Impact of dietary supplementation of *Moringa oleifera* leaf powder on the growth performance and body composition of the Mosquito Fish, *Gambusia affinis*

Sushma E., *Mary Mettilda Bai S., Sneha S., Vinoliya Josephine Mary J. and Anitha C.

Department of Zoology, Holy Cross College (Autonomous), Nagercoil - 629004.
Affiliated to Manonmaniam Sundaranar University, Tirunelveli - 627012.
*Corresponding Author - Email: marymettildabai@holycrossngl.edu.in

ABSTRACT

Gambusia affinis, commonly known as mosquito fish, plays an important role in mosquito control as it feeds on mosquito larvae. However, its slow growth poses a problem for aquaculture. This study analyses the impact of dietary supplementation of moringa leaf powder on the growth performance and body composition of Gambusia affinis. Four test diets were formulated with different concentrations (0%, 10%, 20% and 30%) of moringa leaf powder supplementation. After a 37-day feeding trial, weight gain, length gain, specific growth rate and biochemical parameters were analysed. Although moringa supplementation had no significant effect on growth, higher fat content was detected in fish-fed moringa supplementation compared to the control group. These conclusions indicate that Moringa oleifera leaf powder at the above-mentioned concentration exhibited a minor impact on growth rates and body composition.

Keywords: *Moringa oleifera, Gambusia affinis, Dietary Supplement, Growth Performance, Body Composition.*

1. Introduction

Aquaculture is increasingly important and optimizing nutrition and growth efficiency remains a challenge, particularly for species like *Gambusia affinis*, which has an important role in biological mosquito control but exhibits a slow growth rate [1,2]. Enhancing the growth of *Gambusia affinis* is the key to its aquatic durability. Traditional feed often doesn't meet its needs, highlighting their need for alternative supplements [3]. To improve growth and nutritional status, alternative feed ingredients such as plant-based supplements are being explored. *Moringa olifera* is well known for its nutritional and medical properties [4,5] and presents a promising option for testing the growth and health of the species.

Moringa olifera is high in proteins, vitamins and minerals making it a viable dietary supplement for various animals [6]. *M. olifera* has shown the ability to better growth performance and nutrients in various fish species, including Nile tilapia and African catfish [7,8,9,10]. Also, *M. olifera* has been tested for its ability as a supplement in various animals,

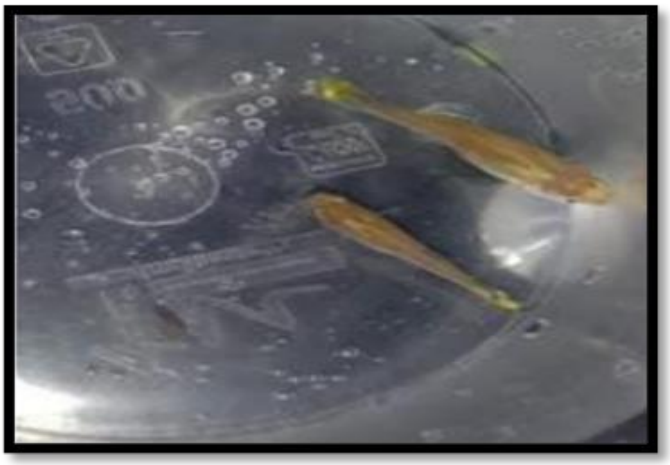
showing the possibility to enhance the growth and health of the animals [11,12]. Therefore, it is understood that the moringa leaf supplements will improve the growth performance of the fish.

Hence this study has been carried out to examine how the inclusion of moringa leaf powder into the feed of *Gambusia affinis* can better the growth and body composition of the fish. The experimental fish *Gambusia affinis* is a fish of interest to control mosquitos. There is a high demand for it in the market. Many aqua-culturists are rearing this fish for sale. For confined rearing, feeding is an important parameter. Therefore, this research is significant, as it may give more effective and reliable aquatic practices.

2. Materials and Methods

A lot of (100) *Gambusia affinis* (Plate 1) were purchased and acclimatized in laboratory conditions for two weeks.

Plate 1: Experimental fish, *Gambusia affinis*



Feed Preparation: The basic diet includes rice bran, soybean powder, fish meal, groundnut oil cake, and tapioca powder, put together to maintain the nutritional requirements of *Gambusia affinis* as shown in Table 1. Minerals like copper sulphate, potassium iodide, zinc sulphate and calcium chloride ensure a balanced diet that supports growth, health and physiological processes in fish. Vitamin A and Vitamin E are used in the feed to improve survival rates and enhance growth performance and disease resistance in fish. The ingredients were made into the basic diet [13].

The prepared feed was divided into four parts. Moringa leaf powder was added to the 2^{nd},3^{rd} and 4^{th} part of the basic diet by replacing equivalent basic diet components with 10%, 20%, and 30% of moringa leaf powder respectively. Thus, four experimental diets: one control

diet (0% moringa) and three dietary formulations of moringa leaf powder at 10%, 20% and 30%.

Table 1: Fish feed ingredients

Ingredients	Quantity (gm)
Rice bran powder	273.5
Soybean powder	273.5
Fishmeal	200
Groundnut oil cake	129
Tapioca powder	129
Vitamin A	0.15
Vitamin E	0.015
Common salt	0.0315
Copper sulphate	0.0037
Potassium iodide	0.0015
Zinc sulphate	0.003
Calcium chloride	0.3
Total	1000 (gm) 1 kg

Experimental setup: Fish were acclimated to the control diets for two weeks. For the experiment, the fish were grouped into four groups of equal (15) numbers. Each group was further divided into three subgroups of equal (5) numbers to get triplicates (Plate 2). The first group served as the control (0% moringa) other three served as Experimental 1 (10% moringa), Experimental 2 (20% moringa) and Experimental 3 (30% moringa). Then introduced into the experiment tank after taking the initial length and weight. The fish were fed to satiation once daily for 37 days with designated feed. While the feeding trial was ongoing, water quality parameters were monitored and maintained within optimal ranges for *Gambusia affinis* (Table 2).

Plate 2: Experimental setup

Table 2: Water Quality Measure

Parameter	**Value**
Temperature	25◦ - 30◦C
pH	6.5 – 8.0
Dissolved oxygen	5 mg/l

Growth Performance Assessment: After the feeding trial, fish were weighed (wet weight), and their standard length (SL): from the tip of the snout to the posterior end excluding the length of the caudal fin and total length (TL): From the tip of the snout to the tip of the longer lobe of the caudal fin was measured. Growth performance parameters including growth in terms of weight (GW), specific growth rate (SGR) and length gain (LG) were calculated using standard formulas:

Growth in terms of wet body weight (weight gain) = Final Weight – Initial Weight.

Growth in terms of body length (length gain) = Final Length – Initial Length.

Specific growth rate SGR (%) = $\frac{\text{final weight – initial weight}}{\text{Duration (days)}} \times 100$

Biochemical Analysis: Fish in each treatment group were sacrificed, and whole fish samples were obtained for biochemical analysis following standard procedures. The amount of carbohydrates, protein and fat was measured by following the procedure of the Anthrone method [14], Lowry et al. method [15] and Folch et al. method [16].

3. Results

Growth Performance: Fish fed the control diet (0% moringa) exhibited the highest growth in weight, specific growth rate and length gain (Table 3).

Table 3: Growth in terms of Weight (Gm)

Diet	Initial weight (g) Mean ±SD	Final weight(g) Mean ±SD	Growth(g) Mean ±SD	SGR
Control	1.18±1.76	1.88±1.77	0.7±0.01	1.89
Experimental 1	1.40±2.11	1.70±2.55	0.3±0.44	0.81
Experimental 2	1.31±3.78	1.46±1.69	0.15±2.08	0.40
Experimental 3	1.50±2.25	1.79±2.06	0.29±0.19	0.78

Growth in terms of length

The highest growth in terms of length was also observed in the control group (Table 4 and 5).

Table 4: Growth in terms of Total Length

Diet	Initial length(mm) Mean ± SD	Final length(mm) Mean ±SD	Growth(mm) Mean ± SD
Control	2.5±3.9	3±1.7	0.5±2.2
Experimental 1	2.8±4.24	3.05±4.5	0.25±0.26
Experimental 2	2.6±4	2.9±3.4	0.3±0.6
Experimental 3	2.7±4.1	2.9±3.46	0.2±0.64

Table 5: Growth in terms of Standard Length (Cm)

Diet	Initial length (cm) Mean ±SD	Final length(cm) Mean ±SD	Growth (cm) Mean ±SD
Control	2.2±3.3	2.6±1.83	0.4±1.47
Experimental 1	2.4±3.5	2.47±3.71	0.07±0.21
Experimental 2	2.3±3.5	2.6±3.05	0.3±0.45
Experimental 3	2.3±3.6	2.7±3.17	0.4±0.43

Biochemical Composition: The fat content was notably higher in groups fed with moringa-supplemented diets compared to the control group (Table 6).

Table 6: Effect of food quality on the body composition of the fish, *Gambusia affinis*

Diet	Carbohydrate mg (%	Protein mg (%	Fat mg (%)
Control	1.2	6.8	0.85
Experimental 1	1	5.8	1.7
Experimental 2	0.76	4.4	3
Experimental 3	1	5.2	3.5

4. Discussion

The impact of feeding *Gambusia affinis* on a normal fish diet incorporating three different concentrations of powdered *Moringa olifera* leaves was investigated. The results showed that fish consumed with the control diet had increased weight gain in comparison to those fed with any of the experimental dietary formulations containing moringa leaf powder. The standard length of the fish in the control group and the experimental group 3 were similar. However, the total length was greater in the control group compared to all experimental groups. In terms of body composition, the control group had higher carbohydrate and protein content compared with the experimental groups. Interestingly, the fat content was highest in fish from Experimental Group 3, compared with the control and the other experimental groups (Experimental Groups 1 and 2). In aquaculture, integrating *Moringa oleifera* offers several benefits, such as reducing reliance on conventional feed ingredients and promoting sustainability [17]. However, findings suggest that great inclusion levels of moringa leaf in fish diets can lower digestibility coefficients and protein digestibility [18].

This may be the reason for the poor growth performance of the fish in the experimental groups. Research on different fish species reveals specific impacts of moringa supplementation. For instance, feeding *Clarias gariepinus* with moringa leaf meal increases fat content in the fish's body tissues due to the high-fat content of *Moringa oleifera* leaves [19]. Similarly, additional moringa leaf meal in the Nile tilapia diets leads to increased fat content, caused by the fat-rich nature of moringa leaves [20,21]. Studies on the Nile tilapia also prove that *Moringa oleifera* aqueous extract increases growth and biochemical parameters, including increased fat content associated with moringa's nutritional components [22]. The metabolic effects of moringa supplementation are notable, as seen in reduced carbohydrate content in fish with Moringa oleifera in their diet, indicating a shift towards fat as the primary energy source [21,11]. Similar findings in broiler chickens advise implications for fish metabolism because of moringa's excessive fat content [11].

Overall, while moringa leaf meal improves growth in the Nile tilapia, it concurrently lowers carbohydrate levels, influencing metabolic processes [23]. Further research is recommended to optimize moringa inclusion levels in fish feed, considering factors such as palatability, digestibility and long-term impacts on growth and health parameters [22].

5. Conclusion

Various studies recommended that moringa leaf powder is a positive supplement for many fish species. The findings of the present study indicate that it isn't suitable for the fish *Gambusia affinis*. The control diet without moringa supplementation resulted in good growth performance. Additional research is needed to analyze the optimal inclusion of moringa leaf powder content in the diet of *Gambusia affinis* and to understand the specific reasons behind the observed adverse effects and also, to test the disease-curing ability by challenging the fish with pathogens.

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