.05$ ) higher in T2 and T3 than T1. Survival rate was greater than 98% in all treatments, with no significant difference between them ( $P > 0.05$ ). The present study recommended rearing Nile tilapia in reusing water from systems with biofloc technology (BFT) without adding carbon source for best growth performance and prolonged the useful life, quality of water and reduced overall water consumption.

**Keywords:** *Biofloc, Nile tilapia, feed utilization, growth performance and body composition.*

### **INTRODUCTION**

Nile tilapia is an economically important species. It is the second cultured species in the world, contributing significantly to global food security (Dawood *et al.*, 2019; Van Doan *et al.*, 2019; Amin *et al.*, 2019 and Magouz *et al.*, 2020). Nile tilapia is a tropical fish species that can be reared efficiently in warm water with temperature ranged from 25 to 30°C (Dawood *et al.*, 2020).

It is necessary to prolong the useful life of freshwater to guarantee aquaculture production (FAO, 2018) by using cultivation techniques that have an advantage over traditional fish farming practices; for example, using biofloc technology (BFT) (Avnimelech, 2009). It is important to add Carbohydrate for improving C:N ratios because in most artificial feeds the C:N ratio cannot meet the needs of heterotrophic bacteria (Avnimelech, 2012).

Biofloc technology is considered as the new blue revolution in Aquaculture, because it exploits the proliferation of microorganisms (bacteria, fungi, microalgae and zooplankton) using carbon source to maintain water quality.

BFT systems have resulted in advances in the production of tilapia with regard to the different growth stages (Caipang *et al.*, 2015 and García-Ríos *et al.*, 2019). It has a positive effect on the proximal composition of the cultured organisms and the nutrition of brood stock,

due to the consumption of the microorganisms present in the biofloc (Ekasari *et al.*, 2013 and Pérez-Fuentes *et al.*, 2018).

Nile tilapia can be cultured in biofloc using up to 100% reuse water derived from other BFT systems because it can tolerate adverse environmental conditions and is considered to be one of the most physiologically adaptable species to biofloc culture, which allows cultivation at high densities (Pérez-Fuentes *et al.*, 2016). The reduction in water consumption using BFT could be greater if the same water can be reused in multiple culture cycles (Krummenauer *et al.*, 2014).

The objective of the present study was to evaluate the effect of the reuse of biofloc water and the effects of no carbohydrate addition for Nile Tilapia production on growth performance, feed utilization, body composition, water quality and economical Evaluation.

## MATERIALS AND METHODS

### *Study site:*

The experiment was performed at the experimental fish lab, Department of Animal and Fish Resources, Faculty of Agriculture, Suez Canal University, Egypt. The experiment established for 60 days from 28 August to 25 October 2020.

### *Experimental Fish:*

Nile tilapia fingerlings obtained from a private fish hatchery (Khalil Saad Khalil Hatchery), Ismailia, with average body weight  $20.35 \pm 0.35$  g and body length  $10 \pm 0.25$  cm were acclimatize for 7 days prior the start of the experiment. Fish were fed on the same diet used in the study. Prior the experiment fish were starved for 24 h and measuring there total length and body weight.

### *Experimental tanks:*

Experiment was carried out in 9 rectangular tanks (66×47×44 cm) of reinforced plastic with water volume 75 L, tanks were supplied with dechlorinated tap water. Aeration was continuously provided using an air blower in the tanks. In control treatments (clear system) water was exchanged daily to remove feaces and uneaten feed, while for experimental BFT tanks, no water exchange was done (zero water exchange); with the exception of compensation for the evaporated portion. During the experimental period fish were held under natural light system (12:12 h, light: dark).

### *Experimental design:*

No of the treatment	Treatment
1	Clear system (control)
2	Water-reusing biofloc with carbohydrate addition
3	Water-reusing biofloc with no carbohydrate addition

All tanks were stocked with Nile tilapia fingerlings at stocking densities (400 Fish/m<sup>3</sup>). In this study sugar was used as an external carbon source it was added in three tanks, while in the other three tanks no carbohydrate was added. Suger was added after two hours of feeding at the same amount of feeding ration to maintain the optimal C: N ratio for activate heterotrophic bacteria growth (>N15:1) (Avnimelech, 1999). Adding carbohydrate, aeration conditions are the main circumstances that cause floc growth and develop (Azim and Little, 2008).

Water-contained flocs were reused from tanks already rich in flocs before the start of experiment for one month. The initial physicochemical concentrations of water were TSS (650.55 mg/l), TAN (3.6 mg/l) and NO<sub>3</sub>-N (450.8 mg/ L).

**Experimental Diets:**

Fish in all treatments were fed commercial diet containing (30% crude protein) at daily feeding rate 3% of the total stocked biomass divided into two equal portions offered two times/day (9.00 and 14.00). Feed were re-adjusted bi-weekly after weighing fish. Proximate chemical analysis of the experimental diet showed in Table (1).

**Table (1): Chemical composition of the diets.**

Component	Content (% on DM)
Dry mater	90.1
Crude Protein	30.3
Fat	6.1
Ash	4.95
Crude fiber	4.8
NFE <sup>1</sup>	53.85
Organic carbon	37.45
GE (Kcal/ 100g) <sup>2</sup>	450.70

*Nitrogen Free Extract= 100 - (protein + fat+ ash + fiber) GE = gross energy was calculated as 5.65, 9.45and 4.12 Kcal /100gram of protein, lipid and carbohydrate, respectively after (NRS, 2011)*

**Water quality:**

Water temperature and dissolved oxygen were measured using a portable oxygen meter (OxyGuard meter) daily at 13.00 h. pH values were recorded daily using a portable pH meter (OxyGuard meter).

Water sample (50ml) were collected from each tank and filtered by filter papers for analyzed (TAN), (TSS), Nitrite-N (NO<sub>2</sub>-N) and Nitrate-N (NO<sub>3</sub>-N). Ammonia nitrogen (TAN). Nitrite and nitrate was measured bi-weekly using spectrophotometer. Total suspended solid (TSS) values were measured twice during the experimental using Spectrophotometer (LKB Bichrom UV visible spectrophotometer) according to (APHA, 1992; Mullin and Riley, 1955).

**Biofloc volume:**

Biofloc volume (water settle able solids) was determined weekly using Imhoff cone to monitor the developing of biofloc, Imhoff or settling cones are a simple way to index suspended solids concentration. The cones have marked graduations on the outside that used to mensuration the volume of solids that settle from 1 liter of system water. Registering the volume of biofloc at 1000 mL of the tank water after 15-20min sedimentation according to (Avnimelech & Kochba, 2009).

**Growth Performance and Feed utilization:**

The growth achievement parameters and feed along with protein utilization variables were calculated with the following equations:

Average weight gain (AWG) = Average final weight (g) – Average initial weight (g).

Average daily gain (ADG) = [Average final weight (g) – Average initial weight (g)] / time by days.

Specific growth rate (SGR %/day) =100[(LnWt1 – Ln Wt0) / t].

Where: Ln: normal log, Wt0: initial weight (g), Wt1: final weight (g), T: time by days.

Survival (%) :( Final number of fish/Initial number of fish) ×100.

Net yield (g)= Final biomass (g)/tank -Initial biomass (g/tank).

Feed conversion ratio (FCR) =Feed intake (g)/WG (g).

Feed conversion efficiency (FCE) =WG (g)/Feed intake (g).

Protein efficiency ratio (PER) = WG (g)/protein intake (g).

**Chemical analysis of fish and biofloc:**

At the end of experiment a random sample of fish was sampled from each tank at different treatments and precipitated flocs were collected from different treatments for determination of proximate composition. Chemical analysis of biofloc and whole-body DM%, CP%, EE % and ash content % were performed according to standard (AOAC, 1995) methods. Fish and biofloc sample were dried in an oven at 70°C for a period of 24 hours till constant weight, then grounded and stored at -20 °C for analysis, ash content was determined by incineration at 600°C for 2 h, Crude protein was determined by micro-Kjeldhal method, %N × 6.25 (using Kjeltech auto analyzer, Model 1030, Tecator, Höganäs, Sweden). Fat content was determined by Soxhelt extraction with petroleum ether (40-60 °C).

**Statistical analysis:**

The data were analyzed by one-way ANOVA using Statistical Analysis System SAS version 9.0.0 (SAS, 2004) program at P<0.05 level, means were compared by Duncan new multiple range test (Duncan, 1955).

**Economical evaluation:**

The cost of feed to raise unit biomass of fish was estimated by a simple economic analysis. The estimation was based on local retail sale market price of all the dietary ingredients at the time of the study.

Cost /kg diet (LE) = Cost per Kg diet L.E.

Consumed feed to produce 1kg fish (kg) = Feed intake per fish per period/ final weight per fish Kg/Kg

Feed cost per kg fresh fish (LE) = amount of feed X price

Relative % of feed cost/ kg fish = Respective figures for step 3/ highest figure in this step.

Feed cost /1Kg gain (LE) = Feed intake per Kg gain X Cost /kg diet (LE)

Relative % of feed cost of Kg gain = Respective figures for step 5/ highest figure in this step

\* Cost of 1 kg diet used was 7.20 L.E.

## **RESULTS AND DISCUSSION**

**Water quality:**

The results of the physical and chemical variables of the water are shown in Table (2). Water temperature ranged from (27.5-27.60 °C), pH value were (8.03, 7.50 and 7.10), Dissolved Oxygen (DO) was (6.58, 6.40 and 6.51mg/l) for treatments (T1, T2 and T3), respectively, throughout the experimental period, and were within the acceptable level for Nile tilapia in all treatments (Kubitza, 2011). There were no significant differences between temperature and DO in all treatments. However, the control treatment had higher concentrations of DO than the rest of other treatments with a carbon source. This is may possibly due to the absence of bacterial biomass, which is present in the tanks with biofloc, in addition to greater photosynthetic activity. Avnimelech (2011) suggests that the minimum concentration of dissolved oxygen for the farming of tilapia in bioflocs should be 4 mg/l.

pH In the control treatment, pH value was significantly higher than other treatments (P≤0.05) it could be attributed to response to adding carbon source and accumulation of nitrifying bacteria in the system, which was clearly observed in treatments (T2 and T3) this was in agreement with (Pérez-Fuentes *et al.*, 2016) .

Total alkalinity was (48.89, 70.00 and 56.11 mg L/l CaCO<sub>3</sub>) for T1, T2 and T3, respectively. There were a significant (P<0.05) differences between all treatments. This was in agreement with (Azim and Little, 2008), who reported that a biofloc system reduces the buffering capacity of the water, requiring the constant addition of correctives.

The total ammonia nitrogen (TAN) values were 2.20, 3.70 and 3.16 mg /l for T1, T2, and T3

treatments, respectively. The lowest concentration for TAN was obtained in T1 treatment, which differed significantly from T2 and T3 ( $P \leq 0.05$ ), because ammonia conversion rate was slower in control due to the absence of heterotrophic bacteria than BFT treatments but did not differ from T1 ( $P > 0.05$ ).

**Table (2): Water quality parameters for experimental groups which reared on three water systems.**

Parameter	T1 (Control)	T2 (Bf + c)	T3 (Bf - c)
Temperature (°C)	27.54±1.20	27.54±1.20	27.68 ±0.58
pH	8.03 ±0.01 a	7.50 ±0.01 b	7.10 ±0.01b
DO (mgL-1)	6.58 ±0.09	6.40 ±0.09	6.51 ±0.09
CO <sub>2</sub> (mgL-1)	4.50 ±0.75	4.50 ±0.75	4.50 ±0.75
Alkalinity (mgL-1)	48.89± 0.82c	70.00± 0.84 a	56.11± 0.84b
Ammonia (mgL-1)	0.34 ±0.04	0.35 ±0.08	0.34 ±0.09
Floc level (mlL-1)	<0.5	20.61 ±0.80	20.17 ±1.35
TAN (mg/L)	2.20± 0.84b	3.70 ± 0.24a	3.56 ± 0.24a
NO <sub>2</sub> -N- (mg/L)	0.80± 0.84b	0.99 ± 0.55a	0.56 ± 0.54c
NO <sub>3</sub> -N- (mg/L)	450.30±1.10b	321.18 ± 88.9c	466.82 ± 177.3a
SRP (mg/L)	22.20±1.10b	19.36 ± 6.19c	42.20 ± 11.15a
TSS (mg/L)	588.64± 441c	841.51 ± 441a	634.99 ± 277.3b
SVI-15 (ml/g)	18.2±10.5c	100.51±88.2a	26.2±18.2b

Data are presented as means ± standard error (SE). Values in the same row with different superscript letters are significantly different ( $P < 0.05$ ).

NO<sub>2</sub> showed mean values of (0.80, 0.99 and 0.56 mg /l) and NO<sub>3</sub> were (450.30, 321.18, 466.82 mg/l) for T1, T2 and T3 treatments, respectively, with a statistical difference between treatments ( $P < 0.05$ ), these are in agreement with (Yanbo *et al.*, 2006). Nitrite and nitrate were accumulated during the first weeks due to the processes of nitrification in biofloc systems, while, control treatment was renewed daily, which prevented the nitrate from accumulating NO<sub>2</sub>-N concentration in BFT and seems to be relatively stable. The opposite was observed in control treatments, which might be explained by the higher rate of nitrification processes in these treatments, this was in agreement with Azim and Little, (2008).

Table (2) showed that TSS were (588.64, 841.51 and 634.99 mg/l) for treatments (T1, T2 and T3), respectively. Control treatment recorded the lowest concentration and T2 recorded the highest one followed by T3. There were significant differences between all treatments ( $P < 0.05$ ). SRP were (22.20, 19.36 and 42.20 mg/l) for treatments (T1, T2 and T3), respectively. In T2 (biofloc + C -tanks 19.36 mg/L) was decreased recording the lowest concentration, while it was consistently accumulated in T3 (42.20 mg/l) and recorded the highest concentration; there were significant differences between all treatments ( $P < 0.05$ ).

The higher level of TSS and lower concentrations of SRP indicated organic carbon addition stimulates the growth of heterotrophic bacteria, the TAN was assimilated and converted into microbial biomass; as a consequence, the TSS levels can increase this was in agreement with (Long *et al.*, 2015 and Nootong, 2011).

Phosphorus in feed is largely (80%–90%) released into aquaculture systems, it is a necessary nutrient element for bacteria growth, cannot be converted into gas and removed like nitrogen. Its conversion into the microbe's biomass is the most common biological phosphorus removal method (Barak *et al.*, 2003). In the current study, SRP in T2 (biofloc + C -tanks 19.36 ± 6.19 mg/L) was decreased, while it was consistently accumulated in T3 tanks. In carbohydrate-added tanks (T2), as the microbe's biomass (flocs) was growth higher than that of T3 tanks, the TSS level was higher 841.51 ± 441 mg/L than that of T3 tanks (634.99 ± 277.3), more SRP may be stored in the flocs and removed during the management when flocs were taken out.

The higher accumulation of NO<sub>3</sub>-N and lower level of NO<sub>2</sub>-N in the T3 tanks indicated that nitrification is enhanced when no carbohydrate is added in BFT aquaculture systems.

According to the removal of nitrogen in aquaculture, nitrogen in excretion, faeces and unutilized feed is or firstly converted into the form of TAN (Crab *et al.*, 2007). As the same amount of nitrogen (the same amount of feed) was provided to all tanks and heterotrophic bacteria was enhanced in T2 (TSS increased faster than T3), more TAN may have been assimilated by heterotrophic bacteria than that of T3. While the concentrations of TAN in all tanks had no differences. It indicated that more TAN may be converted by nitrification or assimilated by nitrifying bacteria in T3 (biofloc – C -tanks) than T2 (biofloc + C -tanks). TAN had low concentrations in all groups, this was in agreement with (Azim & Little, 2008; Xu *et al.*, 2016a and Xu *et al.*, 2016b) who demonstrated that it can be controlled by both assimilation and nitrification.

Low levels of TSS and SVI in T3 tanks help to maintain DO concentrations and remove excess flocs. Some studies suggested TSS concentration in BFT aquaculture systems should be controlled not too high (Avnimelech, 2012).

#### **Nutritional quality of flocs:**

Table (3) showed that protein contents of flocs in T2 ( $26.20 \pm 0.62\%$ ) were significantly higher than that in T3 ( $24.30 \pm 0.47\%$ ). The crude lipid contents of flocs in T2 were similar with that in T3. More nitrogen was assimilated and converted into the form of bacteria when C: N ratios increased. Significantly higher protein content in flocs was achieved in this experiment and in previous studies (Azim & Little, 2008 and Nootong & Pavasant, 2011).

**Table (3): Nutritional compositions (% dry basis) of flocs in T1 control, T2 carbohydrate -added tanks (biofloc +c -tanks) and T3 no carbohydrate-added tanks (biofloc C-tanks)**

Composition of flocs	T1	T2	T3
Protein	12.60 $\pm$ 0.20c	26.20 $\pm$ 0.62a	24.30 $\pm$ 0.47b
Crude lipid	2.80 $\pm$ 0.40b	7.40 $\pm$ 0.40a	6.80 $\pm$ 0.42a

Data are presented as means  $\pm$  standard error (SE). Values in the same row with different superscript letters are significantly different ( $p < 0.05$ ).

In this study crude protein varied from 24.30 to 26.20 % and was slightly lower than that suggested by (Azim and Little, 2008), however these values are higher than those found (23.7-25.4%) by (Elías *et al.*, 2015). This may be due different fish species, environmental conditions or experimental error.

#### **Growth performance and yield parameters:**

Different growth parameters of Nile tilapia (*O. niloticus*) fingerlings of the experimental groups were shown in Table (4). The initial body weight was approximately (20.05 g) with no significant difference among experimental groups. The final body weight, weight gain, daily weight gain, specific growth rate, initial biomass, final biomass and net yield were significantly ( $P < 0.05$ ) highest in T2 and T3. No significant difference ( $P < 0.05$ ) between the group of fingerlings Nile tilapia on (T2, tanks) and (T3, tanks). By adding carbon source to the culture medium in limited-discharge systems (i.e., by changing the C: N ratio), it is possible to obtain a significant enhancement of bacterial growth and of the fixation of toxic nitrogen metabolite species (Hari *et al.*, 2006; Avnimelech, 2009 and Crab, 2010). In addition to the improvement in water quality, the increase in bacterial biomass, which provides supplemental feed, is known to be associated with improved fish survival and growth and to reduce the releases of nutrient-rich water into receiving streams (De Schryver *et al.*, 2008; Avnimelech 2009 and Krummenauer *et al.*, 2011).

The average daily weight gain of Nile tilapia was (0.25-0.32 g / day), which suggest that the growth of tilapia during their culture in biofloc with reuse water was not affected by the quality of the water from the BFT culture. Therefore, the useful life of the water can be prolonged at least for the development of a new biofloc culture cycle. This is consistent with reports from other researchers, who indicated that the use of the same water from prior BFT cultures is highly beneficial for the culture of *L. vannamei* shrimp, because good water quality is maintained, and the productive performance is increased. (Krummenauer *et al.*, 2014).

After 60 days of culture, the total production of tilapia in T2 was (752 ± 1.2g/tank) which indicates that the cultivation of tilapia in biofloc with reuse water affect the productive performance in agreement with (Azim and Little, 2008 and Eid *et al.*, 2020).

Survival rate was greater than 95% in all treatments, with no significant difference between them (P>0.05). This suggests that reuse water derived from BFT cultures can be used in the development of a new biofloc culture and does not negatively impact the survival of tilapia. The survival rate recorded in the present study is comparable to the survival rate reported by other researchers for tilapia (93 to 95 percent) when cultivated in biofloc from first-use water or reused water (Luo *et al.*, 2014 and Eid *et al.*, 2020).

Some other studies reported that the addition of carbohydrate sources in the BF system may improving the growth performance and feed utilization, which depends on the use of different C: N ratios and different feed intake levels as well as the differences in the carbon sources (Wang *et al.*, 2015 and Zhao *et al.*,2016) .

**Table (5): Growth performance of fingerlings Nile tilapia reared on biofloc water and reused biofloc without adding sugar.**

Parameter	Control	T2	T3
Initial weight(g)	20.05± 0.20	20.2± 0.20	20.15± 0.20
Final weight(g)	34.83 0.20b	39.6± 0.40a	38.12± 0.60a
Weight gain g	14.7±8± 0.44b	19.4± 0.64a	17.97± 0.54a
Weight gain/day	0.25± 1.04b	0.32± 1.04a	0.30± 1.04a
SGR	0.92± 1.04b	1.13± 1.04a	1.06± 1.04a
Initial number (fish/tank)	20	20	20
Initial biomass (g/tank)	401.00 ± 0.04	404.00 ± 0.20	403.00± 0.24
Final biomass g/tank	661± 1.44b	752± 1.24a	724.± 1.54a
Net Yield g	260.27± 22.24b	348.4± 22.20a	321.3± 32.30a
Survival rate	95.00± 1.04	95.00± 1.04	95.00± 1.04

*Data are presented as means ± standard error (SE). Values in the same row with different superscript letters are significantly different (P < 0.05).*

**Feed Utilization:**

Feed utilization data for fingerlings Nile tilapia were presented in Table 5. There were significant differences (P<0.05) between all experimental groups. There were no significant (P<0.05) differences among experimental groups (T2 and T3). T2 and T3 had the best feed utilization parameters than the control group.

**Table (5): Feed utilization for fingerlings Nile tilapia reared under three water systems.**

Item	T1 (CO.)	T2 (Bf + c)	T3 (Bf – c)
Feed intake	33.41± 1.20a	31.13± 1.20b	31.13± 1.40b
FCR	2.27± 0.20a	1.61± 0.20b	1.73± 0.20b
FE	0.44± 0.20b	0.62± 0.20a	0.58± 0.40a
PER	1.47± 0.20b	2.06± 0.20a	1.92± 0.60a

*Data presented as means ± standard error (SE). Values in the same row with different superscript letters are significantly different (p < 0.05).*

The results of the present study indicated that fish in T2 and T3 had better growth and feeding performance than T1. Weight gain, SGR, and PER were at the highest levels and FCR at the lowest level in fish with C/N ratio of 15:1. In some studies, the positive effects of the application of BFT on growth performance and FCR have been reported in different species, e.g., in *O. niloticus* (Mirzakhani *et al.*, 2019 and Eid *et al.*, 2020), *L. vannamei* (Khanjani *et al.*, 2017 and Panigrahi *et al.*, 2019), *L. rohita* (Ahmad *et al.*, 2016), *C. auratus* (Wang *et al.*, 2015), and *C. carpio* (Najdegerami *et al.*, 2016). However, (Bakhshi *et al.*, 2018) stated that no

significant difference was observed between the control and BFT treatments with different carbon sources in terms of the final weight, final productivity, weight gain, and SGR of common carp fingerlings, although a small increase was noticed. (Dauda *et al.* 2018) mentioned that the biomass gain, SGR, and FCR of *C. gariepinus* were not significantly different among the control and BFT treatments with different C/N ratios probably because this species is an inefficient filter feeder of bioflocs (Ekasari *et al.*, 2016).

#### **Body chemical composition:**

Table (6) showed the Chemical composition (%) of tilapia fillets and bioflocs formed during the 60 days of rearing (*O. niloticus*) culture in water-reusing biofloc. The proximate composition of fish whole body may change as a reflection of a number of factors, including water quality, stress factors, availability of nutrients, feed intake and utilization (Dawood *et al.*, 2016). In the present study, the whole-body fat recorded the highest value in T2 and the lowest value recorded in T1 and T3. The decrease in ether extract (EE) can be attributed to the decreased feed intake that can result in low amounts of accumulated lipids in body composition. The highest protein content was recorded in T1 followed by T3 and T2, respectively. The results of the present study were close to the data found by (Verma *et al.*, 2016). In contrast with our result, (Azim and Little, 2008) recognized no significant difference between clear and biofloc 6 in chemical composition of Nile tilapia. Ash in biofloc system had the highest content it might be explained by continuous availability of abundant minerals and trace elements from the bioflocs. The results of the present study were close to the data found by (Eid *et al.*, 2020).

**Table (6): Chemical composition of Nile tilapia fingerlings.**

Item	T1 (CO.)	T2 (Bf + c)	T3 (Bf - c)
Dry mater	25.44 ± 0.20a	24.46 ± 0.24b	23.80 ± 0.28c
Protein %	60.67 ± 0.27a	58.84 ± 0.27b	59.36 ± 0.24b
EE %	19.05 ± 0.27b	20.90 ± 0.20a	19.99 ± 0.26b
Ash %	17.36 ± 0.27b	18.37 ± 0.22 a	18.16 ± 0.28a

Data presented as means ± standard error (SE). Values in the same row with different superscript letters are significantly different ( $p < 0.05$ ).

#### **Economic Evaluation:**

Calculations of economic efficiency of the tested diets based on the cost of feed, costs of one Kg gain in weight and its ratio with the control group are shown in Table 7. The lowest feed cost per kg fresh fish was in T2 (0.79 LE), Relative % of feed cost / kg fish (83.58%), Feed cost /1Kg gain T2 (11.59 LE) and Relative % of feed cost of Kg gain (70.93%) in group of fish fed diet T2.

**Table (7): Economic analysis of Nile tilapia fingerlings reared under different water system for 60 day.**

Item	Treatment		
	T1 (control )	T2 (Bf + c)	T3 (Bf - c)
Cost /kg diet (LE)	7.20	7.20	7.20
Consumed feed to produce 1kg fish (kg)	2.27	1.61	1.73
Feed cost per kg fresh fish (LE)	0.95	0.79	0.82
Relative % of feed cost/ kg fish	100	83.58	86.31
Feed cost /1Kg gain (LE)	16.34	11.59	12.46
Relative % of feed cost of Kg gain	100	70.93	76.25



## CONCLUSION

It could be concluded that the best growth performance, feed utilization, survival, productive performance, proximal composition and economic evaluations for Nile tilapia fingerlings can be achieved by rearing fish in reusing water from systems with biofloc technology (BFT) without adding carbon source, which prolonged the useful life and quality of water and reduced overall water consumption. So it could be considered as an additional strategy to maintain or increase production of Nile tilapia.

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## تأثير إعادة استخدام مياه البيوفلوك على أداء النمو والاستفادة من الغذاء لإصبعيات البلطي النيلي

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تم إجراء هذه التجربة لدراسة تأثير إعادة استخدام مياه البيوفلوك على أداء النمو والاستفادة من الغذاء و التركيب الكيميائي لجسم الأسماك و جودة المياه و معدل البقاء و التقييم الاقتصادي . تم استخدام ثلاث معاملات الأولى الكنترول الثانية إعادة استخدام مياه البيوفلوك مع إضافة كربوهيدرات و الثالثة إعادة استخدام مياه البيوفلوك بدون استخدام كربوهيدرات، كانت مدة التجربة 60 يوما بمتوسط وزن ابتدائي للأسماك 20 جرام ومتوسط الطول 10 سم تم استخدام 9 أحواض مستطيلة من البلاستيك المقوي بحجم كلي 75 لتر وتم تخزين الأسماك بكثافة (400 سمكة / م<sup>3</sup>)، تم تسجيل كلا من درجة الحرارة و الأس الهيدروجيني و الأكسجين المذاب يوميا بينما تم قياس النترات و النيتريت و الأمونيا و نيتروجين الامونيا الكلي كل أسبوعين و تم قياس المواد الصلبة العالقة مرتين خلال التجربة ، كما تم قياس معدلات نمو الأسماك كل أسبوعين ، أظهرت النتائج أن أفضل معايير جودة المياه كانت عند T2 و T3 ، وزن الجسم النهائي ، زيادة الوزن، زياده الوزن اليومي ، معدل النمو النوعي ، الكتلة الحيوية الأولية ، الكتلة الحيوية النهائية ، صافي المحصول ، نسبة كفاءة البروتين ، كفاءة تحويل الغذاء و التقييم الاقتصادي كانت معنويا ( $P < 0.05$ ) أعلى في T2 و T3 عن T1 ، كان معدل البقاء أكبر من 95% في جميع المعاملات ، مع عدم وجود فرق معنوي بينهما ( $P > 0.05$ ). أوصت الدراسة الحالية بإمكانية تربية البلطي النيلي في المياه المعاد استخدامها من أنظمة البيوفلوك دون إضافة مصدر الكربون مما يحقق أفضل أداء للنمو وإطالة العمر الإنتاجي ونوعية المياه وتقليل الاستهلاك الكلي للمياه.