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Productive performance of hybrid Nile Tilapia fingerlings to rations containing different levels of Jojoba oil

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ABSTRACT

The present study aimed to improve the health status of Nile tilapia fingerlings fish throughout the early developmental stages and to produce high-quality fingerlings, resist unfavorable environmental conditions. Fry of mixed sex hybrid red tilapia 3 g approximately were obtained from a hatchery (GAFRD) found at km 21, Alexandria. After the acclimatization fish, a total number of 315 fries were stocked in 9 ponds randomly divided into three equal experimental groups, each group containing 105 fries distributed in 3 equal replicate ponds each containing 35 fries. The important results showed that Jojoba oil is superior in its contents of eicosenoic acid (C20:1), lignoceric acid (C24:0), and erucic acid (C22:1). Dietary treatments decreased mortality percentage. It decreased feed intake and improved the feed conversion ratio. It increased values of apparent protein digestibility. Values of hemoglobin, RBC's & WBC's cell count, albumin, creatinine, AST, and ALT were significantly affected. Meanwhile, total protein, globulin, albumin: globulin ratio, uric acid and urea were not significantly affected. Moisture and gross energy of body fish were not affected. Energy retention and protein productive value % improved. From the acquired results, it can be mentioned that under conditions available throughout the carrying of this work, incorporating Jojoba oil in Nile Tilapia rations has a positive growth performance effect and represents the best feed utilization. It has no occurring adverse effects on digestibility or blood content. Also, it can be mentioned that may be occurring an improvement in fish performance related to the complementary impact of fatty acids contents in the two sources of oils that were used in the tested rations compared to the control that contained only sunflower oil. Also, Jojoba oil is considered a growth promoter causing an improvement in their performance and encouraging the improved fish health in their early life to produce good quality fingerlings of fish used later on to produce fish on a large scale.

INTRODUCTION

In the latest years there are many attempts to decrease the gap among protein production, animal protein demand and consumption, especially fish protein. In Egypt, aquaculture grows quickly to meet the demand for fish protein (as an animal protein source). Moreover, **GAFRD (2018)** mentioned that in Egypt the total fish production was

increased from 724,300 tons in 2000 to 1,762,174 tons in 2016. In addition to, Egypt produces about 1,048,276 tons of tilapia fish, which represents 80% of total fish production in 2016 as noted by (**GAFRD, 2018**; **Farrag *et al.*, 2020**). **GAFRD (2012) and Abdel-Hakim1 *et al.* (2014)** reported that, during 2012 the total fish productions from all resources were determined by 1371975 tons.

Jojoba (*Simmondsia chinensis*) oil is actually a wax made of long chain monoesters of C20 and C22 fatty acids and alcohols with almost no triglycerides (**Heuzé *et al.*, 2016**).

Jojoba oil is light yellow in color, odorless, and outstandingly stable. It never becomes rancid and withstood repeated heating at between 295°C and 380°C over four days without alteration. It does not need much refining (**El Bassam, 2010**).

Jojoba oil has some medicinal properties such as the relief of headaches and throat inflammation and in treating wounds (**Ranzato *et al.*, 2011)**. Jojoba oil is reported to have anti-inflammatory activity, as well as antimicrobial (**Habashy *et al.*, 2005**) and antifungal/insecticidal properties (**Abdel-Mageed *et al.*, 2016)**.

So this work aimed to investigate the influence of adding Jojoba oil in hybrid fingerlings to improve health status by studying its impact on growth performance, feed utilization and body composition of hybrid fingerlings *Nile Tilapia*.

MATERIALS AND METHODS

This work was carried out at the Fish Experimental Station, Animal Production Department, Faculty of Agriculture, Al-Azhar University, Cairo, Egypt as a co-operation with the Animal Production Department, National Research Centre, 33 El-Bohouth Street, P.O. Box: 12622, Dokki, Cairo, Egypt.

Experimental Unit

Fry mixed sex hybrid red tilapia with average initial body weight of 3 g. The experimental fish were obtained from hatchery (GAFRD) that found at km 21, Alexandria Governorate. After acclimatization fish were randomly distributed into the experimental pond. A total number of 315 fry were stocked in 9 pond (1.5 m x 1.00 m x 1.m) randomly divided into three equal experimental groups, each group contained 105 fry distributed in 3 equal replicate ponds each contained 35 fry). The ponds were supplied all day with air blowers. Water temperature was maintained at (28-25°C). The part of water pond was exchanged with fresh water 10 % /day.

Water Quality

The water temperature and dissolved oxygen were measured daily by oxygen meter (Lutron model Do- 5509, Taiwan) and the pH values were recorded by digital pH meter (Hanna model PHEP, USA). Total ammonia concentration was measured by comparison apparatus using HACH kits (Hach Co., Loveland, Colorado, USA). The percentages of unionized ammonia (NH_4) were calculated from multiplying the total ammonia value by the appropriate factor according to the following equation:

Ammonia concentration (mg/L as NH3) = A/ 100 x 1.2 x total ammonia.
Where A is a coefficient related to water pH and temperature.

Experimental Rations

Two levels of JO (0.05 or 0.10%) that equals 0.5 or 1 ml / kg feed (R_2 and R_3, respectively) as a partial replacement of soybean oil that used in basal or control (zero% of JO). This replacing equal 10 or 20% of the quantity of soybean oil that used in control ratio.

The experimental rations were formulated as iso-caloric and iso-nitrogenous in the form of pelleted floating rations with a diameter 2 mm for the first eight weeks of the experiment, thereafter the pellets diameter was 3 mm, 29.75% crude protein till the end of the experimental period.

The fish were hand-fed at rate 3 % three times /day (9, 12, and 3 pm) throughout the experimental period (84 days).

Growth Performance Parameters

Fish growth performance, weight gain, average body weight gain and survival rate were determined by the following equations:

Body weight gain (BWG) = $(W_1) – (W_0)$.

Where: W_0: means initial weight. W_1: means final weight.

Survival rate (SR %) = Number of fish at final / Number of fish at start x100.

Calculation of feed conversion ratio (FCR)

The feed conversion ratio (FCR) expressed as the proportion of total dry matter intake (TDMI), g / total live body weight gain (TBWG), g as the following equation:

FCR = total dry matter intake, (TDMI), g / total body weight gain (TBWG), g.

Calculation of Crude Protein Efficiency Ratio (CPER)

(PER) = total body weight gain (TBWG), g / total crude protein intake (TCPI), g.

Feed Efficiency

Generally, the following equation using in calculation the feed efficiency

Feed efficiency (FE %) = [Weight gain (g) / Feed intake (g)]

Protein productive value (PPV %) = $[PR_1 – PR_0 / PI] 100$.

Where: PR_1 = is the total fish body protein at the end of the experiment. (On dry matter basis). PR_0 = is the total fish body protein at the start of the experiment. (On dry matter basis) PI = Protein intake.

Energy Retention Percentages (ER %)

The energy retention percentage was calculated according to the following equation:

Energy retention (ER %) = $E\text{-}E_0 / E_F X 100$

Where: E= the energy in fish carcass (kcal) at the end of the experiment.

E0= the energy in fish carcass (kcal) at the start of the experiment.

EF = the energy (kcal) in feed intake.

Digestibility Study

Feces and diets collected seriously were measured through the final 14 days of the experimental time and siphoning any uneaten feed carefully out of each tank approach about 30 minutes after the final feeding. Feces were collected separately by siphoning method from each replicate tank in the morning. It filtered; oven dried at 60 ^{o}C and kept in airtight containers to estimate the chemical analysis and apparent protein digestibility in accordance to **Furukawa and Tuskahara (1966**) method.

Blood Measurements

At the end of the feeding trial, 30 fish, ten of each treatment were captured and anesthetized for blood sampling from caudal vein; five fish of each aquarium were weighted and prepared to collect the blood samples from caudal vein by heparinized syringes. Then it was centrifuged at 4000 rpm for complete 20 minutes for preparation of blood plasma. Plasma kept frozen at -18°C for subsequent analysis.

Body Composition of Different Experimental Group Fish

In the beginning of the feeding trial a total number of 15 fingerlings Tilapia fish were used to determine their whole-body composition. Meanwhile, at the end of the feeding trial, ten from each treatment were randomly chosen also to evaluate their whole body composition. to calculated values of both energy and protein retention.

The chemical composition of feed ingredients presented in **Table (1)**, meanwhile composition and chemical analysis of the experimental rations is shown in **Table (2)**.

Table 1. Chemical composition of feed ingredients.

Item	Ingredients				
	Fish meal	**Soybean meal**	**Corn gluten**	**Yellow corn**	**Wheat bran**
Dry matter (DM)	93.58	94.5	92.85	92.07	91.50
Chemical composition on dry matter basis:					
Organic matter (OM)	78.00	93.72	98.14	98.28	94.78
Crude protein (CP)	65.00	44.16	68.00	9.15	14.08
Crude fiber (CF)	00.00	4.15	1.87	2.50	10.09
Ether extract (EE)	8.22	1.08	2.83	2.85	3.05
Nitrogen free extract (NFE)	4.78	44.33	25.44	83.78	67.56
Ash	22.00	6.28	1.86	1.72	5.22
Gross energy kcal/ kg DM	4644	4608	5241	4365	4305
Metabolizable energy Kcal/ kg DM	376.18	362.23	417.85	356.79	324.00
Protein energy ratio (mg CP/ Kcal ME)	172.79	121.91	162.74	25.65	43.46

Gross energy (kcal/ kg DM) was calculated according to **Blaxter (1968)**; **MacRae and Lobley, 2003**). Where, each g CP = 5.65 Kcal, g EE = 9.40 kcal and g CF and NFE = 4.15 Kcal.

Metabolizable energy (ME):- calculated using values of 4.50, 8.15 and 3.49 Kcal for protein, fat and carbohydrate, respectively. Protein energy ratio (mg CP/ Kcal ME): Calculated according to (**NRC, 2011**).

Table 2. Composition and chemical analysis of the experimental rations.

Ingredients	**Experimental rations**		
	R_1 0.00 % Jojoba oil	**R_2 0.05 % Jojoba oil**	**R_3 0.10 % Jojoba oil**
Composition of the experimental rations			
Fish meal	13.00	13.00	13.00
Soybean meal	27.00	27.00	27.00
Corn gluten	6.00	6.00	6.00
Yellow corn	44.00	44.00	44.00
Wheat bran	9.00	9.00	9.00
Sunflower oil (SFO)	0.50	0.45	0.40
Jojoba oil (JO)	0.00	0.05	0.10
Di-calcium phosphate	0.10	0.10	0.10
Sodium chloride	0.10	0.10	0.10
Vitamin & mineral Mixture*	0.30	0.30	0.30
Chemical analysis (%)			
Dry matter (DM)		92.50	
Chemical composition on Dry matter basis			
Organic matter (OM)		93.61	
Crude protein (CP)		29.75	
Crude fiber (CF)		2.56	
Ether extract (EE)		3.55	
Nitrogen free extract (NFE)		57.75	
Ash		6.39	
Gross energy kcal/ kg DM		4517	
Metabolizable energy kcal/ kg DM		364.36	
Protein energy ratio (mg CP/ Kcal ME)		81.65	

Each Kg vitamin & mineral mixture premix contained Vitamin A, 4.8 million IU, D3, 0.8 million IU; E, 4 g; K, 0.8 g; B1, 0.4 g; Riboflavin, 1.6 g; B6, 0.6 g, B12, 4 mg; Pantothenic acid, 4 g; Nicotinic acid, 8 g; Folic acid, 0.4 g Biotin,20 mg , Mn, 22 g; Zn, 22 g; Fe, 12 g; Cu, 4 g; I, 0.4 g, Selenium, 0.4 g and Co, 4.8 mg.

Gross energy (kcal/ kg DM) was calculated according to (**Blaxter, 1968; MacRae and Lobley 2003**). Where, each g CP = 5.65 Kcal, g EE = 9.40 kcal and g CF and NFE = 4.15 Kcal.

Metabolizable energy (ME):- calculated using values of 4.50, 8.15 and 3.49 Kcal for protein, fat and carbohydrate, respectively. Protein energy ratio (mg CP/ Kcal ME): Calculated according to (**NRC, 2011**).

received ration containing 0.10 % JO.

Analytical Procedures

Chemical analysis of the ingredients, experimental rations and body composition of the fish basal diet that fed to all tested groups and samples of body composition of fish were analyzed according to **AOAC** (**2016**) methods.

Fatty acid profiles were determined according to method that described by **AOAC (2000a, 2000b)** through out convert oil to methyl esters.

Blood samples were evaluated according to the method described by **Weiss and Wardrop (2010)**. It included the red blood cell count (RBC's), white blood cell count

(WBC's) and hemoglobin (Hb) concentration. Serum total proteins and albumin were determined according to the methods of **Henary *et al.* (1974)** and **Doumas *et al.* (1971)**, respectively. The activities of aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were determined according to the procedure of **Reitman and Frankel (1957)**.

Serum urea, uric acid and creatinine were determined according to the methods of **Patton and Crouch (1977); Houot (1985)**, respectively. On the other hand, globulin and albumin: globulin ratio (A: G ratio) were calculated by difference. Test kits supplied by bioMérieux-France, were used.

Calculated Data

According to **Blaxter** (**1968); MacRae and Lobley (2003**) the gross energy (kcal/ kg DM) of basal diet and body composition of tested group fish were calculated to calculating the energy retention percentages, using the following values, each g CP= 5.65 Kcal, g EE= 9.40 Kcal and g CF & NFE = 4.15 Kcal.

Statistical Analysis

Collected data were subjected to statistical analysis as one way analysis of variance according to **SPSS (2020)**. Duncan's Multiple Range Test **Duncan (1955)** was used to separate means when the dietary treatment effect was significant according to the following model: $Y_{ij} = \mu + T_i + e_{ij}$ Where: Yij = observation μ = overall mean.

Ti = effect of experimental rations for i = 1–3, 1 = G1: hybrid fingerlings of Nile Tilapia fish received ration containing 0.00 % Jojoba oil (JO) and assigned as control group; G2: hybrid fingerlings of Nile tilapia fish received ration containing 0.05 % JO and G3: hybrid fingerlings of Nile tilapia fish and e_{ij} = the experimental error.

RESULTS AND DISCUSSION

Fatty acid profile of two sources of oils used in ration formulation

Results of fatty acids composition (%) in sunflower and Jojoba oils (**Table 3**) mentioned that sunflower oil superior in their contents of plasmatic, stearic and linoleic acid**s.** Meanwhile, Jojoba oil superior in their contents of eicosenoic, lignoceric and erucic acids. But the other fatty acids were almost in the same range**.** This variation may be plays a key role to the physicochemical properties of the oil. Jojoba oil is reported to have anti-inflammatory activity, as well as antimicrobial (**Habashy *et al.*, 2005**) and antifungal/insecticidal properties (**Abdel-Mageed *et al.*, 2016)**. Also, the following chemical formula is typical of an ester found in Jojoba oil that noted by **Wendel (1980**)

CH3 (CH2)7CH = CH-(CH2)7CO-O-(CH2)11CH = CH (CH2)7CH3

Water Quality

As presented in **Table (4)** generally, water temperature varied from 27.2 to 29.8°C; dissolved oxygen ranged from 5.7 to 6.00 mg/L. On the other hand, pH values ranged from 7.4 to 7.7. Meanwhile, values of ammonia (NH_3) ranged from 0.20 to 0.24 mg/L. In addition to, nitrite ranged from (0.04 to 0.06).

Table 3. Fatty acids composition (%) in sunflower and Jojoba oils.

Fatty acids		Percentages in	
		Sunflower oil	Jojoba oil
Palmitic	C16:0	5.80	3.00
Palmitoleic	C16:1	0.10	1.00
Stearic	C18:0	3.90	1.00
Oleic	C18:1	15.90	15.00
Linoleic	C18:2	71.70	5.00
Alpha Linolenic	C18:3	0.60	0.50
Gamma Linolenic	C18:3	0.10	0.50
Arachidic	C20:0	0.30	0.50
Eicosenoic	C20:1	0.20	60.00
Lignoceric	C24:0	0.50	5.00
Behenic	C22:0	0.70	0.50
Erucic	C22:1	0.00	7.90
Others		0.20	0.10

Table 4. Average values of water quality parameters of all experimental ponds during the experimental period (12 weeks).

Parameter	Rang from … to …
Water Temperature °C	27.2 - 29.8
Dissolved Oxygen (mg/L)	5.7 - 6
PH	7.4 - 7.7
Ammonia (NH4-mg/L)	0.2 - 0.24
Nitrites (NO2- mg / L)	0.04 - 0.06

Present results ammonia (NH_4) and nitrites concentration that recorded during the whole experimental period in agreement with those found by (**El-Sayd, 2006)**. Meanwhile, **Abdelhamid *et al.* (2011a, 2011b)** showed that the water quality criteria were generally within the normal ranges (25.6-26.2 °C, 7.02-7.53 pH and 5.95-610 mg/ l DO. The present results is in harmony with those found by **Stickney (1979)** showed.

Our results are in the range that obtained by **Boyd and Tucker (1998)** who recorded that when waters pH ranged from 6.5 to 9 this range was the most suitable for fish production. **Eid *et al.* (2021)** noted water temperature ranged from (27.5-27.60 °C), pH value was ranged from 7.1 to 8.03, dissolved Oxygen was ranged from 6.40 to 6.58 mg/L They also, noticed 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. Also, they mentioned that total NH_3 values were ranged from 2.20 to 3.70 mg /l among the different treatments.

Growth performance and survival ratio of different experimental groups

Data of **Table** (**5**) mentioned that incorporation JO in hybrid fingerlings *Nile tilapia* fish realize an improving in their values of FW, TBWG ADG and it also, improved their survival ratio through depressing the number of dead fish during the experimental duration period that lasted for 84 days. Fish fed 0.10% JO containing diet (G_3) recorded the best values of FW, TBWG and ADG comparing to control (G_1) and the experimental group fish that received 0.05% JO containing diet (G_2). In addition to inclusion JO in fish diet decrease percentage rate of the mortality. These may be related to improve the health of fish and it also considered as anti oxidant.

Table 5. Growth performance and survival ratio of different experimental groups.

Item	Experimental groups				
	G_1 0.00 % Jojoba oil	G_2 0.05 % Jojoba oil	G_3 0.10 % Jojoba oil	SEM	Sign. P<0.05
Initial weight, g (IW)	2.99	3.02	3.03	0.012	NS
Final weight, g (FW)	18.55^b	19.63^b	21.95^a	0.35	*
Total body weight gain, g (TBWG)	15.56^b	16.61^b	18.92^a	0.35	*
Duration experimental period		84 days			
Average daily gain, g (ADG)	0.185^b	0.198^b	0.225^a	0.005	*
Number of fish at the starter	105	105	105	-	-
Number of fish at the end	93	97	96	-	-
Survival ratio	88.57 %	92.38 %	91.43 %		
Number of dead fish	12/105	8/105	9/105	-	-
Mortality rate percentages	11.43 %	7.62 %	8.57 %	-	-

a, and b: Means in the same row having different superscripts differ significantly (P<0.05).

SEM: Standard error of mean NS: Not significant *: Significant at (P<0.05).

G_1: hybrid fingerlings of Nile Tilapia fish received ration containing 0.00 % Jojoba oil (JO) and assigned as control group.

G_2: hybrid fingerlings of Nile Tilapia fish received ration containing 0.05 % Jojoba oil (JO).

G_3: hybrid fingerlings of Nile Tilapia fish received ration containing 0.10 % Jojoba oil (JO).

Feed utilization and apparent protein digestibility of different experimental groups

Data presented in **Table (6)** cleared that group fish that fed 0.01% JO (G_3) significantly (P<0.05) improved both values of TBWG and feed conversion ratio (FCR), meanwhile it insignificantly (P>0.05) increased their value of apparent protein digestibility (APD) compared to (G1). G3 showed a decreasing values of protein efficiency ratio (PER) comparing to the control one (G1).

Ali and El-Feky (2019) noted that addition of prebiotics in commercial diets of Nile Tilapia (Oreochromis niloticus) fingerlings caused improving in their diet and protein digestibility, which may in turn, described the better growth and feed efficiency observed with the supplemented diets. Moreover, Ringo et al. (2010) reported that addition of β-glucan had no negative influence on the activity of the major enzymes in stomach and intestine of Nile Tilapia fish.

Table 6. Feed utilization and apparent protein digestibility of different experimental groups.

Item	Experimental groups				
	G_1 0.00 % Jojoba oil	G_2 0.05 % Jojoba oil	G_3 0.10 % Jojoba oil	SEM	Sign. P<0.05
Total body weight gain, g (TBWG)	15.56[b]	16.61[b]	18.92[a]	0.35	*
Feed intake (FI), g	22.79[a]	21.19[b]	20.88[b]	0.302	*
Feed conversion ratio (FCR)	1.465[c]	1.276[b]	1.104[a]	0.052	*
Crude protein %			0. 2975		
Crude protein intake (CPI), g	6.78[a]	6.30[ab]	6.21[b]	0.090	*
Protein efficiency ratio (PER)	2.29[a]	2.64[b]	3.05[c]	0.110	*
Apparent protein digestibility (APD)	75.66	75.82	76.08	0.095	NS

a, b and c: Means in the same row having different superscripts differ significantly (P<0.05).

SEM: Standard error of mean *: Significant at (P<0.05). NS: not significant

G_1: hybrid fingerlings of Nile Tilapia fish received ration containing 0.00 % Jojoba oil (JO) and assigned as control group.

G_2: hybrid fingerlings of Nile Tilapia fish received ration containing 0.05 % JO.

G_3: hybrid fingerlings of Nile Tilapia fish received ration containing 0.10 % JO.

Blood parameters of different experimental groups

As shown in **Table (7)** blood parameters include hemoglobin concentration (Hb), both RBC's & WBC's cells count, albumin, creatinine, AST and ALT were affected by dietary treatments. Meanwhile, the other blood parameters include total protein, globulin, albumin: globulin ratio, uric acid and urea. Group fish fed 0.10 % JO (G_3) recorded significantly (P<0.05) increasing in their content of Hb, RBC's and WBC's, meanwhile it in significantly (P<0.05) increasing in their content of creatinine, AST and ALT, comparing to the control (G_1), but the other parameter were in the same trend with the two other groups (G_1 and G_2). Furthermore, group fish fed 0.05 % JO (G_2) showed effect in comparison with two other groups (G_1 and G_3). The effect of dietary treatments on growth and health of *Nile Tilapia* was evaluated through the examination of Hb concentration, RBC's and WBC's cells count, plasma total protein, albumin and plasma globulin. These parameters considered as measures of oxygen carrying capacity of blood and indices nutritional value of diets, in addition to the value of the classical blood variables (erythrocyte count, Hb and hematocrite … etc) indicators of fish health as noted by **Abou Sinna (2006**) who fed Nile Tilapia on diet differ in their contents of protein sources as alternative sources for fish meal. The present results of blood parameters was in agreement with these values of blood parameters that obtained by **El Kobaby (2003); Abou Sinna (2006); Abdelhamid *et al.* (2009)** who fed Nile tilapia on diets containing different source of protein as a replacement of fish meal at different levels. Also, our results was in agreement with those obtained by **Al-Hassan *et al.* (1990)** who studied seasonal variations in the hemoglobin concentration and haematocrit values of Silurs triostegus *(Silurus* spp.*)*.

Table 7. Blood parameters of different experimental groups.

Item	Experimental groups				
	G_1 0.00 % Jojoba oil	G_2 0.05 % Jojoba oil	G_3 0.10 % Jojoba oil	SEM	Sign. P<0.05
Hb concentration (g/dl)[1]	11.50[b]	11.55[ab]	11.60[a]	0.017	*
RBC's cell count (x106/µl) [2]	1.52[b]	1.56[ab]	1.59[a]	0.012	*
WBC's cell count (x106/µl) [3]	4.83[b]	4.86[ab]	4.89[a]	0.011	*
Total protein (g/ dl)	4.16	4.18	4.17	0.007	NS
Albumin (g/ dl)	2.21[a]	2.19[ab]	2.18[b]	0.006	*
Globulin (g/ dl)	1.95	1.99	1.98	0.010	NS
Albumin: globulin ratio	1.13	1.10	1.10	0.007	NS
Urea mg/dl	4.35	4.33	4.31	0.011	NS
Uric acid mg/dl	1.95	1.93	1.91	0.009	NS
Createnine mg/dl	0.344[a]	0.340[ab]	0.336[b]	0.001	*
AST (U/l)[4]	21.11[a]	21.06[ab]	21.02[b]	0.016	*
ALT (U/l)[5]	9.32[a]	9.28[ab]	9.25[b]	0.014	*

a and b: Means in the same row having different superscripts differ significantly (P<0.05).

SEM: Standard error of mean.

[1]Hb: Hemoglobin concentration [2]Red blood cell count (x106/µl) [3]White blood cell count (x106/µl)

[4]AST: Aspartate aminotranseferase [5]ALT: Alanine aminotransferase

G_1: hybrid fingerlings of Nile Tilapia fish received ration containing 0.00 % Jojoba oil (JO) and assigned as control group. G_2: hybrid fingerlings of Nile Tilapia fish received ration containing 0.05 % JO.

G_3: hybrid fingerlings of Nile Tilapia fish received ration containing 0.10 % Jo.

Body composition of different experimental groups

Data obtained of body fish composition (**Table 8**) illustrated corresponding values of body fish composition were ranged from 75.28 to 75.52 %; 87.64 to 87.58 %; 64.35 to 64.52 %; 23.12 to 23.20 %, 12.36 to 12.45 % and 5817 to 5819 kcal/ kg DM for the moisture, organic matter, crude protein, ether extract, ash and gross energy, respectively. These results were in agreement with those obtained by **Ali and El-Feky (2019)** and **Abo-State *et al.* (2021)** who using prebiotics or manna oligosaccharide and β-glucan in commercial diets of Nile Tilapia **(***Oreochromis niloticus*) fingerlings and they noticed that there were no statistical differences had been discovered in whole body moisture, ether extracts and ash. But they noted that body crude protein content was higher in the fish fed on diets with β-glucans diets (p<0.05). Also, our results was in harmony with the results of **Wafaa *et al*. (2014)**; **Mohamed *et al. (*2018)** who, evaluated the effect of incorporation prebiotic, probiotic, manna oligosaccharide and β-glucan in commercial diets of *Cyprinus carpio* Frays or of Nile Tilapia **(***Oreochromis niloticus*) fingerlings, respectively.. On the other hand, **Abdel-Hakim *et al.* (2014)** mentioned that gross energy contents in Nile Tilapia whole bodies varied from 556.51 to 557.94 kcal/ 100 g. **Abdel-Hakim *et al.* (2013)** recorded that gross energy/kcal/100g contents in whole Nile tilapia

bodies ranged from 549.91 and 568.85 kcal/100g which almost near from the results that illustrated in our study.

Table 8. Body composition of different experimental groups.

Item	Experimental groups				
	G_1 0.00 % Jojoba oil	**G_2 0.05 % Jojoba oil**	**G_3 0.10 % Jojoba oil**	**SEM**	**Sign. P<0.05**
Moisture	75.38	75.52	75.41	0.122	NS
Dry matter (DM)	24.62	24.48	24.59	0.122	NS
Chemical analysis on DM basis					
Organic matter (OM)	87.64	87.58	87.55	0.020	NS
Crude protein (CP)	64.52	64.40	64.35	0.089	NS
Ether extract (EE)	23.12	23.18	23.20	0.077	NS
Ash	12.36	12.42	12.45	0.020	NS
Gross energy kcal/ kg DM*	5819	5818	5817	2.386	NS
Gross energy cal/ g DM	5.819	5.818	5.817	0.002	NS

SEM: Standard error of mean NS: Not significant

*Gross energy (kcal/kg DM) was calculated according to (**Blaxter, 1968; MacRae and Lobley 2003**).

G_1: hybrid fingerlings of Nile Tilapia fish received ration containing 0.00 % Jojoba oil (JO) and assigned as control group.

G_2: hybrid fingerlings of Nile tilapia fish received ration containing 0.05 % Jojoba oil (JO)

G_3: hybrid fingerlings of Nile tilapia fish received ration containing 0.10 % Jojoba oil (JO)

Energy retention (ER) % and protein productive value (PPV) % of different experimental groups

Data illustrated in **Table (9)** cleared that value of energy retention percentages (ER %) improved gradually Jojoba oil used. The corresponding values of ER % were 87.95, 100.95 and 116.69% for three groups G_1, G_2 and G_3, respectively. Furthermore, values of protein productive value (PPV) % were also, take the same direction where the dietary treatment significantly (P<0.05) improved PPV % in comparison with the control group. The corresponding values of PPV % were 148.05, 169.84 and 195.97 % for the three experimental groups G_1, G_2 and G_3, respectively. When **Abo-State *et al.* (2021)** studied effect of dietary supplementation of manna oligosaccharide and β-glucan on the performance and feed utilization of Nile tilapia fingerlings, they mentioned that there were significant differences (P<0.05) of PPV and ER % between the treatments. The superior values of PPV and ER % were occurred in group fish fed on diets supplemented with mannan oligosaccharide (MOS) and β-glucan at 2 and 4g/kg, followed by diet supplemented with 6 g/kg, and the worst values of PPV and ER were observed with the control. No differences (P>0.05) were observed among various levels of MOS and β-glucan on PPV and ER %.

Table 9. Energy retention (ER) % and protein productive value (PPV) % of different experimental groups.

Item	Experimental groups			SEM	Sign. P<0.05
	G_1 0.00 % Jojoba oil	G_2 0.05 % Jojoba oil	G_3 0.10 % Jojoba oil		
Initial weight (IW), g	2.99	3.02	3.03	0.01	NS
Final weight (FW), g	18.55^{b}	19.63^{b}	21.95^{a}	0.35	*
Calculation the energy retention (ER) %					
Energy content in body fish (cal / g body fish)	5.819	5.818	5.817	0.02	NS
Energy at the end in body fish (E)	107.94^{c}	114.21^{b}	127.68^{a}	2.913	*
Energy at the start in body fish (E_0)	17.40^{b}	17.58^{ab}	17.63^{a}	0.047	*
Energy retained in body fish (E-E_0)	90.54^{c}	96.63^{b}	110.05^{a}	2.882	*
Energy of the feed (cal / g feed)	4.517				
Quantity of feed intake	22.79^{a}	21.19^{b}	20.88^{b}	0.302	*
Total energy feed (EF)	102.94^{a}	95.72^{b}	94.31^{c}	1.346	*
Energy retention (ER) %	87.95^{c}	100.95^{b}	116.69^{a}	4.155	*
Calculation the protein productive value (PPV) %					
Crude protein % in body fish	64.52	64.64	64.35	0.089	NS
Total protein at the end in body fish (PR_1)	11.97^{c}	12.64^{b}	14.12^{a}	0.322	*
Total protein at the start in body fish (PR_2)	1.93	1.94	1.95	0.008	NS
Protein Energy retained in body fish (PR_3) = (PR_1 – PR_2)	10.04^{c}	10.70^{b}	12.17^{a}	0.318	*
Crude protein in feed (CP %)	29.75				
Total Protein intake (PI), g	6.78^{a}	6.30^{b}	6.21^{b}	0.090	*
Protein productive value (PPV) %	148.08^{c}	169.84^{b}	195.97^{a}	6.922	*

a, b, c and d: Means in the same row having different superscripts differ significantly (P<0.05).

SEM: Standard error of mean NS: Not significant *: Significant at (P<0.05).

G_1: hybrid fingerlings of Nile Tilapia fish received ration containing 0.00 % Jojoba oil (JO) and assigned as control group.

G_2: hybrid fingerlings of Nile Tilapia fish received ration containing 0.05 % Jojoba oil (JO).

G_3: hybrid fingerlings of Nile Tilapia fish received ration containing 0.10 % Jojoba oil (JO) **.**

CONCLUSION

From obtained results, it can be mentioned that inclusion Jojoba oil at different levels in Nile Tilapia diets has a positive growth performance effect and represents the best feed utilization with no realize any adverse effects on digestibility or blood parameters. Also, adding Jojoba oil in fish diets considered a growth promoters caused an improving in their performance and encourage the improve the fish health in their early life thought out the fingerlings to produce a good quality fingerling of fish during the rearing period and to use it in production the fish in the large scale.

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