PRODUCTIVE PERFORMANCE OF *O. NILOTICUS* FINGERLINGS FED DIETS SUPPLEMENTED WITH EITHER PROTECTED OR UNPROTECTED FATS

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ABSTRACT

The current study aimed to investigate the effect of adding different levels (3, 6, 9 and 12%) of protected fat (PF) or unprotected fat (UPF) on growth performance of *O. niloticus*. Feeding period lasted for fourteen weeks with initial fish weight of 15.2 g. Growth performance parameters were recorded throughout the feeding period, blood parameters in serum and chemical composition of fish were bodies determined at the end of the experiment. Results showed that final weight increased (P<0.05) with all PF and UPF levels as compared to the control group. Final weight increased (P<0.05) by increasing level of PF and UPF from 3 to 9%, and resulted a decrease (P<0.05) in final weight of fish at 12% PF and UPF level. Final weight was the heaviest (P<0.05) for fish fed 9% PF. Average daily gain, total weight gain and specific growth rate of fish in all fat groups showed an increase (P<0.05) compared with the control, but all values were higher (P<0.05) in PF than in UPF groups. Feeding diets with PF or UPF improved (P<0.05) feed conversion ratio, protein productive value and fat productive value. The best results were recorded in group fed 9% PF. Glucose concentration in blood serum decreased (P<0.05) only with 6, 9 and 12% PF levels, while it was not affected by all UPF levels. Total serum protein concentration was higher (P<0.05) with 3, 6 and 9% UPF and was not affected by PF levels. Albumin concentration was affected (P<0.05) only by 12% PF, being lower and both 6 and 12% UPF levels, being higher than the control. However, globulin concentration decreased (P<0.05) by increasing PF level more than 3% and increasing UPF more than 9%. Yet, albumin/globulin ratio did not differ significantly by PF and UPF levels. Activity of AST increased (P<0.05) by all PF levels, being the highest with 12% PF level. However, all UPF levels did not affect AST activity. Concentration of triglycerides increased (P<0.05) by all PF levels and decreased only by high UPF levels (9 and 12%). Concentration of cholesterol decreased (P<0.05) only by 12% UPF level. Feeding all PF levels increased (P<0.05) DM content in fish bodies however, all UPF levels did not affect DM content in body fish. Increasing level of PF or UPF more than 3% decreased (P<0.05) CP content and increased EE content in body of fish. Ash content decreased (P<0.05) by the lowest PF or UPF level (3%) and increased (P<0.05) by the highest PF or UPF level (12%). The observed higher body weight gain in all PF and UPF groups reflected lower cost of each kg gain in all PF and UPF groups, being the lowest for fish fed 6% PF diet. The present study cleared that both PF and UPF could be incorporated up to 9% in diet of Nile tilapia thus there fats pronouncedly improved growth performance of *O. niloticus* without any adverse effect on liver function.

Keyword: *O. niloticus, protected fat, growth performance, blood, liver function.*

INTRODUCTION

Dietary fat supplement is an important source of energy and is containing essential fatty acids for normal growth performance as it acts as carriers for many vitamins and hormones. Also, fats play an important role in cell membrane structure (NRC, 1983).

Oils seeds contain mostly triglycerides that are rich in unsaturated fatty acids (NRC, 2001). Nutritionally, fats are exclusively an energy source, because they contain very little of protein, mineral or vitamins and can be used to increase energy density of a ration as fat supplies 2.25 times as much energy as digestible starch or sugar (Church, 1991).

Ca-salt of fatty acids has been utilized as a dietary protected fat supplement in ruminant rations without any depressions on feed intake for its high energy, and reducing feeding costs and environmental pollution. The beneficial effects of dietary supplementation of protected fat were reported on body weight, gain and digestibility of growing calves (Jenkins and Palmquist, 1984, El-Bedawy, 1995 and Omer, 1999). No available data have been reported on the effect of dietary protected fat as compared to normal fat on growth performance of fish.

Therefore, the aim of this work is to study the effect of different dietary sources and levels of fats (protected or unprotected) on growth performance of *Oreochromis niloticus* fingerlings and the purpose of using protected fat was decreasing consumption of sunflower oil (human food) and to lowering the cost of rations formulated with fish oil.

MATERIAL AND METHODS

The present work was conduced in Aquaculture Research Unit Laboratory at Kafr El-Sheikh, Central Laboratory for Aquaculture Research during the period from July to November, 2007

Fish and dietary treatments:

Two hundred and fifty of Nile Tilapia fingerlings *Oreochromis niloticus* with an average initial body weight of (15.2 gm/fish) were equally placed in twenty five experimental glass aquaria (80 x 35 x 40 cm, 10 fingerlings in each) containing dechlorinated tap water (80 liter each). Each treatment contained three replicates one replicate/aquarium. Water temperature was thermotically adjusted at 25.2°C and excreta were removed every day by siphoning.

Nine isonitroginous diets (32.1% CP) were formulated and provided with protected or unprotected fat at levels of 3, 6, 9, and 12%. The protected fat purchased from Magnapac (Noreisa, Madrid, Espain), contained 84% palm oil (60.1% palmitic, 0.1% palmitoleic, 30% oleic, 3% linoleic, 4.7% stearic and 2.1% myristic acid), 12.5% CA-carbonate and 3.5 moisture where is the other fat source. The unprotected fat used in the present study was sunflower oil.

All dietary ingredients were obtained from Kafr El-Sheikh market. Experimental diets were offered twice daily at a level of 3% of live fish biomass. Chemical analysis of the experimental diets is shown in Table (1).

Table 1. Ingredients and chemical composition of the experimental diets used in feeding fish in different experimental groups.

Ingredients	Control	3% PF	6% PF	9% PF	12% PF	3% UPF	6% UPF	9% UPF	12% UPF
Fish meal	16	16	16	16	16	16	16	16	16
Soybean meal	50	50	50	50	50	50	50	50	50
Yellow corn	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
Wheat bran	5	5	5	5	5	5	5	5	5
Cellulose	12	9	6	3	-	9	6	3	-
Vit. premix	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Protected fat	-	3	6	9	12	-	-	-	-
Unprotected fat	-	-	-	-	-	3	6	9	12
	Chemical analysis (%) on D.M basis								
DM	88.9	88.9	88.7	88.2	88.0	89.3	89.0	88.9	88.7
CP	32.1	32.1	32.1	32.1	32.1	32.1	32.1	32.1	32.1
EE	1.95	4.24	7.31	10.37	13.3	4.4	7.5	10.47	13.6
Ash	8.1	7.9	7.9	7.2	7.0	7.7	7.8	7.63	7.3
CF	6.1	5.9	5.9	5.7	5.61	5.9	5.8	5.34	5.2
NFE	51.75	49.86	46.79	44.73	41.99	49.9	46.8	44.79	48.8

CP=Crud protein, EE= Ether extract, CF= Crud fiber, NFE=Nitrogen free extract, PF = Protected fat, UNP = un Protected.

Data recorded:

Fish in each treatment were weighed weekly for fourteen weeks of the experimental period. Growth performance parameters were recorded as the following:

Total weight gain (TWG) = Final weight (g) - Initial weight (g)

Average daily gain (ADG) = Total weight gain (g)/Period (day)

Fat productive value (FPV %) = (Fat retained/fat intake) x 100

Protein efficiency ratio (PER %) =(Weight gain (g)/protein intake (g) x 100 (Davis and Morries, 1997)

Protein productive value (PPV %) = [Retained protein (g)/protein intake (g)] x100 (Marias and Kissil, 1979)

Feed conversion ratio (FCR) = Feed intake (g)/weight gain (g) (Tacon, 1987)

Specific growth rate (SGR%/d) = Ln Wt_1 - Ln Wt_0/T) x 100

where: Ln is the natural logarithm (Pouomogne and Mbongblang, 1993).

Economical evaluation of the experimental diets was done to define the most efficient diet according to Diana *et al.* (1996a &b) and Yi *et al.* (2001).

Analytical methods:

At the end of the experimental period, blood samples were taken for determination of concentrations total protein (Peters, 1968), albumin (Drupt, 1974), glucose (Young, 2001), total cholesterol (Trinder, 1969), triglyceride and activity of AST and ALT (Reitman and Frankel, 1957) in blood serum. While, globulin was calculated by the difference between total protein and albumin concentrations. Biochemical blood parameters in blood serum were analyzed using commercial kits (Diagnostic System Laboratories, INC, USA).

Chemical analysis of the experimental diets and fish bodies were carried out according to A.O.A.C. (1990).

Statistically analysis:

The data of fish growth and blood parameters were statistically analyzed according to SAS (1998) Computer Program System. The significant differences among treatment groups were tested using Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISSCUTIONS

Growth performance:

Data of Table (2) show that average final body weight significantly ($P<0.05$) increased with increasing dietary fat levels of both of fat sources as compared to the control. It is of interest to note that final body weight increased significantly ($P<0.05$) by increasing levels of protected (PF) and unprotected fat (UPF) from 3 to 9%, thereafter increasing the levels of fat to 12% resulted in significant decrease in final fish weight. Fish group fed 9% protected fat showed the heaviest final body weight (64.4 g/fish), while the lowest one was recorded by the control group (39.5 g/fish).

Average daily gain (ADG), total weight gain (TWG) and specific growth rate (SGR) of fish in all fat groups showed significant ($P<0.05$) increase compared to the control group, whereas all values in PF groups were significantly ($P<0.05$) higher than the UPF groups (Table 2).

Table 2. Growth performance *O. niloticus* affected by source and level of fat.

Group	IW (g)	FW (g)	TWG (g)	ADG (g)	SGR (%/d)
Control	15.0	$39.5^{c} \pm 0.1$	$24.5^{d} \pm 0.00$	$0.25^{c} \pm 0.0$	$0.94^{c} \pm 0.00$
3% PF	15.2	$57.4^{a} \pm 0.0$	$42.2^{a} \pm 0.1$	$0.43^{a} \pm 0.01$	$1.35^{a} \pm 0.01$
6% PF	15.2	$59.3^{a} \pm 0.3$	$44.1^{a} \pm 2.2$	$0.45^{a} \pm 0.01$	$1.39^{a} \pm 0.03$
9% PF	15.3	$64.4^{a} \pm 0.3$	$49.2^{a} \pm 2.1$	$0.50^{a} \pm 0.02$	$1.47^{a} \pm 0.05$
12% PF	15.35	$44.4^{b} \pm 0.4$	$29.1^{c} \pm 2.0$	$0.30^{ab} \pm 0.02$	$1.09^{b} \pm 0.02$
3% UPF	15.1	$48.2^{b} \pm 0.0$	$33.1^{b} \pm 1.1$	$0.34^{b} \pm 0.0$	$1.19^{ab} \pm 0.02$
6% UPF	14.9	$49.5^{ab} \pm 0.1$	$34.6^{b} \pm 1.2$	$0.35^{b} \pm 0.0$	$1.2^{ab} \pm 0.01$
9% UPF	15.2	$53.4^{a} \pm 0.1$	$38.2^{b} \pm 1.1$	$0.39^{b} \pm 0.0$	$1.28^{ab} \pm 0.03$
12% UPF	15.2	$44.5^{b} \pm 0.3$	$29.3^{c} \pm 1.3$	$0.30^{b} \pm 0.0$	$1.1^{b} \pm 0.00$

A, b and c: Means within the same column having different letters are significantly different at $P<0.05$.
IW = Initial weight FW = Final weight. ADG = Average daily gain
BWG = Body weigh gain SGR = Specific growth rate.

These results agreed with the results obtained by Yones and Abd El-Tawab (2005) who found that multi feeding 10% protected fat achieved the highest final body weight ADG, BWG and SGR. Similar results were obtained by Lanari *et al.*

(1993) when they replaced 9% of fish oil in seasons (*Diceutrachis labrax*) diet by protected fat. Also, Stowell and Gatlin (1992) found that channel catfish recorded the highest weight gain and the best feed conversion when fed on diet containing 10% of lipid as compared with diet contain 5%.

Feed utilization:

Data of Table (3) show that feeding diets with PF or UPF improved significantly ($P<0.05$) feed conversion ratio (FCR), protein productive value (PPV) and fat productive value (FPV). The best results were recorded in group fed 9% PF.

In accordance with the present results, Stowell and Gatlin (1992) found that channel catfish recorded the best feed conversion ratio when fed diet contained 10% of lipid as compared to that contained 5% lipid. Also, Abo State (1997) stated the best PER value was obtained by Nile Tilapia fed diet containing 9% lipid. However, Magouz *et al.* (2002) observed that diets containing 4% lipid (non-protected) had the higher FPV than those containing 8 or 12% fat, regardless of fat source. Also, Stickney and McGeachin (1984) found that the best FCR was observed when in fish fed 12% beef tallow.

Table 3. Efficiency of feed, protein and fat utilization *O. niloticus* affected by different sources and levels of fat.

Group	FI	FCR	PER (%)	PPV (%)	FPV (%)
Control	88.2+0.01	3.6 [a] ± 0.01	0.95 [d] ± 0.0	15.76 [d] ± 0.3	32.4 [cb] ± 0.8
3% PF	92.8±0.00	2.2 [c] ± 0.03	1.57 [a] ± 0.2	26.61 [ab] ± 0.3	37.98 [a] ±0.81
6% PF	88.2±0.02	2.0 [c] ± 0.03	1.64 [a] ± 0.21	29.79 [a] ± 0.1	31.3 [b] ± 0.8
9%PF	92.49±0.00	1.88[d] ± 0.02	1.84 [a] ± 0.21	32.75 [a] ± 0.0	26.87 [b] ± 1.3
12% PF	81.48±0.03	2.8 [b] ± 0.02	1.24 [b] ± 0.3	20.9 [b] ± 0.0	15.92 [d] ± 1.7
3% UPF	92.68±0.1	2.8 [b] ± 0.11	1.23 [b] ± 0.1	19.89 [c] ± 0.3	29.46 [b] ± 0.1
6% UPF	85.5±0.01	2.5 [b] ± 0.02	1.32 [b] ± 0.2	21.19 [b] ± 0.3	22.25 [c] ± 1.1
9% UPF	84.04±0.07	2.2 [c] ± 0.14	1.56 [a] ± 0.2	25.46 [b] ± 0.2	20.3 [c] ± 1.2
12% UPF	84.97±0.00	2.9 [b] ± 0.13	1.19 [c] ± 0.2	19.81 [c] ± 0.0	13.38 [d] ± 3.1

a, b and c: Means within the same column having different letters are significantly different at P<0.05. FI = Feed intake, PER = Protein efficiency ratio, PPV = Protein productive value, FCR = Feed conversion ratio, SGR= Specific growth rate and FPV= Fat productive value

Body composition:

Data of Table (4) show that feeding all PF tested levels significantly ($P<0.05$) increased DM contents, however, all UPF levels did not affect DM content in body of fish. On the other had, increasing level of PF or UPF more than 3% significantly ($P<0.05$) decreased CP content and increased EE content in body of fish (Table 4).

It is worthy to note that ash content significantly ($P<0.05$) decreased by lowest PF or UPF level (3%) and significantly ($P<0.05$) increased by the highest PF or UPF level (12%, Table 4).

Similar trend of decreased CP content and increase in DM content with increasing level of dietary non protected fat in *Oreochromis niloticus* was diets observed by Winfree and Stickney (1981). Also, Abo-State (1997) found that DM and EE contents of the body increased by raising fat level in the diets of *Oreochromis niloticus*. Such trend was in contrast with the findings Yonies and Abd El-Tawab (2005), who found that carcass composition of mullet (saltwater fishes) after feeding diet containing protected fat had lower DM than control and both protected and non protected fat had CP level higher than control. This difference can be explained by the fact that saltwater fishes utilize diets containing high level of lipid more efficiency than fresh water fishes.

Table 4. Body composition of fish fed protected or unprotected fat (on DM basis).

Group	DM%	Chemical analysis (%)		
		CP	EE	Ash
Control	25.8 ^{c} ± 0.01	63.2 ^{a} ± 0.03	7.9 ^{d} ± 0.07	18.9 ^{b} ± 0.01
3% PF	28.3 ^{b} ± 0.01	59.4^{ab} ±0.0	11.2^{cd} ± 0.0	17.5^{c}±0.01
6% PF	29.2 ^{b} ± 0.01	58.1 ^{b} ±0.01	13.9 ^{c} ± 0.03	18.34^{b}±0.00
9% PF	29.9 ^{ab} ± 0.0	58.3 ^{b} ±0.11	15.3^{ab} ± 0.03	18.4^{b}±0.011
12% PF	30.5 ^{a} ± 0.05	54.2 ^{c}±0.12	17.1 ^{a} ± 0.01	20.2^{a}±0.00
3% UPF	26.7 ^{c} ± 0.04	59.8 ^{ab} ± 0.0	12.1 ^{c} ± 0.07	17.3^{c}±0.012
6% UPF	27.3 ^{c} ± 0.0	58.7 ^{b} ± 0.0	13.6 ^{c} ± 0.07	18.9^{b}± 0.07
9% UPF	27.9 ^{c} ± 0.01	57.3 ^{bc} ± 0.05	14.9 ^{b} ± 0.07	18.1^{b}±0.03
12% UPF	28.9 ^{b} ± 0.07	56.6 ^{c} ± 0.03	16.2 ^{a} ± 0.07	20.1^{a}±0.03

a, b and c: Means within the same column having different letters are significantly different at $P<0.05$.

Blood parameters:

Data presented in Table (5) show that glucose concentration in blood serum significantly decreased only with 6, 9 and 12% PF level, while it was not affected significantly by all UPF levels. An opposite trend was nearly observed for total protein concentration, being significantly ($P<0.05$) higher with 3, 6 and 9% UPF and was not affected by PF levels.

It is of interest to note that albumin concentration was affected significantly ($P<0.05$) only by 12% PF, being lower and both 6 and 12% UPF levels and higher than the control treatment. However, globulin concentration significantly ($P<0.05$) decreased by increasing PF level more than 3% and increasing UPF more than 9%. Yet, albumin to globulin ratio did not differ significantly by PF and UPF levels (Table 5).

These results are in accordance with the findings of Avila *et al.* (2000), who mentioned that blood glucose concentration decreased with protected fat supplementation in ration of lactating cows. Also, Baraghit *et al.* (2003) found that total protein concentration was higher in serum of buffaloes fed supplemental oil than those fed protected or control ration. Moreover, Bruckmaier *et al.* (1998) stated that albumin and globulin concentration was higher in plasma of dairy cows fed free fatty acid compared with those fed ration without any additives.

Table 5. Some blood serum parameters of fish fed different levels of protected and unprotected fat.

Group	Glucose (mg/dl)	Total protein (g/dl)	Albumin (g/dl)	Globulin (g/dl)	AL/GL Ratio
Control	101.25^{a}±3.3	4.43^{b} ± 0.1	1.87^{b} ± 0.0	2.56^{a}± 0.09	1.37
3% PF	100.5^{a}±4.1	4.51^{ab}± 0.20	1.88^{b}±0.01	2.63^{a}±0.03	1.40
6% PF	49.72^{b}±4.2	4.29^{b}±0.22	1.87^{b}±0.11	2.42^{b}±0.03	1.30
9% PF	99.51^{b}±4.0	4.18^{b}±0.33	1.87^{b}±0.02	2.31^{c}±0.02	1.24
12% PF	95.40^{b}±4.1	4.20^{b}±0.30	1.79^{c}±0.02	2.41^{b}±0.00	1.35
3% UPF	103.13^{a}±3.2	4.82^{a}±0.30	1.98^{abc}±0.01	2.84^{a}± 0.01	1.43
6% UPF	102.11^{a}±3.9	4.93^{a}±0.31	2.30^{a} ±0.00	2.63^{a}± 0.02	1.14
9% UPF	100.20^{a}±3.4	4.73^{a}±0.32	2.20^{b} ±0.01	2.52^{ab}±0.02	1.14
12%UPF	99.870^{a}±3.8	4.66^{ab}±0.29	2.32^{a} ±0.08	2.34^{c}±0.01	1.01

A, b and c: Means within the same column having different letters are significantly different at P<0.05.
AL=Albumin, GL = Globulin

Liver function:

Results of Table (6) activity of AST increased significantly (P<0.05) in all fish groups fed the four PF levels, being the highest with 12% PF level. However, all UPF levels did not affect significantly (P<0.05) the AST activity.

Concentration of triglycerides significantly (P<0.05) increased in groups fed all PF levels and decreased (P < 0.05) only by high UPF levels (9 and 12%). However, concentration of cholesterol significantly (P<0.05) decreased only by 12% UPF level (Table 6).

Concerning activity of transaminases, similar results were reported by Moallem *et al.* (1997), who found that AST activity was higher in cows fed protected fat as compared to controls. Concerning lipid metabolism, Demeterova *et al.* (2002) and Selberg *et al.* (2004) mentioned that the concentration of total lipids in blood serum or plasma of dairy cows increased with fat supplementation in rations of dairy cows. Also, Demeterova *et al.* (2002) and Salado *et al.* (2004) stated that addition of protected fat in ration of dairy cows increased the concentration of triglyceride in blood. Moreover, Petit *et al.* (2001) found that protected fat supplementation lead to a significant increase in the concentration of total cholesterol in blood of dairy cow compared to control group.

Table 6. Activity of transaminases (AST and ALT) and fat metabolism metabolites in blood serum of fish fed different levels of protected and unprotected fat.

Group	AST activity	ALT activity	Triglycerides (mg/dl)	Cholesterol (mg/dl)
Control	145.7 ^{c} ± 3.2	16.7 ^{c} ± 1.81	147.5 ^{b} ± 1.7	213.75^{ab}±7.1
3% PF	153.2 ^{b} ± 3.7	18.1 ^{b} ± 2.1	152.0 ^{ab} ± 3.2	230.4^{a}±7.6
6% PF	155.7 ^{b} ± 3.7	19.3 ^{ab} ± 2.02	157.15 ^{a} ± 5.7	232.73^{a} ±5.9
9% PF	155.3 ^{b} ± 3.8	22.2 ^{a} ± 2.09	159.3 ^{a} ± 3.9	237.21^{a}±5.89
12% PF	162.1 ^{a} ± 3.7	24.1 ^{a} ± 2.1	162.1 ^{a} ± 4.2	240.37^{a}±7.4
3% UPF	145.8^{c}±5.22	16.37^{c}±0.0	144.7 ^{b}±5.9	200.05 ^{b}±9.1
6% UPF	146.35^{c}±5.3	17.51^{c}±1.1	140.3^{bc}±5.8	198.31 ^{b}±8.9
9% UPF	148.24^{c}±3.9	18.20^{b}±1.9	139.5 ^{c}±5.7	195.27^{bc}±7.3
12% UPF	149.17^{c}±4.1	18.91^{ab}±1.9	133.2 ^{c}±5.5	187.34 ^{c}±10.2

a, b and c: Means within the same column having different letters are significantly different at $P<0.05$.

AST = Aspartate amino transferase   ALT = Alanine amino transferase

Water quality parameter:

Data present in Table (7) show that water physicochemical parameters are within the suitable range for growth of Nile Tilapia (Abd El-Hakim *et al.,* 2002 and Abdel-Hamid *et al.,* 2003).

Table 7. Water quality parameters in different treatment groups.

Group	DO mg/l	pH	Nitrite mg/l	Total ammonia mg/l
Control	8.1	6.29	0.05	0.9
3% PF	8.3	6.6	0.04	0.81
6% PF	8.32	6.22	0.041	0.77
9% PF	8.39	6.00	0.05	0.91
12% PF	8.00	7.00	0.07	0.95
3% UPF	8.5	6.31	0.051	0.78
6% UPF	8.1	6.30	0.03	0.9
9% UPF	8.11	6.61	0.061	0.91
12% UPF	8.19	6.2	0.01	0.93

DO= Dissolved Oxygen

Economical evaluation:

The feeding evaluation results (Table 8) showed that although the cost to produce 1 kg of the control diet was lower than the other experimental diets, feed conversion ratio (kg diet/kg gain) were lower in all PF or UPF diets than the control group. This may due to the higher body weight gained in all PF and UPF groups. The lowest feeding cost/kg gain (3.65 LE) was observed by fish group fed diet containing 9% PF.

Table 8. Economic evaluation of feeding fish diets supplemented with different levels from protected and unprotected fat.

Group	Price/kg feed (L.E.)	Feed consumed (kg)(to produce kg gain	Total feed cost/kg gain in BW (L.E.)
Control	$1.85^{d} \pm 0.00$	$3.6^{a} \pm 0.00$	$6.66^{a} \pm 0.00$
3% PF	$1.88^{c} \pm 0.01$	$2.2^{c} \pm 0.1$	$4.14^{b} \pm 0.01$
6% PF	$1.91^{c} \pm 0.02$	$2.0^{c} \pm 0.2$	$3.82^{c} \pm 0.02$
9% PF	$1.94^{c} \pm 0.02$	$1.9^{d} \pm 0.2$	$3.65^{c} \pm 0.03$
12% PF	$1.97^{bc} \pm 0.03$	$2.8^{b} \pm 0.3$	$5.52^{b} \pm 0.03$
3% UPF	$2.00^{b} \pm 0.1$	$2.8^{b} \pm 0.2$	$5.60^{b} \pm 0.02$
6% UPF	$2.15^{b} \pm 0.0$	$2.6^{b} \pm 0.2$	$5.59^{b} \pm 0.2$
9% UPF	$2.30^{a} \pm 0.9$	$2.2^{c} \pm 0.3$	$5.06^{b} \pm 0.0$
12% UPF	$2.45^{a} \pm 0.7$	$2.9^{b} \pm 0.3$	$7.1^{a} \pm 0.11$

a, b and c: Means within the same column having different letters are significantly different at $P<0.05$.

CONCLUSION

Based on the obtained results it could be recommended the incorporation of protected fat in Nile Tilapia diets at levels between 6 to 9% for better growth performance and economical results without any adverse effects on blood parameters.

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الاداء الانتاجى لاسماك البلطى النيلى المغذاه على علائق تحتوى على الدهون المحمية او الغير محمية

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يهدف البحث الى دراسة تأثير اضافة مستويات مختلفة (٣ ، ٦ ، ٩ ، ١٢%) من الدهون المحمية وغير المحمية فى العلائق على الاداء الانتاجى والاستفادة من الغذاء وتركيب الجسم والدم ووظائف الكبد فى اسماك البلطى النيلى كما تم عمل تقييم اقتصادى لاستخدام هذه العلا ئق فى نهاية التجربة. تم تركيب عليقة مقارنة و٨ علائق تجريبية تحتوى العلائق الاربعة الاولى على دهون محمية والاربعة الاخيرة على دهون غير محمية بالمستويات السابق ذكرها.

العلائق كانت متساوية فى نسبة البروتين الخام (٣٢%) وتم تغذيعتها لاسبعيات البلطى النيلى بمتوسط وزن بداية ١٥,٢ جم/سمكة ولمدة ١٤ اسبوعا.

وقد اظهرت النتائج ان الوزن النهائى لجسم السمك قد ازداد مع كل المعاملات مقارنة بالمجموعة الضابطة ، ولقد لوحظ زيادة الوزن النهائى بزيادة النسب المضافة من الدهون المحمية او الغير محمية من (٣-٩%) ، وقد انخفض الوزن النهائى للاسماك التى غذيت بنسبة (١٢%) من الدهون المحمية او الغير محمية وكان اعلى وزن نهائى مع مجموعة الاسماك التى تم تغذيتها على دهون محمية بنسبة (٩%) .

تبين ان ADG، TWG، SGR لكل الاسماك فى كل المعاملات قد ازدادت مقارنة بالمجموعة الضابطة ولكن جميع القيم كانت اعلى فى حالة اضافة الدهون المحمية مقارنة بالمجموعات التى غذيت بالدهون الغير محمية .

وقد اظهرت النتائج تحسن معدل التحويل الغذائى والقيمة الانتاجية للبروتين والقيمة الانتاجية للدهون فى مجموعة الاسماك التى غذيت بالدهون المحمية على مستوى (٩%) ، وقد تبين انخفاض مستوى السكر بدم الاسماك فى المجموعات التى تم تغزيتها على عليقة بها نسب دهون محمية (٦-٩-١٢%) بينما لم تتاثر الاسماك فى جميع المعاملات الاخرى ، وارتفع تركيز البروتين الكلى لسيرة الاسماك فى المعاملات التى تم تغذيتها دهون غير محمية (٣-٦-٩%) بينما لما تتأثر المجموعات الاخرى.

وقد تبين ان تركيز الالبومين انخفض مع معاملة الدهون المحمية (١٢%) بينما ارتفع فى معاملتى الدهون الغير محمية (٦-٩%) مقارنة بالمجموعة الضابطة بينما انخفض مستوى الجلوبولين لسيرم دم الاسماك بزيادة نسب الدهون المحمية اعلى من (٣%) ونسب الدهون الغير محمية اعلى من (٩%) وبالرغم من ذلك لم يتاثر نسبة الالبيومين الى الجلوبولين. وقد ازداد معدل AST فى كل معاملات الدهون الغير محمية وكان الاعلى فى حالة الاضافة بنسبة (١٢%) بينما لم يتاثر قيم ASTفى جميع المعاملات التى غذيت بدهون غير محمية وقد ازداد مستوى الجليسردات الثلاثية فى كل معاملات الدهون المحمية والغير محمية وانخفض فقد مع معاملتين الدهون الغير محمية (٩-١٢ %) بينما انخفض تركيز الكولسترول فقط مع معاملة الدهون الغير محمية (١٢%) .

أظهر التحليل الكيماوى للاسماك ان جميع المعاملات التى تم تغذيتها على دهون محمية ازداد بها قيم المادة الجافة بينما لم تتاثر باضافة الدهون الغير محمية وقد تبين ان زيادة نسب الدهون المحمية والغير محمية عن (٣%) ادت الى انخفاض نسبة البروتين الخام وازدياد المستخلص الاثيرى بينما انخفض الرماد عن مستويات الاضافة المنخفضة من الدهون المحمية والغير محمية (٣%) وقد ازداد مع معدلات الاضافة العالية (١٢%) .وقد لوحظ ان معدل اكتساب الوزن كما يقابلة مستوى تكلفة اقل فى جميع المعاملات وقد كان الاقل فى المعاملة التى تم تغذيتها على نسبة اضافة (٦%) . وقد اظهرت الدراسة انه من الممكن اضافة الدهون المحمية او الغير محمية حتى نسبة (٩%) فى العليقة مع ظهور تحسن فى معدلات النمو بدون اى تاثير سلبى على وظائف الكبد.