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"Effect of Dietary Moringa oleifera Supplementation on Growth Performance (Body Weight and Length) of Fish"

Aml. Farag. Younes[1*], Basit. Fathullah. Abdullah[2], Sultana. M. Hussien[3]

[1]Department of Animal production, Faculty of Agriculture, Omar Al-Mokhtar University, El -Beida-Libya

[2]Agriculture Research center, El -Beida-Libya

[3]Department of Food Science Technology, Faculty of Agriculture, Omar Al-Mokhtar University, El -Beida-Libya

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Abstract: This study evaluated the effect of dietary supplementation with *Moringa oleifera* leaf powder on growth performance and morphometric parameters of fish over a 7-week experimental period. Fish were randomly assigned to three dietary treatments: a control group (0% Moringa), 30% Moringa supplementation, and 50% Moringa supplementation. Growth performance was assessed through measurements of body weight, weight gain, relative growth rate (RGR), specific growth rate (SGR), and total body length. The results showed significant differences ($P < 0.05$) among treatments in final body weight, growth indices, and body length parameters. The 30% supplementation group recorded comparatively improved growth indicators relative to the control and 50% groups, while the 50% inclusion level showed the lowest performance values. Variations were also observed in weight gain, RGR, and SGR, indicating that growth responses were influenced by the dietary inclusion level of Moringa leaf powder. These findings suggest that dietary incorporation of *Moringa oleifera* leaf powder affects growth performance and morphometric traits in fish, and that optimal inclusion levels are essential to achieve favorable outcomes. The study contributes to ongoing research exploring plant-based feed additives as sustainable alternatives in aquaculture nutrition.

Keywords: *Moringa oleifera;* aquaculture nutrition; growth performance; weight gain; body length; phytogenic feed additives.

Introduction

Aquaculture has become one of the fastest-growing food production sectors worldwide, contributing significantly to global food security and animal protein supply [1]. However, the rapid expansion of aquaculture systems has increased the demand for cost-effective, nutritionally balanced, and environmentally sustainable feed resources [2]. Conventional feed ingredients such as fishmeal and soybean meal are often expensive and subject to market fluctuations, prompting the search for alternative plant-based feed additives that can enhance growth performance while reducing production costs [3]. In recent years, attention has shifted toward the use of natural phytogenic additives in aquafeeds due to their nutritional richness and bioactive properties. Among these, *Moringa oleifera* has gained considerable interest. This fast-growing tropical tree, commonly known as the drumstick tree or miracle tree, is characterized by its high protein content, essential amino acids, vitamins (A, C, and E), minerals (calcium, iron, and potassium), and various bioactive compounds including flavonoids, phenolics, and saponins [4- 5]. These constituents are known to exert antioxidant, antimicrobial, and growth-promoting effects, making Moringa leaves a promising feed supplement in aquaculture. Several studies have reported that dietary inclusion of Moringa oleifera leaf meal improves feed utilization efficiency, enhances digestive enzyme activity, and promotes weight gain in different fish species. The growth-enhancing effects are primarily attributed to its high-quality protein content and the presence of natural growth stimulants that support metabolism and nutrient absorption [6]. Additionally, the antioxidant compounds in Moringa may reduce oxidative stress in cultured fish, thereby improving overall physiological performance and growth indices. Growth performance indicators such as body weight and body length are fundamental parameters in evaluating the effectiveness of dietary interventions in aquaculture. Improvements in these parameters reflect enhanced feed conversion, better nutrient assimilation, and optimal metabolic functioning [7]. Therefore, investigating the impact of dietary Moringa supplementation on fish growth performance is essential for determining its practical value as a sustainable feed additive. The present study aims to evaluate the effect of dietary ***Moringa oleifera*** supplementation on growth performance, specifically body weight and body length, in fish. This research contributes to the growing body of evidence supporting the use of plant-based functional feed ingredients in sustainable aquaculture systems.

Materials and methods

The study was conducted to evaluate the impact of varying levels of *Moringa oleifera* leaf powder as a dietary supplement on fish growth performance. Fish were randomly assigned to three experimental groups, with 3 replicates (tanks) per group, over a 7-week experimental period. The groups included: Control Group: Fed a basal diet without additives (0%). Group 2 (30% MO): Fed a diet supplemented with 30% *Moringa*. Group 3 (50% MO): Fed a diet supplemented with 50% *Moringa* [8]. Data were collected

*Corresponding Author
Aml. Farag. Younes*
Email: amal.alhamary@omu.edu.ly.

weekly (from Week 1 to Week 7) for all tanks. The measurements included: Body Weight (BW): Fish in each tank were weighed using a sensitive digital balance, and the arithmetic mean for each tank was recorded (Mean ± SE). Body Length (BL): Total length was measured for four fish per tank using a graduated measuring ruler, from the tip of the snout to the end of the caudal fin. Growth efficiency was evaluated using the following indices: Relative Growth Rate (RGR): This represents the percentage increase in weight or length relative to the initial measurement. Specific Growth Rate (SGR): Calculated to estimate the daily percentage increase using the formula:

$$SGR = \frac{\ln(W_2) - \ln(W_1)}{T} \times 100$$

(Calculations were based on an experimental duration of 49 days).

Statistical Analysis: Statistical analysis of the data was performed using Minitab software. One-way Analysis of Variance (ANOVA) was utilized to compare the three groups. Results in tables and figures are expressed as Mean ± Standard Error (Mean ± SE). Furthermore, Tukey's Test was applied to identify significant differences between means at a probability level of ($P < 0.05$).

Results

Table 1 and Figure 1 present the mean (± SE) values of fish body weight under different dietary inclusion levels of Moringa oleifera leaf powder (0%, 30%, and 50%) over a 7-week period. The initial body weights were 110 ± 0.83 g (control), 99 ± 0.50 g (30%), and 107 ± 0.79 g (50%). At Week 4, body weights were 105.7 ± 0.60 g for the control group, 97.7 ± 0.33 g for the 30% group, and 74.7 ± 10.3 g for the 50% group. By Week 7, the final recorded weights were 82 ± 4.49 g (control), 89 ± 0.55 g (30%), and 54 ± 8.13 g (50%). Statistical analysis indicated significant differences ($P < 0.05$) among treatments within the same column, as shown by different superscript letters, while values sharing the same letter were not significantly different. Figure 1 graphically illustrates the progression of body weight across the experimental weeks, visually confirming the numerical values and treatment-related variations presented in Table 1.

Table 1. Changes in initial body weight, mid-term weight, and final weight of fish as influenced by dietary supplementation of different levels of *Moringa oleifera* leaf powder.

Groups (Treatments)	Initial Weight (W1)	Mid-term Weight (Week 4)	Final Weight (W7)
Control (0%)	110 ± 0.83	105.7 ±0.60	82 ±4.49
***Moringa* 30%**	99 ±0.50	97.7 ±0.33	89 ±0.55
***Moringa* 50%**	107 ±0.79	74.7 ±10.3	54 ±8.13

"Values are expressed as Mean ± Standard Error (Mean ± SE). Different letters (a, b) within the same column indicate statistically significant differences between treatments ($P < 0.05$), while values sharing the same letter indicate no significant differences."

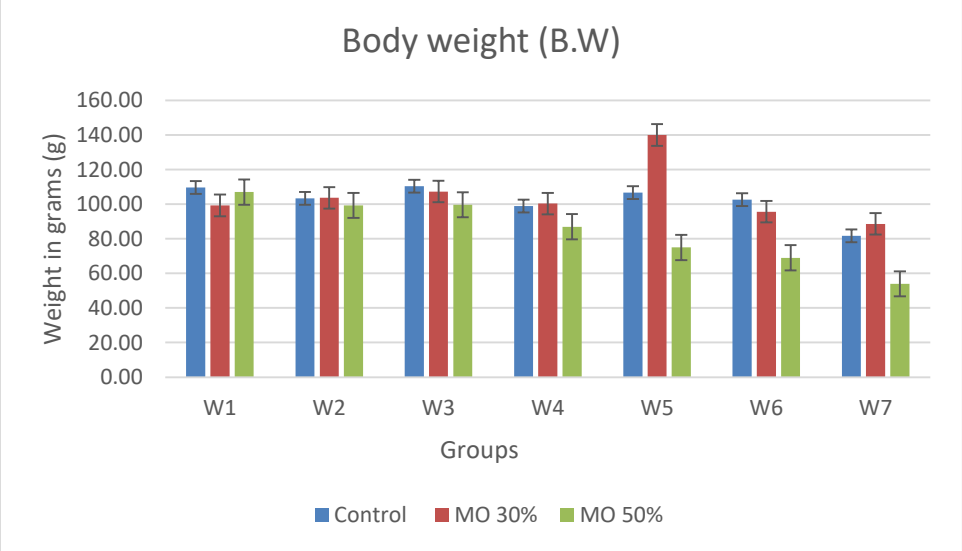

Figure 1: Effect of dietary *Moringa oleifera* supplementation levels (0%, 30%, and 50%) on fish body weight (g) over a 7-week period.

Table 2 presents the effect of graded dietary inclusion levels of *Moringa oleifera* leaf powder (0%, 30%, and 50%) on weight gain and growth indices over the 7-week experimental period. The control group (0%) recorded a weight gain of −28.0 g, a relative growth rate (RGR) of −25.53%, and a specific growth rate (SGR) of −0.60% per day. The 30% supplementation group showed a weight gain of −10.7 g, RGR of −10.77%, and SGR of −0.23% per day. In contrast, the 50% group recorded a weight gain of −53.0 g, RGR of −49.53%, and SGR of −1.39% per day. The table quantitatively summarizes the calculated growth performance indices across treatments, allowing direct comparison of weight change and growth rate parameters among the experimental groups during the study period.

Table 2. Effect of different levels of *Moringa oleifera* supplementation on weight gain and growth indices (RGR and SGR) during a 7-week experimental period.

Treatments	Weight Gain (g)	Relative Growth Rate (RGR%)	Specific Growth Rate (SGR %/day)
Control (0%)	-28.0	%25.53-	-0.60
Moringa (30%)	-10.7	%10.77-	-0.23
Moringa (50%)	-53.0	%49.53-	-1.39

Table 3 and Figure 2 summarize the effect of graded dietary inclusion levels of *Moringa oleifera* leaf powder (0%, 30%, and 50%) on fish body length over the 7-week experimental period. In the control group (0%), the initial length was 8.67 ± 0.47 cm and the final length was 7.92 ± 0.44 cm, with a total length gain of 0.75 cm and a specific growth rate (length) of 0.19. The 30% group recorded an initial length of 8.63 ± 0.13 cm and a final length of 9.21 ± 0.04 cm, with a total length gain of 0.58 cm and a specific growth rate of 0.13. In contrast, the 50% group showed an initial length of 8.29 ± 0.11 cm and a final length of 7.04 ± 0.04 cm, with a total length gain of −1.25 cm and a specific growth rate of −0.34. Statistical differences ($P < 0.05$) among treatments are indicated by different superscript letters within the same column. Figure 2 graphically presents the changes in total body length across treatments, visually reflecting the numerical values reported in Table 3.

Table 3. Effect of adding different levels of *Moringa oleifera* on the mean body length (cm) of fish during a 7-week experimental perio

Treatments	Initial Length (cm)	Final Length (cm)	Total Length Gain	Specific Growth Rate (Length)
Control (0%)	8.67 ± 0.47^{a}	7.92 ± 0.44^{b}	0.75	0.19
Moringa (30%)	8.63 ± 0.13^{a}	9.21 ± 0.04^{b}	0.58	0.13
Moringa (50%)	8.29 ± 0.11^{b}	7.04 ± 0.04^{a}	1.25-	0.34-

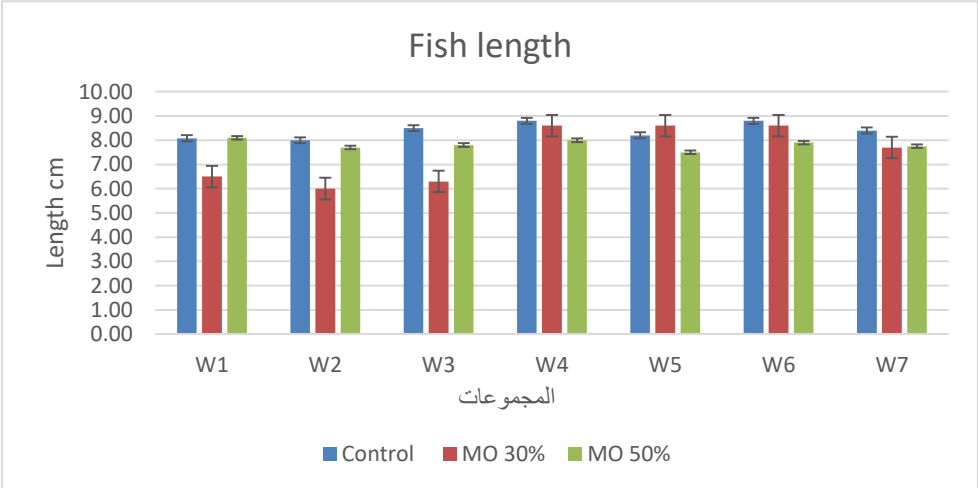

Figure 2: Changes in total body length (cm) of fish fed diets containing different concentrations of *Moringa oleifera* leaf powder.

Discussion

The present study demonstrated that dietary inclusion of *Moringa oleifera* leaf powder influenced growth performance parameters, including body weight, weight gain, specific growth rate (SGR), relative growth rate (RGR), and body length over the 7-week experimental period. Growth performance indicators are considered sensitive markers for evaluating dietary efficiency and nutrient utilization in aquaculture systems [9]. Variations observed among treatments in both weight and length parameters indicate that graded inclusion levels of Moringa leaf powder affected growth responses under the present experimental conditions. Previous studies have reported that moderate inclusion levels of *Moringa oleifera* leaf meal can enhance growth performance due to its high protein content, balanced amino acid profile, vitamins, and bioactive compounds [10]. The leaves contain approximately 25–30% crude protein and are rich in essential micronutrients, which may support metabolic activity and tissue development in fish. However, growth response is highly dependent on inclusion level, processing method, fish species, and overall diet formulation[11]. Excessive inclusion of plant leaf meals may reduce palatability or nutrient availability due to fiber content and anti-nutritional factors such as tannins and phytates, which can interfere with digestion and nutrient absorption[12]. The growth indices (SGR and RGR) recorded in this study are consistent with the concept that dietary plant protein sources can variably affect growth efficiency depending on their concentration in the diet. Similar trends have been reported in Nile tilapia (*Oreochromis niloticus*) and African catfish when high levels of Moringa leaf meal were incorporated, where reduced growth performance was linked to increased crude fiber levels and the presence of anti-nutritional compounds[13]. In aquaculture nutrition, optimal inclusion levels of phytogenic additives are critical, as excessive substitution of conventional protein sources with leaf meals may compromise digestibility and feed conversion efficiency [14]. Regarding body length parameters, changes in total length and length-specific growth rate further support the sensitivity of morphometric indices to dietary modifications. Morphometric growth responses are commonly used alongside weight measurements to provide a comprehensive assessment of somatic development [15]. Previous investigations have similarly shown that dietary Moringa supplementation can influence morphometric traits, although outcomes vary according to species and inclusion rate [16]. Overall, the findings of the present study align with earlier aquaculture research indicating that while *Moringa oleifera* possesses significant nutritional potential, its dietary level must be carefully optimized to achieve desirable growth outcomes. These results contribute to the growing body of literature evaluating plant-based functional feed ingredients as sustainable alternatives in aquaculture production systems [17].

Conclusion: The present study demonstrated that dietary supplementation with *Moringa oleifera* leaf powder significantly influenced growth performance and morphometric parameters of fish over the 7-week experimental period. Variations were observed in final body weight, weight gain, specific growth rate (SGR), relative growth rate (RGR), and total body length among the different dietary treatments.

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