Plant Archives Vol. 25, Supplement 1, 2025 pp. 613-616 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2025.v25.supplement-1.083

EFFECT OF PARTIAL REPLACEMENT OF FISHMEAL WITH MORINGA LEAF POWDER ON GROWTH PERFORMANCE AND SURVIVAL OF PACIFIC WHITE SHRIMP, *LITOPENAEUS VANNAMEI* (BOONE, 1931)

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(Date of Receiving : 01-08-2024; Date of Acceptance : 04-10-2024)

ABSTRACT

The efficacy of partial replacement of fishmeal with *Moringa oleifera* leaf powder on growth performance and survival of Pacific white shrimp, *Litopenaeus vannamei* was the purpose of the study. During from March to May of 2021, the experiment was carried out in the Wet Laboratory, Department of Aquaculture, College of Fisheries Science, Kamdhenu University, Veraval for 60 days. The five experimental diets were formulated with 35% protein level. The supplementary diet was prepared and fed to *L. vannamei* at 10% body weight twice a day. The control diet was prepared without moringa leaf powder. The treatment diet contained 5, 10, 15, and 20% moringa leaf powder replacement. Fifteen *L. vannamei* post larvae (average weight 0.012 gm) were stocked per each of the 20 plastic tanks. *L. vannamei*'s growth, survival rate, specific growth rates (SGR), feed conversion ratio (FCR) feed conversion efficiency (FCE) and protein efficiency ratio (PER) were assessed. According to the study's findings, the (T4) diet, which included 20% Moringa leaf powder protein had the highest mean weight gain, SGR, PER, FCE and lowest FCR. The control diet had the highest survival rate of 100%. Results of the current study revealed that the replacement of 20 % Moringa leaf powder significantly affected the weight gain, SGR, FCR, FCE and PER of *L. vannamei.*
***Keywords*: *Moringa oleifera* leaf powder, *Litopenaeus vannamei*, fishmeal replacement,

Introduction

Shrimp farming plays a pivotal role in the socio-economic condition of the coastal population of India by way of contributing to foreign exchange earnings and livelihood options. (Babu *et al.* ,2014). The total production of crustaceans is about 9.3 million tonnes throughout the worldwide in 2018. In which *Litopenaeus vannamei* (Pacific white shrimp) production is around 4.9 million tonnes and it representing 53% of total crustacean production (FAO. 2020).

Feeds and feeding are two important aspects to consider in shrimp aquaculture. As proteins are the costliest components in shrimp feeds, the proportion of its inclusion in the formulations affect diet cost. Protein ingredients that can be utilized to substitute for fishmeal, either partially or completely included terrestrial plant meals and animal by-products readily available on the world markets (Samocha *et al.,* 2004). Fishmeal is considered an essential ingredient in marine shrimp diets because of its balanced amount of essential amino acids and fatty acids, vitamins, minerals and palatability (Suarez *et al.,* 2009). Replacement of fishmeal by cheaper ingredients of either animal or vegetable origin in aquatic animal feed is necessary because of the rising cost and uncertain availability of fishmeal (Fontainhas *et al.,* 1999).

Moringa oleifera is a fast-growing and high valued plant widely available in the tropics and subtropics and has several economically important industrial and medicinal uses (Dewangan *et al.,* 2010 and Yuangsoi and Masumoto 2012). Thus, the leaves, fruits, bark, and roots have high nutritive value and possess medicinal properties, such as antitumor, anti-inflammatory, antiulcer, antihypertensive, cholesterol-lowering, antioxidant, antidiabetic, hepato-protective, antibacterial, and antifungal activities (Anwar *et al.,* 2007). Therefore, the present study was undertaken with following objectives to evaluate "Effect of partial replacement of fishmeal with *Moringa* leaf powder on growth performance and survival of Pacific white shrimp, *Litopenaeus vannamei* (Boone 1931)".

Materials and Methods

The research titled "supplementation of fish meal with *Moringa oleifera* leaf powder (MOLP) and its effect on growth performance and survival in rohu, *Litopenaeus vannamei* " took place at the College of Fisheries Science, KU, Veraval lasted for 60 days. The post larvae of *L. vannamei* were brought from commercial shrimp hatchery. Post larvae were brought to Wet Laboratory and acclimatized in the FRP tank (500 L) with continuous aeration and feeding for 5 days. Post larvae with a total weight of approximately 0.012 g were selected for the experiment. There are five treatments and four replications. *Litopenaeus vannamei* was stocked at the density of 10 nos. per tank in all 20 experimental tanks. During the experimental period, experimental animal was fed twice daily at 5% of their body weight, with morning and evening feeding sessions. The shrimp were provided with a basal diet containing 35% crude protein during this period (Table 1).

Experimental diet preparation

Table 1: Feed formulation and proximate composition of feed ingredients (% dry matter).

Ingredients (%)	Diet T_0 (Control)	Diet T1 (5%)	Diet T2 (10%)	Diet T3 (15%)	Diet T4 (20%)
Moringa leaf powder	0	5	10	15	20
Sterilized Fishmeal	37	36	35	34	34
GNOC	35	35	33	33	30
Tapioca powder	10	9	8	7	6
Wheat flour	10	9	8	7	6
Vitamin and minerals	4	3	3	2	2
Fish oil	4	3	3	2	2
Total	100	100	100	100	100

Growth, survival and feed utilization analysis

Fortnightly interval, all the fish in each treatment were counted with their body weight for analysis of the growth performance, feed utilization and survival. Before taking the weight, fish were starved overnight. To calculate the growth parameters and feed utilization in the experiment, the following formulas were used:

Mean weight gain = Final average body weight – Initial average body weight

Weight gain (%) = (Final weight – Initial weight) / Initial weight × 100;

Specific Growth Rate (SGR) (%/day) = Ln (Final weight) – Ln (Initial weight) / Experiment duration × 100;

Feed Conversion Ratio (FCR) = Feed intake (g) / Weight gain (g);

Protein Efficiency Ratio (PER) = Weight gain (g) / Protein intake (g);

Survival (%) = Total no. of live fish/ Total no. of fish stocked × 100

Throughout the experimental period, water quality parameters including temperature, pH, dissolved oxygen (DO), total alkalinity, ammonia, and total hardness were examined weekly using the standard methods of APHA (2017). Statistical analysis was performed by using standard statistical methods (Snedecor and Cochran, 2014).

Results

Growth performance and survival rate of *Litopenaeus vannamei*

The experimental results for the 60-day study on the effect of partial replacement of fishmeal with *Moringa oleifera* leaf powder are provided in the Table 2. The outcomes include mean weight gain (MWG), specific growth rate (SGR) and survival rate (SR) for all five treatment groups were calculated.

The higher growth performance was reported in T_4 (20% MOLP) treatment at the end of the experiment, followed by in T_3, T_2, T_1 and lowest in T_1. Based on the statistical analysis, there were significant difference ($p<0.05$) observed in MWG, PWG and SGR among the treatment groups. There was no significant difference ($p>0.05$) in the survival rate of *L. rohita* when given different amounts of moringa seed meal.

Feed utilization by *Litopenaeus vannamei*

In the present research feed utilization of *Litopenaeus vannamei* in the various treatments was analyzed through parameters such as feed conversion ratio (FCR), Feed conversion Efficiency (FCE) and protein efficiency ratio (PER), which are displayed in Table 3. Lowest (best) FCR was observed in T_4 treatment group followed by in T_3. The highest PER was observed in T_4 treatment group followed by in T_3. The statistical analysis of the FCR, FCE and PER revealed significant differences ($p<0.05$) between the $T_{0,}$ T_1 and T_2 $T_{3,}$ T_4 treatment groups compared to the others. However, no significant differences ($p>0.05$) were observed among the T_2, T_3, and T_4 treatment groups (Table 3).

Table 2 : Growth performance of *L. rohita*, fed diet with 0% (Control), 5, 10, 15, and 20% supplementation of *M. oleifera* seed meal

Parameters	Control	Treatments			
	T0 (Control)	T1 (MOLP 5%)	T2 (MOLP 10%)	T3 (MOLP 15%)	T4 (MOLP 20%)
IW (g)	0.012±0.000^a	0.011±0.000^a	0.012±0.000^a	0.011±0.000^a	0.011±0.000^a
FW (g)	1.234±0.08^a	1.553±0.04^b	2.072±0.08^c	2.367±0.06^d	2.608±0.136^e
MWG (g)	1.222±0.039^a	1.542±0.022^b	2.061±0.042^c	2.356±0.033^d	2.597±0.068^e
SGR (%)	1.214±0.040^a	1.534±0.023^b	2.053±0.042^c	2.348±0.033^d	2.589±0.070^e
Survival (%)	100±0.00^a	95±3.19^a	91.66±4.99^a	93.33±0.00^a	86.66±3.84^a

* Mean ± standard deviation (SD). Different lowercase letters on the values within the same sample indicate significant differences ($p < 0.05$).
** IW- Initial weight, FW- Final Weight, MWG-Mean weight gain, SGR- Specific growth rate

Table 3 : Feed utilization of T_1, fed diet with 0% (Control), 5, 10, 15, and 20% supplementation of *M. oleifera* leaf powder (MOLP)

Parameters	Control	Treatments			
	T0 (Control)	T1 (MOLP 5%)	T2 (MOLP 10%)	T3 (MOLP 15%)	T4 (MOLP 20%)
FCR	1.695±0.021^b	1.662±0.012^b	1.439±0.021^a	1.399±0.025^a	1.384±0.014^a
FCE	0.590±0.007^a	0.602±0.004^a	0.695±0.009^b	0.716±0.013^b	0.723±0.008^b
PER	1.686±0.021^a	1.720±0.020^a	1.986±0.012^b	2.045±0.014^b	2.065±0.008^b

Discussion

The availability of low-cost protein sources for the formulation of aquafeed lowers the production cost in aquaculture systems (FAO, 2020). Due to the expensive rate of fish meal and the continuous reduction in the availability of dietary fish meal over the last decade, it is required to find alternative protein sources for aquafeed (Abdel-Latif *et al,* 2022). *Moringa oleifera* seeds (MOS) are high in protein, vitamins, and minerals, as well as high in essential amino acids (EAA), such as cysteine, methionine, and tryptophan (Yuangsoi *et al,* 2014). However, there is less information available on the use of Moringa leaf powder in the diet of rohu.

At the end of experiment highest weight gain was observed at 20% *Moringa* leaf powder meal protein (T4) and lowest weight gain was observed at 5% *Moringa* leaf powder meal protein (T1). Ayotunde *et al.* (2016) reported a *Clarias gariepinus* Fingerlings fed diets with >20% FM replacement had significantly lower weight gain. Similar result was found in present study.

In comparison to the previous study of Ayotunde *et al.,* (2016), which found a good SGR (0.79) with control diet (0 % Moringa powder), on the other hand present study found an excellent SGR (2.59) at 20% replacement of moringa leaf powder. Compared to El-Kassas et al (2020) study, which found a good SGR (3.35) with a 5% replacement of moringa leaf powder. Whereas the present study found a highest SGR (2.59) with a 20% replacement of moringa leaf powder.

Results of present experiment shows that above 15% Moringa leaf powder replacement was direct affect the survival rate. The best survival was obtained in T3 (93.33%) as compared to T1, T2 and T4. Ayotunde *et al.,* (2016) observed 82.49% Survival at 10% replacement of moringa leaf powder and 80.09% Survival at 20% replacement of moringa leaf powder. On the other hand, present study shows 93.33 % survival rate with 15% Moringa leaf powder incorporation.

In study of Hussain *et al.,* (2018) noted a good FCR (1.33) at 10%, however in present study reports good FCR of 1.44, 1.40, and 1.39 with respective replacements of 10%, 15%, and 20% of moringa leaf powder. In agreement with the findings of Suarez *et al.,* (2009), who discovered a good FCR (1.80) with the same substitution of 15% moringa leaf powder used in this investigation. The highest FCE was found in T4 (0.723 ± 0.008^{b}) and lowest in T0 (0.590 ± 0.007^{a}). With respect to FCR and FCE, treatment T0 and T1 significantly difference with T2, T3 and T4 on the experimental study of *L. vannamei.*

According to Suarez *et al.,* (2009) findings, a good PER (1.89) was identified 15%, and present study discovered an excellent PER (2.045) with the same substitution of 15% moringa leaf powder. In comparison to the previous study of El-kassas *et al.,* (2020), which found a highest PER (1.92) with 5% replacement of moringa leaf powder. Whereas the present study found an excellent PER (2.045) at 15% replacement of moringa leaf powder.

Physio-chemical water parameters including pH, temperature, dissolved oxygen and total alkalinity were recorded during the study period on weekly basis. It was in ideal range throughout the experiment.

To conclude, the research findings provide evidence that expensive fishmeal can be effectively supplemented with affordable plant products, such as *Moringa oleifera* leaf powder (MOLP) at a rate of 15%. This supplementation has demonstrated positive outcomes in terms of growth, body composition, and feed utilization, all without any adverse effects.

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