Zagazig J. Agric. Res., Vol. 52 No. (2) 2025 357-368

Animal, Poultry and Fish Production Research

Available online at http://zjar.journals.ekb.eg
http:/www.journals.zu.edu.eg/journalDisplay.aspx?Journalld=1&queryType=Master

THE IMPACT OF PARTIALLY REPLACING THE NILE TILAPIA FINGERLINGS (*Oreochromis niloticus*) DIET WITH *Moringa oleifera* LEAVES' POWDER ON SURVIVABILITY, BODY INDICES, GROWTH PERFORMANCE, BODY COMPOSITION, AND FEED UTILIZATION

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Received: 16/03/2025 ; Accepted: 05/04/2025

ABSTRACT: This work was carried out to study the effects of replacing the basal diet of Nile tilapia fingerlings by grading levels of *Moringa oleifera* leaves (MOL) on growth performance and body composition. One hundred and fifty *Oreochromis niloticus* fingerlings with an average weight of 10.84 ± 0.12g were divided into five experimental groups (30 per group). Each fish group had three equal replicates (10 per each). MOL was used at five levels 0, 5, 10, 15, and 20% instead of the basal diet. The experimental period persisted for 10 weeks. The results showed that fish body weight, body weight gain, feed intake and feed conversion ratio did not significantly differ between Tilapia fed the basal diet and 5% MOL. While, significant ($P \leq 0.05$) decreases in growth indices occurred in the Tilapia group fed diet contain 10, 15 and 20% MOL. The survival rate was 90% for Tilapia fed 0, 10, 15, and 20% MOL compared to 93.33% for fed 5% MOL. The hazard components (ammonia and nitrite) in water decreased significantly ($P<0.05$) with MOL. In comparison with the control group, the chemical composition of the Tilapia body showed increases in OM, NFE and EE in 5% MOL Tilapia group, while contents of CP and ash were significantly elevated with 10 and 20% MOL Tilapia groups. The condition factor, hepatosomatic index and intestinal somatic index) did not significantly differ between Tilapia fed 5% MOL and control. The MOL did not affect the condition factor. The results showed that replacing 5% of the basal diet with MOL did not negatively affect growth performance and body composition, but improved water quality and survivability.

Key words: Partially replacing, nile tilapia fingerlings, *Moringa oleifera* leaves'.

INTRODUCTION

Fish feeds contribute about 75 to 85% of running costs of fish production **(Dickson *et al.*, 2016).** Using antibiotics and animal protein resources as growth promoters is becoming unaffordable in fish production. Alternative medicinal plants were incorporated into diets as growth promoters to avoid potential health and environmental hazards and the high cost **(Shourbela *et al.*, 2021; Kumar *et al.*, 2022)**.

Nile tilapia considered one of the most productive food fish in Egypt and all over the world **(Modadugu and Belen, 2004; Mugwanya *et al.*, 2021)**. Egypt is known to be one of the leading countries in the field of aquaculture with an average annual production exceeding one million tons (1,137,000) **(FAO, 2016)**. About 65% of this production comes from the most cultivated species, the Nile tilapia (*Oreochromis niloticus*) **(Dickson *et al.*, 2016)**.

In Egypt, *Moringa oleifera* (MO) has been grown in Aswan, North Sinai, and El-Sharkyia governorates **(Richter *et al.*, 2003; Falowo *et al.*, 2018).** MO has many beneficial effects on health **(Cheenpracha *et al.*, 2010; Abd Rani *et***

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***al.*, 2018; Toppo *et al.*, 2015).** *Moringa oleifera* leaves (MOL) contains many benefit nutrients (vitamins, minerals, and protein) **(Afuang *et al.*, 2003; Murro *et al.*, 2003)**. EXtensive studies have shown to use MOL in different fish species such as improvement of the growth performance of Nile tilapia **(Elabd *et al.*, 2019)** and rohu **(Hussain *et al.*, 2018),** enhancement of feed utilization indices and nutrient digestibility of Bocourti's catfish **(Puycha *et al.*, 2017)**.

This work was carried out to study the effects of partial replacement of Nile tilapia fingerlings diet with graded levels 0, 5, 10, 15 and 20% of MOL on growth performance, water quality, survival rate, and body composition.

MATERIALS AND METHODS

This study was carried out in The Animal Production Department, Faculty of Agriculture, Zagazig University, Egypt, during summer of 2022. The experimental work included 5 treatments. MOL was included in place of 0, 5, 10, 15, and 20% of the basal diet in Nile tilapia fingerlings. The experimental period lasted for 10 weeks.

Fish and Aquaria

One hundred and fifty fingerlings of monosex Nile tilapia (*Oreochromis niloticus*) with an average initial weight of 10.84 ± 0.12g were divided into five experimental groups (30 fish/ group). Each group had three equal replicates (10 fish each). Fingerlings were procured from a private farm El-Tal El-Kabir, Ismailia Governorate, Egypt. Each fish group was housed in a glass aquarium (70 × 50 × 30 cm). Fish were kept for 2 weeks to acclimate before the start of the main experimental period. Fish aquaria were supplied with dechlorinated tap water from a storage tank. The air was supplied by aquarium air pumps. Fish waste was drained by suction with a third of the water volume daily. The glass aquariums were cleaned every two weeks to avoid any natural food formation such as algal growth. Water samples are collected periodically from aquaculture to determine dissolved oxygen and pH. The average dissolved oxygen concentration was 5.5-6.5 mg/L and the pH value was 7.5. The water temperature was measured using a thermometer and its average value was 26 ± 2 °C during the experimental period.

Experimental Diets

The MOL was purchased from a local market in Zagazig, Egypt. The ingredients and formulation of the basal diet are shown in Table 1. The basal diet and MOL pelleted were milled and mixed to formulate the diets, then pelleted again. The MOL levels in experimental diets were 0, 5, 10, 15, and 20% instead of basal diet as shown in Table 2. The chemical composition of MOL and basal diet (Table 3) and experimental diets (Table 4) were determined according to **AOAC (2006).**

Feeding regime

Fish were hand-fed *ad libitum* twice daily at 9 AM and 3 PM. Diets were provided six days a week.

Growth parameters

The fish replicates were weighed every two weeks. Body weight gain (BWG) and Feed conversion ratio (FCR) as follows:

BWG = $[BW_n - BW_0]$.

Where: BW_n is the final body weight (g) and BW_0 is the initial body weight (g).

FCR = [feed intake (g; on dry matter basis) / weight gain g].

Survival rate

At the end of the trial period, the Survival rate was calculated from the following equation:

Survival rate (%) = (number of Survival fish / initial fish number) × 100.

Body indices and body composition

At the end of the experimental trial, the weight in g and length in cm of each fish were determined. The condition factor was estimated as recommended by **Froese (2006)** by using the equation:

$$\text{Condition factor (K)} = [\text{body weight g} / (\text{body length cm})^3] \times 100$$

After eviscerating five fish as a representative sample from each replicate, the liver, intestine, and gonads were weighed wet, then hepatosomatic index (HSI), intestinal somatic index (ISI), and gonadosomatic index (GSI) were calculated as follows:

Table 1. Ingredients and formulation of the basal diet

Ingredients	%
Fish meal	20
Soybean meal	37.5
Yellow corn	20.5
Wheat flour	15
Fish oil	3
Vegetable oil	2
Premix [a]	2
Total	100

[a]; Minerals and vitamins mixture consisted of: 30000 mg Copper, 250 mg Iodine, 300 mg Selenium, 50000 mg Manganese, 400 mg Cobalt, 60000 mg Zinc and 3000 IUGm\ 30KgIU CaCo3, retinol (VA) 10,000 international units (IU); cholecalciferol (VD) 1,500 IU; tocopherol (VE) 2500 IU; menadione (VK), 40IU; thiamin (VB1) 1IU; riboflavin (VB2), 9IU; pyridoxine (VB6),3IU; cyanocobalamin (VB12) IU, 0.1, folic acid, 1.5IU; antiIU ascorbic acid (VC),60IU.

Table 2. levels of Moringa oleifera leaves (MOL) in the tested diets

Items %	Experimental diets				
	1	2	3	4	5
Basal diet	100	95	90	85	80
MOL	0 (control)	5	10	15	20
Total	100	100	100	100	100

Table 3. Chemical composition of the basal diet and *Moringa oleifera* leaves

Items %	Basal (Control) diet	*Moringa oleifera* leaves (MOL)
Moisture	10.71	12.03
Dry matter	89.29	87.97
Organic matter	82.34	77.22
Crude protein	31.25	24.38
Crude fiber	4.69	14.78
Ether extract	3.00	7.23
Nitrogen free extract	43.40	30.83
Ash	6.95	10.75

Table 4. Chemical composition of the tested diets

Items %	*Moringa oleifera* leaves (MOL)				
	0 (control)	5	10	15	20
Moisture	10.71	10.78	10.84	10.91	10.97
Dry matter	89.29	89.22	89.16	89.09	89.03
Organic matter	82.34	82.08	81.83	81.57	81.32
Crude protein	31.25	30.91	30.56	30.22	29.88
Crude fiber	4.69	5.19	5.70	6.20	6.71
Ether extract	3.00	3.21	3.42	3.63	3.85
Nitrogen free extract	43.40	42.77	42.13	41.52	40.88
Ash	6.95	7.14	7.33	7.52	7.71

HIS = [liver weight g / body weight g] × 100

ISI = [intestine weight g / body weight g] × 100

GSI= [gonads weight g / body weight g] × 100

From each replicate, a sample of 5 fish were taken, oven-dried at 65ºC for 72 hours, ground, and then subjected to the chemical analysis according to **AOAC (2006)**.

Statistical Analysis

Data of the experiment were statistically analyzed using the general linear model program of the **SAS (1996)**. The data in the excel sheets were examined by one-way ANOVA. Significant differences between treatment means were tested by Duncan's Multiple Range Test **(Duncan, 1955).**

RESULTS AND DISCUSSION

Chemical Composition of MOL and Experimental diets

The chemical composition of *Moringa oleifera* leaves (MOL) showed a decrease in organic matter (OM), crude protein (CP), and nitrogen free extract (NFE), while the crude fiber (CF), ether extracts (EE), and ash were increased in MOL in comparison with the basal diet (Table 3). The chemical composition of MOL was nearly similar to those reported by **Richter *et al.* (2003) (**25% CP and 8.4% ash), **Wu *et al.* (2013)** (23.0-30.3%CP and 12.0% ash), **Idowu *et al.* (2017)** (26.94% CP, 4.38% CF, 3.36% ash, and 51.08% NFE), and **Moyo *et al.* (2011)** (30.3% CP).

The chemical composition of experimental diets (Table 4) showed a decrease in the values of OM, CP and NFE by using MOL instead of the control diet. The decrease in these parameters was linearly by levels of MOL. On the other hand, the CF, EE and ash of diets increased by MOL.

The difference in chemical composition of MOL among studies may be due to agriculture location, plant age, and soil fertility.

Effect of the experimental dietary MOL on feed intake

In parallel with the control, the results showed significant ($P \leq 0.05$) decline in feed intake (Table 5) with the replacement levels 10, 15 and 20% of dietary MOL, while the 5% MOL level did not significantly alter the feed intake.

MOL contains antinutritional factors like phytate 10.58 ± 0.01 (mg/100g), oxalate 334.33 ± 0.67 (mg/100g), tannin 8.19 ± 0.01 (mg/100g), alkaloid 1.72 ± 0.01% and HCN 3998.30 ± 0.49 (mg/100g) (**Auwal *et al.*, 2019**). These antinutritional substances may have adverse effect on feed palatability.

Table 5. Effect of dietary level of *Moringa oleifera* leaves (MOL) on feed intake (g)

Items	MOL level %					*P* value
	0 (control)	5	10	15	20	
2 weeks	$3.87^{bc} \pm 0.06$	$3.91^{ab} \pm 0.02$	$3.93^{ab} \pm 0.01$	$3.95^{a} \pm 0.02$	$3.84^{c} \pm 0.03$	0.008
4weeks	$4.72^{a} \pm 0.04$	$4.76^{a} \pm 0.13$	$4.53^{ab} \pm 0.26$	$4.47^{b} \pm 0.08$	$4.45^{b} \pm 0.01$	0.046
6 weeks	$6.30^{a} \pm 0.04$	$6.21^{a} \pm 0.13$	$5.58^{b} \pm 0.26$	$5.55^{b} \pm 0.08$	$5.54^{b} \pm 0.01$	0.002
8 weeks	$7.40^{a} \pm 0.26$	$7.25^{a} \pm 0.16$	$6.59^{b} \pm 0.27$	$6.36^{b} \pm 0.12$	$6.43^{b} \pm 0.05$	0.001
10 weeks	$8.77^{a} \pm 0.02$	$8.39^{b} \pm 0.12$	$7.64^{c} \pm 0.08$	$7.13^{c} \pm 0.22$	$7.16^{c} \pm 0.10$	0.001
Average	$6.21^{a} \pm 0.11$	$6.11^{a} \pm 0.10$	$5.65^{b} \pm 0.17$	$5.45^{b} \pm 0.12$	$5.49^{b} \pm 0.02$	0.001

a, b, c and d: means in the same row with different superscript differ significantly (P≤ 0.05).

Effect of the experimental dietary MOL on water quality

All the tested levels of MOL significantly (P<0.05) reduced the concentrations of ammonia and nitrite in aquaria water (Table 6). These results are in harmony with that demonstrated by **Kaleo *et al.* (2019)** who found that dietary 0.5% MOL extract substantially counteracted ammonia stress in giant freshwater prawns. Moreover, MOL can mitigate the influence of other physical stressors such as transportation and hyperthermia-induced stress in Nile tilapia **(Gbadamosi *et al.*, 2016; Gbadamosi *et al.*, 2017),** confinement stress in common carp **(Khalil and Korni, 2017),** and starvation in Nile tilapia **(Elabd *et al.*, 2019)**.

Effect the experimental of dietary MOL on body weight, body weight gain and survival rate

The values of final body weight (FBW; Table 7), and the average body weight gain (BWG; Table 8) did not differ between the control diet and 5% MOL. On the other hand, significant (P≤0.05) reductions in the FBW and BWG with elevating the dietary MOL levels (10, 15 and 20%). The best percentage of livability was noticed in the 5% Mol fish group (93.33%), while it was 90% in all the other treatments.

Results of our study agreed with **Bbole *et al.* (2016)** who showed that mean BWG did not differ significantly (P>0.05) among fish fed diets contain (0, 5, 10, and 15% MOL). **Richter *et al.* (2003)** found that 10% MOL did not had no adverse effect on growth performance, while 20 and 30% MOL instead of the dietary protein, decreased (P≤0.05) the growth performance. Also, **Billah *et al.* (2020)** revealed that adding 10% of MOL powder to a commercial diet improved the growth in Nile tilapia fish. **El-Kassas *et al.* (2020)** reported that using 5% MOL instead of yellow corn, fish meal (FM), middling and soybean meal increased (P≤0.05) growth parameters of Nile tilapia fish.

Billah *et al.* (2020) found that diet containing 10% MOL resulted in enhancing the immune response and survival rate. Further, **Zhang *et al.* (2020)** stated a decrease in mortality rate in carp fish juveniles when 40 and 60% of fish meal was replaced by fermented MOL.

The differences in results among studies may be due to the variations in species, age, and initial weight of fish, feed-stuff replacement, replacement level, and length of experiment. Generally, the use of high levels of MOL led to a drop in fish performance. This effect may be due presence of some antinutritional factors in MOL such as tannins, phytates, and oxalates **(Shih *et al.*, 2011),** hemolytic saponins **(Stevens *et al.*, 2015)**, the relatively high total phenolic (0.7% and 1%), non-hemolytic saponins (1.5% and 2.3%) and phytic acid (0.5% and 0.8%) **(Richter *et al*., 2003).** Also, the anti-nutritional factor include high total content of phenolic, non-hemolytic saponin and phytic acid of MOL, as well as high content of MOL of NDF and ADF led to poor growth performance **(Richter *et al*., 2003; Dongmeza *et al*., 2006; Francis *et al*., 2001).**

Table 6. Effect of dietary level of *Moringa oleifera* leaves (MOL) on water quality

Items	MOL level %					*P* value
	0 (control)	5	10	15	20	
Mg/L						
Ammonia	$0.03^{a} \pm 0.11$	$0.02^{b} \pm 0.11$	$0.02^{bc} \pm 0.18$	$0.02^{bc} \pm 0.12$	$0.02^{c} \pm 0.01$	0.001
Nitrite	$0.10^{a} \pm 0.01$	$0.07^{b} \pm 0.09$	$0.05^{c} \pm 0.02$	$0.04^{c} \pm 0.04$	$0.04^{c} \pm 0.03$	0.001

a, b and c: means in the same row with different superscript differ significantly ($P \leq 0.05$).

Table 7. Effect of dietary level of *Moringa oleifera* leaves (MOL) on body weight and survival rate in Nile tilapia fingerlings

Items	MOL level %					*P* value
	0 (control)	5	10	15	20	
			Body weight g			
Initial	$10.76^{bc} \pm 0.16$	$10.87^{ab} \pm 0.05$	$10.91^{ab} \pm 0.01$	$10.97^{a} \pm 0.05$	$10.68^{c} \pm 0.08$	0.013
2 weeks	$13.12^{ab} \pm 0.10$	$13.23^{a} \pm 0.35$	$12.57^{abc} \pm 0.72$	$12.43^{bc} \pm 0.23$	$12.37^{c} \pm 0.01$	0.050
4weeks	$17.50^{a} \pm 0.53$	$17.26^{a} \pm 0.25$	$15.51^{b} \pm 0.74$	$15.43^{b} \pm 0.30$	$15.38^{b} \pm 0.10$	0.002
6 weeks	$20.55^{a} \pm 0.71$	$20.15^{a} \pm 0.45$	$18.31^{b} \pm 0.75$	$17.68^{b} \pm 0.33$	$17.87^{b} \pm 0.14$	0.001
8 weeks	$24.36^{a} \pm 0.06$	$23.30^{a} \pm 0.33$	$21.21^{b} \pm 0.21$	$19.81^{b} \pm 0.60$	$19.90^{c} \pm 0.27$	0.001
10 weeks	$31.92^{a} \pm 0.70$	$29.29^{a} \pm 0.72$	$25.85^{b} \pm 0.58$	$25.3^{b} \pm 0.09$	$25.07^{b} \pm 2.17$	0.001
			Survival rate			
SR %	90	93.33	90	90	90	ND

a, b and c: means in the same row with different superscript differ significantly ($P \leq 0.05$).

survival rate (SR) = [No. of survival fish / initial fish No.] × 100, **ND:** not detected.

Table 8. Effect of dietary level of *Moringa oleifera* leaves (MOL) on body weight gain (g) in Nile tilapia fingerlings

Items	MOL level %					*P* value
	0 (control)	5	10	15	20	
2 weeks	$2.36^{a} \pm 0.07$	$2.36^{a} \pm 0.30$	$1.66^{b} \pm 0.71$	$1.46^{b} \pm 0.18$	$1.69^{ab} \pm 0.07$	0.028
4weeks	$4.38^{a} \pm 0.44$	$4.03^{a} \pm 0.10$	$2.93^{b} \pm 0.02$	$3.00^{b} \pm 0.08$	$3.01^{b} \pm 0.09$	0.001
6 weeks	$3.05^{a} \pm 0.18$	$2.89^{a} \pm 0.20$	$2.80^{a} \pm 0.02$	$2.25^{b} \pm 0.03$	$2.49^{b} \pm 0.24$	0.007
8 weeks	$3.81^{a} \pm 0.65$	$3.15^{ab} \pm 0.12$	$2.90^{b} \pm 0.55$	$2.13^{c} \pm 0.28$	$2.03^{c} \pm 0.13$	0.002
10 weeks	$7.56^{a} \pm 0.76$	$5.99^{ab} \pm 0.39$	$4.64^{b} \pm 0.38$	$5.49^{b} \pm 0.51$	$5.17^{b} \pm 1.91$	0.001
Average	$4.23^{a} \pm 0.17$	$3.68^{a} \pm 0.14$	$2.99^{b} \pm 0.12$	$3.22^{b} \pm 0.01$	$2.88^{c} \pm 0.45$	0.001

a, b and c: means in the same row with different superscript differ significantly ($P \leq 0.05$).

Effect the experimental of dietary MOL on feed utilization

The results showed notable reduction (P≤ 0.05) in FCR (Table 9) of fish fed diet contained high levels of MOL (10, 15 and 20%). The worst FCR values were observed with fish fed diet containing 15 and 20% MOL. However, the average FCR value with 5% MOL level did not significantly changed compared to the control diet (P≤0.05). These results concurred with **Zhang *et al.* (2020)** who found that replacing 60% of dietary fish meal by fermented MOL had significant (P≤0.05) negative effect on feed efficiency of fish. Also, MOL contains tannins, phytates, oxalates **(Shih *et al.*, 2011)** and hemolytic saponins **(Stevens *et al.*, 2015)**. So, the unfavorable impact of MOL on FCR may be attributed to the antinutritional factors existent in MOL on nutrient utilization **(Abd El-Rhman *et al.*, 2025)**.

Effect of the experimental dietary MOL on chemical composition of fish body

The chemical composition of the fish body (Table 10) showed insignificant increases in OM, NFE, and EE in the fish body fed the diet containing 5% MOL, while the CP and ash contents were significantly heightened in fish fed 20% MOL compared to the control. These results are matched with **Dongmeza *et al.* (2006)** who found a considerable reduction in the lipid gain of Nile tilapia fed different levels of dehydrated methanolic extracts of MOL. On the other hand, there are no significant differences in the whole-body ash, or moisture related to those contents in fish fed the basal diets. Also, **Arsalan *et al.* (2016)** found that the replacement of dietary FM up to 10% using MOL led to a considerable increase in the CP in the body of *L. rohita*. Moreover, **Ganzon (2014)** reported higher CP and ash contents in *L. calcarifer* fed a diet supplemented with 10% MOL based diets.

Effect of the experimental dietary MOL on body indices

The results of the body indices (K, HSI, ISI, and GSI) are demonstrated in Table 11. There were linear decreases (P<0.05) in body length (cm), weight of liver and intestine in fish fed diet contain MOL. Likewise, dietary MOL instigated insignificant reduction in HSI and ISI. The MOL did not affect K values among treatments. On the other hand, the gonadal weight and GSI increased by all levels of MOL, specifically with the level 20% (P<0.05). These results are consistent with **Bbole *et al.* (2016)** who showed that condition factor and HSI were not changed (P>0.05) with MOL (0, 5, 10 and 15%) of. Also, **Tekle and Sahu (2015)** found that supplementing ethanolic flower extract of MOL could significantly improve HSI and ISI of Nile tilapia fish. **Zhang *et al.* (2020)** found that decreased HSI in fish groups fed diet containing 20 and 40% fermented MOL in place of fish meal of compared with the control and fish groups fed 10% MOL. However, **Billah *et al.* (2020)** found that diet contains 10% MOL resulted in an increase in K value.

Table 9. Effect of dietary level of *Moringa oleifera* leaves (MOL) on feed conversion ratio (FCR)* of Nile tilapia fingerlings

Items	MOL level %					*P* value
	0 (control)	5	10	15	20	
2 weeks	1.64 ± 0.07	1.66 ± 0.21	2.37 ± 1.25	2.71 ± 0.32	2.27 ± 0.11	0.114
4weeks	1.08^{b} ± 0.10	1.18^{b} ± 0.06	1.55^{a} ± 0.08	1.49^{a} ± 0.01	1.48^{a} ± 0.04	0.001
6 weeks	2.07^{bc} ± 0.06	2.15^{bc} ± 0.12	1.99^{c} ± 0.08	2.47^{a} ± 0.02	2.22^{b} ± 0.23	0.007
8 weeks	1.94^{b} ± 0.41	2.30^{b} ± 0.14	2.27^{b} ± 0.54	2.99^{a} ± 0.34	3.17^{a} ± 0.17	0.009
10 weeks	1.16^{c} ± 0.12	1.40^{b} ± 0.08	1.65^{a} ± 0.12	1.30^{b} ± 0.71	1.38^{b} ± 0.58	0.003
Average	1.47^{c} ± 0.09	1.66^{c} ± 0.04	1.89^{a} ± 0.14	2.19^{a} ± 0.03	1.91^{a} ± 0.21	0.001

a, b and c: means in the same row with different superscript differ significantly (P≤ 0.05).
Feed conversion ratio (FCR) = [feed intake (g) / weight gain (g)].

Table 10. Effect of dietary level of *Moringa oleifera* leaves (MOL) on chemical composition of Nile tilapia fish body

Items	MOL level %					*P* value
	0 (control)	5	10	15	20	
Moisture	77.99 ± 2.33	77.77 ± 0.43	77.44 ± 0.41	78.69 ± 0.32	79.01 ± 0.51	0.440
Dry matter	22.01 ± 2.33	22.23 ± 0.43	22.56 ± 0.41	21.31 ± 0.32	20.99 ± 0.51	0.440
Organic matter	79.18^{a} ± 0.21	79.99^{a} ± 0.29	78.07^{a} ± 0.39	74.28^{b} ± 4.59	73.54^{b} ± 0.12	0.010
Crude protein	61.44^{c} ± 0.57	60.43^{d} ± 0.15	65.46^{a} ± 0.63	63.71^{b} ± 0.30	65.62^{a} ± 0.63	0.001
Ether extract	14.63^{a} ± 2.26	16.15^{a} ± 0.89	9.45^{b} ± 1.03	10.42^{b} ± 0.68	5.06^{c} ± 0.41	0.001
Nitrogen free extract	3.11 ± 2.57	3.41 ± 0.77	3.16 ± 0.84	0.15 ± 4.84	2.86 ± 1.14	0.532
Ash	20.82^{b} ± 0.21	20.01^{b} ± 0.29	21.93^{b} ± 0.39	25.72^{a} ± 4.59	26.46^{a} ± 0.12	0.010

a, b, c and d: means in the same row with different superscript differ significantly ($P \leq 0.05$).

Table 11. Effect of dietary level of *Moringa oleifera* leaves (MOL) on body indices in Nile tilapia fish

Items		MOL level %					*P* value
		0	5	10	15	20	
BW	**g**	36.11 ± 3.54	36.60 ± 5.72	31.10 ± 4.22	27.41 ± 4.40	29.40 ± 2.32	**0.082**
Length	**cm**	13.60^{a} ± 0.40	13.45^{ab} ± 0.05	13.15^{bc} ± 0.15	12.25^{d} ± 0.05	12.80^{c} ± 0.30	**0.002**
K	**%**	1.44 ± 0.22	1.50 ± 0.22	1.37 ± 0.22	1.49 ± 0.25	1.40 ± 0.17	**0.933**
Liver	**g**	0.75^{a} ± 0.13	0.58^{ab} ± 0.01	0.44^{bc} ± 0.12	0.37^{c} ± 0.06	0.32^{c} ± 0.14	**0.003**
Intestine	**g**	3.17^{a} ± 0.01	2.72 ± 0.19^{b}	2.33^{c} ± 0.15	2.23^{c} ± 0.01	1.80^{d} ± 0.32	**0.001**
Gonads	**g**	0.24^{c} ± 0.01	0.27^{bc} ± 0.02	0.42^{b} ± 0.00	0.32^{bc} ± 0.16	0.65^{a} ± 0.08	**0.006**
HSI	**%**	2.08 ± 0.52	1.58 ± 0.29	1.41 ± 0.59	1.35 ± 0.13	1.09 ± 0.53	**0.152**
ISI	**%**	8.78 ± 0.86	7.43 ± 0.86	7.49 ± 1.52	8.14 ± 1.46	6.12 ± 1.42	**0.184**
GSI	**%**	0.66 ± 0.13	0.74 ± 0.18	1.35 ± 0.32	1.17 ± 0.24	2.21 ± 0.51	**0.138**

a, b, c and d: means in the same row with different superscript differ significantly ($P \leq 0.05$).

BW: fish body weight, K: condition factor = [body weight g / (body length cm)^3] × 100, **HSI: hepatosomatic index**= [liver weight g / body weight g] × 100, **ISI: intestinal somatic index** = [intestine weight g / body weight g] × 100, and **GSI: gonadosomatic index**= [gonads weight g / body weight g] × 100

Conclusion

The findings of this work could suggest that substituting 5% of Nile tilapia fingerlings basal diet by MOL had no adverse impact on growth performance and body composition, but improved water quality, survivability and body indices.

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تأثير الاستبدال الجزئي لعليقة أسماك البلطي النيلي (*Oreochromis niloticus*) بمسحوق أوراق المورينجا أوليفيرا على أداء النمو والإعاشة وتركيب ومؤشرات الجسم والاستفادة من العلف

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أجري هذا العمل لدراسة تأثير الاستبدال الجزئي للعليقة الأساسية لأسماك البلطي النيلي بمستويات متدرجة من مسحوق أوراق المورينجا أوليفيرا (MOL) على أداء وتركيب جسم الأسماك. تم تقسيم 150 إصبعية بلطي نيلي بمتوسط وزن 10.84 ± 0.12 جم إلى خمس مجموعات تجريبية (30 سمكة/مجموعة). كان لكل مجموعة ثلاث مكررات متساوية (10 أسماك لكل منها). تم استخدام أوراق المورينجا أوليفيرا بخمسة مستويات 0 و5 و10 و15 و20%بدلاً من العليقة الأساسية. وقد استمرت فترة التجربة لمدة 10 أسابيع. أظهرت النتائج أن وزن جسم الأسماك والزيادة في وزن الجسم والعلف المقدم ونسبة التحويل الغذائي لم تختلف معنويا بين الأسماك التي تغذت على العليقة الأساسية والأسماك التي تغذت على العليقة المحتوية على 5% من أوراق المورينجا. وفي المقابل، حدث انخفاضًا معنويًا في هذه القياسات في الأسماك التي تغذت على عليقة تحتوي على 10 و15 و20% أوراق مورينجا. كانت نسبة النفوق 10% للأسماك التي تغذت على عليقة صفر و10 و15 و20% أوراق مورينجا مقابل التي تغذت على 5%. أوراق مورينجا انخفضت المركبات الضارة مثل (الأمونيا والنيتريت) في الماء معنويا مع أوراق المورينجا. أظهر التركيب الكيميائي لجسم السمكة زيادة في المادة العضوية والمستخلص الخالي من النيتروجين ومستخلص الإيثير في مجموعة أسماك 5% أوراق مورينجا، بينما زادت محتويات البروتين الخام والرماد في مجموعات أسماك 10 و20% أوراق مورينجا. لم تختلف قياسات الجسم طول الجسم ووزن الكبد ووزن الغدد التناسلية ومعامل الحالة ومؤشر الكبد الجسمي ومؤشر المعوي الجسم بين الأسماك التي تغذت على عليقة تحتوي 5% أوراق مورينجا والكنترول. حدث انخفاض خطيًا معنويًا في طول الجسم ووزن الكبد والأمعاء بمجموعات الأسماك التي تغذت على علائق بها أوراق مورينجا أعلى من 10%. ولم يتأثر معامل الحالة بالتغذية على أوراق مورينجا. من ناحية أخرى، تحسنت قيم وزن المناسل مع جميع مستويات أوراق المورينجا وبالأخص قيمتها مع الـ 20% (معنويا) من أوراق المورينجا. التوجيه: وجد أن استبدال 5% من العليقة الاساسية بمسحوق أوراق المورينجا اوليفرا لم يكن له تأثيرات سلبية على أداء النمو وتركيب جسم اسماك البلطي النيلي، بل حسن من جودة المياه ونسبة الإعاشة ومؤشرات الجسم.

المحكمـــــون:

1- أ.د. محمد صلاح محمد إبراهيم رئيس بحوث بالمعمل المركزى لبحوث الثروة السمكية قسم بحوث تغذية الأسماك.

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