**DOI:** https://doi.org/10.54393/mjz.v4i02.68

MARKHOR
THE JOURNAL OF ZOOLOGY
https://www.markhorjournal.com/index.php/mjz
Volume 4, Issue 2 (July-Dec 2023)

**Original Article**

# Growth Enhancement in Labeo rohita by Replacing Conventional Feed with Moringa Leaves (Moringa oleifera) Powder

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## ARTICLE INFO

**Key Words:**
Fish Biomass, Conventional Food, Total Length, Fork Length, Moringa oleifera, *Labeo rohita*

**How to cite:**
Nawaz, M., Ayyoub Tanvir, M., Ammar, M., Majid khan, A., Imran, M., & Rehman, I. (2023). Growth Enhancement in Labeo rohita by replacing Conventional feed with Moringa Leaves (Moringa oleifera) Powder: Growth Enhancement in Labeo rohita . MARKHOR (The Journal of Zoology), 4(02). https://doi.org/10.54393/mjz.v4i02.68

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Received Date: 31st July, 2023
Acceptance Date: 8th December, 2023
Published Date: 31st December, 2023

## ABSTRACT

Aquaculture enhancement is the need of time to encounter the food demand of the tremendously increasing population. Conventional animals and plants are equally important for human consumption, so examination of other little-researched nutritious plants such as *Moringa oleifera* (Lam) is necessary as an alternative source of aquaculture food protein that may be cost-effective. **Objectives:** To investigate the growth response of *Labeo rohita* species with the addition of *M. oleifera* leaves in conventional food and assessment of economic return and prospects to increase the farmer's income. **Methods:** The current study was planned to observe the growth response and biomass production in *Labeo rohita* (Rohu) with increased economic returns while feeding at different doses of MOL (i-e. 0%, 10%, and 20% inclusion in conventional feed using MOL). The present study was designed in earthen ponds at Wains Agricultural Farm, UC-52, Shah Sadiq Nehang, Shorkot tehsil, Jhang district, Pakistan for 10 weeks (February to April 2018). **Results:** It was observed that a 10% inclusion of MOL powder in conventional fishmeal produce batter biomass as compared to other doses. At the end of the 10th week, *L. rohita* produced 65.16 g body weight with 10% inclusion whereas a 63.20 g increase was observed with a conventional diet. **Conclusions:** It was inferred that aggregate saving was about 13% when fish was fed with MOL powder diet. Thus, the present study proved a cost-effective approach for fish farming in developing countries like Pakistan.

## INTRODUCTION

Aquaculture is well adapted in developing countries like Pakistan where fish farming is usually practiced in earthen ponds. In Pakistan about nine fish species are being cultured for fish farming [1] where carp farming is common in three provinces (i.e. Punjab, Sindh, and Khyber Pakhtunkhwa). However, the contribution of aquaculture to the Gross domestic product (GDP) is only 1% percent [2]. Quality nutrition (Energy supplements and protein) for animal production plays a key role in socio-economic and public health stability. 40-50% of the fish establishment cost is consumed in the sense of food prevision [3]. High-priced feed items used in fish feed discourage farmers to continue this important practice. Therefore, is needed for time to get locally available low-priced feed material that may act actual alternative to the currently available high-cost feedstuff available in the market [4, 5]. Fish farming is a profitable business and ultimately can eliminate poverty (significant contribution to food security) [6]. *Moringa oleifera* is a familiar plant that belongs to the family *Moringaceae*, with twelve (12) tree and shrub species [7] primarily present in Pakistan and India [8]. Due to its nutritious nature, it is an integral part of the food for

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animals in general and for fish in particular as compared to other protein sources [9]. Vegetative parts *of Moringa oleifera* are a good source of amino acids, vitamins, and minerals [10, 11]. About one billion people in underdeveloped countries depend on fish protein. Thus, it is an excellent source of energy supplement for humans, ruminants, and fish as well [12]. 25-60% of protein is required for fish food that is obtained from animal or plant sources [13]. It is very important to note that it contains (1g leaves powder of *M. oleifera*) about 17-fold higher calcium, 25-fold higher iron, 9 folds higher protein, and 15 folds higher potassium when compared with milk, Spinach, yogurt, and banana respectively [14, 15]. It was revealed that 5g/kg inclusion of MOL is best for fish growth which has a low cost as compared to other protein sources [16]. There is an inadequate pool of knowledge regarding the inclusion of Moringa leaves powder as a protein source in fish food. Therefore, it is very necessary to educate and convince the fish farmers about the addition of miracle tree (*M. oleifera*) leaves to fish food.

## METHODS

The present study was carried out at Wains Agricultural Farm, UC-52, Shah Sadiq Nehang, Tehsil Shorkot, District Jhang (E72°*09'17.7876" & N30° 56'29.5152"*), Pakistan (Figure 1). Freshly harvested *M. oleifera* leaves were heated under steam (at 60℃ for 15 minutes) in an autoclave oven followed by air drying (to prevent nutrient loss under direct sunlight) that caused the deactivation of anti-nutritive factors (such as tannins, phytic acid, and saponin) by reducing the protein digestion in leaves [17, 18]. The air-dried leaves were milled through a 0.01 mm screen. The conventional fish meal (Aqua feed) was purchased from Metro-Faisalabad and three diets were formulated: D1 without the inclusion of MOL, D2 with 10%, and D3 have 20% MOL powder that replaced the conventional feed. Three experimental earthen ponds (with a size of 12×8×8 feet) were used for the proposed experiment. *Labeo rohita* fingerlings were collected from the Government of the Punjab fish hatchery, Faisalabad, and acclimatized for two weeks before the start of the experiment. Twenty of the fingerlings were distributed in each of the three experimental ponds and were fed manually twice a day with 5% feed of the body weight. After every week (7 days), the feeding ratio was adjusted based on body weight gain (The digital scale "Tefal" was used to measure fingerlings' weight/per week in the pasture) [5]. Growth performance (biomass production) as a result of different doses (*M. oleifera* leaf powder) was estimated by using prescribed statistical tools. The fingerlings were taken from each (replicate) pond fortnightly where ten of them were weighed (by using electronic balance) randomly. The mean and standard deviation were calculated by using appropriate statistical tools. Growth performance (in terms of total length and fork length) was also calculated as mentioned below.

Weight gain = (Final weight) - (Initial weight)
Increase in fork length = (Final fork length) - (Initial fork length)
Gain in length = (Final total length) - (Initial total length)

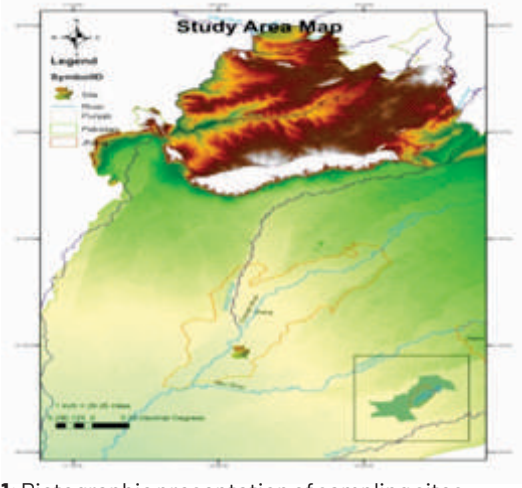


**Figure 1:** Pictographic presentation of sampling sites

## RESULTS

*Moringa* leaves have a good proportion of high-quality protein contents (about 28-36%), iron, carotenoids, and ascorbic acid [10, 19] that has a complete profile of essential food constituents [20] for fish meal [21, 22]. The Moringa tree has been reported as an outstanding source of highly digestible proteins and other nutritional components such as iron, calcium, and vitamin C. Therefore, it is being used as fish feed generally and for human nourishment particularly in South Africa and other developing countries. Overall mean fish weight after the 10th week of the experiment was significantly higher (65.16 ± 2.25 g) when treated with 10% MOL powder as compared to non-treated (63.20 ± 2.49 g) and supplied with 20% of MOL powder (62.96 ± 2.46 g). Overall mean fork length after 10 weeks was significantly higher (7.7 ± 0.34 cm) with 10% treatment as compared to non-treated (0% MOL powder) (7.03 ± 0.32 cm) and treated with higher doses of MOL powder (20%) (7.01 ± 0.32 cm) that was nearly similar to a control group (Table 1).

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**Table 1:** Mean Comparative Weight (g) of *L. rohita* Influenced by MOL Powder

| Week | Increase in weight(g) with D1 | % increase in weight | weight(g) Increase with D2 | % increase in weight | Weight (g) Increase with D3 | % increase in weight |
|---|---|---|---|---|---|---|
| W1 | 42.84±0.61 | 0.00 | 43.08±0.31 | 0.00 | 41.83±0.11 | 0.00 |
| W2 | 44.06±0.28B | 3.67 | 46.01±0.39A | 8.44 | 44.18±0.64B | 7.07 |
| W3 | 50.75±0.40B | 23.76 | 52.93±0.14A | 27.75 | 52.49±0.08A | 30.33 |
| W4 | 61.61±0.70B | 56.39 | 63.33±0.56A | 56.79 | 61.32±0.44B | 58.59 |
| W5 | 64.25±0.61B | 64.38 | 66.62±0.41A | 65.97 | 64.12±0.19B | 67.00 |
| W6 | 68.51±0.84B | 77.11 | 70.65±0.74A | 77.22 | 67.49±1.92C | 77.13 |
| W7 | 73.52±0.98B | 92.16 | 75.31±0.63A | 90.23 | 73.19±0.54B | 94.26 |
| W8 | 75.03±0.64B | 96.70 | 76.87±0.57A | 94.59 | 74.87±0.32C | 99.31 |
| W9 | 75.29±0.36B | 97.48 | 77.95±0.97A | 97.60 | 75.01±0.41B | 99.73 |
| W10 | 76.13±0.17B | 100 | 78.81±.13A | 100 | 75.10±0.34C | 100 |
| Mean | 63.20±2.49B | 67.96 | 65.16±2.55A | 68.74 | 62.96±2.46C | 70.38 |

D1= 0% MOL, D2=10% MOL, D3=20%MOL

Means showing dissimilar letters (in a row) are different significantly(p<0.05)

Table 2 shows comparison of fork length in *L. rohita* influenced by MOL powder. Mean fork length with D1 was 7.03±0.32B. Mean fork length with D2 was 7.7±0.34A. Mean fork length with D3 was 7.01±0.32B.

**Table 2:** Comparison of Fork Length in *L. rohita* Influenced by MOL Powder

| Week | Fork length (cm) increases with D1 | % increase in fork length | Fork length (cm) increases with D2 | % increase in fork length | Fork length (cm) increases with D3 | % increase in fork length |
|---|---|---|---|---|---|---|
| W1 | 4.79±0.15 | 0.00 | 5.03±0.09 | 0.00 | 4.61±0.25 | 0.00 |
| W2 | 4.87±0.17B | 18.31 | 5.23±0.00A | 3.37 | 4.90±0.13B | 6.72 |
| W3 | 5.13±0.07A | 7.79 | 5.29±0.09A | 4.39 | 5.26±0.23A | 15.04 |
| W4 | 5.92±0.10B | 25.86 | 6.18±0.18A | 19.37 | 5.99±0.07B | 31.95 |
| W5 | 6.53±0.25B | 39.82 | 6.64±0.11B | 27.11 | 7.32±0.04A | 62.74 |
| W6 | 7.80±0.32B | 68.88 | 8.18±0.04A | 53.04 | 7.79±0.21B | 73.62 |
| W7 | 8.33±0.08C | 81.00 | 8.58±0.07A | 59.77 | 8.39±0.15B | 87.50 |
| W8 | 8.80±0.10B | 91.77 | 9.67±0.08A | 78.12 | 8.76±0.06B | 96.07 |
| W9 | 8.97±0.17B | 95.66 | 10.37±0.01A | 89.90 | 8.86±0.09B | 98.38 |
| W10 | 9.16±0.04B | 100 | 10.97±0.91A | 100 | 8.93±0.15C | 100 |
| Mean | 7.03±0.32B | 58.78 | 7.7±0.34A | 48.34 | 7.01±0.32B | 63.55 |

D1= 0% MOL, D2=10% MOL, D3=20%MOL

Means showing dissimilar letters (in a row) are different significantly(p<0.05)]

Mean gain in total body length was significantly higher (9.83 ± 0.47cm) with the treatment of 10% MOL powder as compared to 0% and 20% (9.15 ± 0.40cm) and (9.10 ± 0.40 cm) respectively (Table 3). It was observed that the addition of MOL powder to the fish diet (*Rohu*) considerably reduced the food costs (considerably 120 rupees/10%) along with a significant increase in fish biomass (651.6 g as compared to 632 g with conventional feed that saved 11.76 PKR) whereas total saving in each case was 131.76 PKR (13%). Low feed costs and more biomass production root good economic returns to the country and prospects to increase the farmer's income.

**Table 3:** Comparative Analysis for Total Fish Length (cm) Influenced by MOL Powder

| Week | Total length (cm) increase with D1 | % increase in total length | Total length (cm) increases with D2 | % increase in total length | Total length (cm) increases with D3 | % increase in total length |
|---|---|---|---|---|---|---|
| W1 | 6.17±0.16 | 0.00 | 6.23±0.09 | 0.00 | 5.81±0.25 | 0.00 |
| W2 | 6.37±0.17B | 3.43 | 6.80±0.04A | 7.52 | 6.40±0.13B | 10.25 |
| W3 | 6.73±0.07 | 5.59 | 6.84±0.06 | 8..05 | 6.82±0.24 | 17.53 |
| W4 | 7.82±0.10B | 28.26 | 8.08±0.18A | 24.40 | 7.89±0.07B | 36.12 |
| W5 | 8.53±0.25B | 40.42 | 8.64±0.11B | 31.80 | 9.32±0.04A | 60.94 |
| W6 | 9.90±0.32B | 63.86 | 10.28±0.04A | 53.44 | 9.89±0.21B | 70.84 |
| W7 | 10.83±0.08B | 79.80 | 12.20±0.07A | 78.76 | 10.66±0.17B | 84.20 |
| W8 | 11.33±0.10B | 88.36 | 12.36±0.13A | 80.88 | 11.26±0.06B | 94.10 |
| W9 | 11.87±0.17B | 97.61 | 13.01±0.11A | 89.45 | 11.39±0.41C | 96.88 |
| W10 | 12.01±0.13B | 100 | 13.81±0.19A | 100 | 11.57±0.10C | 100 |
| Mean | 9.15±0.40B | 56.37 | 9.83±0.47A | 52.7 | 9.10±0.40B | 63.42 |

D1= 0%MOL, D2=10% MOL, D3=20%MOL

Mean showing dissimilar values are different significantly (p<0.05)]

Figure 2 shows weekly effect of different treatments on the growth and weight of *L. rohita*. D2 treatment showed significant growth and weight among all treatments.

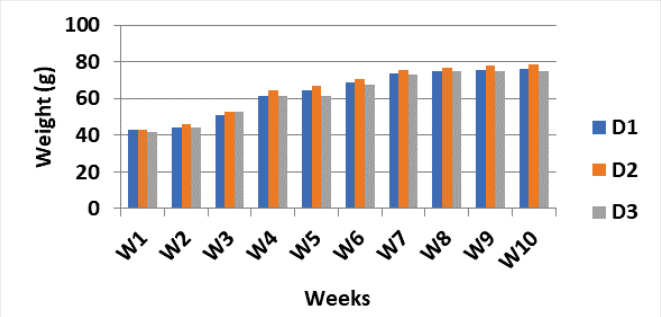


**Figure 2:** Weekly Effect of different treatments on the Growth and Weight of *L. rohita*

## DISCUSSION

*Moringa oleifera* is an important reported plant species belongs to family Moringaceae with impressive medicinal and nutritional range worldwide [23]. 10% MOL powder (as a supplement in conventional feed) proved best for more weight gain in *L. rohita* and its farming practices. The current findings show agreement with Puycha *et al.*, who experimented to observe the *Clarias garipienus growth* with

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MOL inclusion in conventional fish meal [24]. They reported that fish with 10% inclusion added more body weight as compared to non-treated and high doses. Agriculture Organization of the United Nations clarified that supplies of fish meal are strictly inadequate if aquaculture practices continues to expand, the fish meal demand soon will exceed the supplies [25]. It is because plants are easily available with affordable prices as compared to conventional feed that is limited in production. Plant based protein in aquaculture feeds should be considered. The results of present study are strongly corroborated with idowu *et al.,* study where fish (*C. gariepinus*) gain minimum and maximum body weight with 20% and lower dose (15%) of inclusion respectively [26]. These results are synchronized with the findings of Yuangsoi *et al.,* who concluded that lower doses (up to 10% MOL powder) in the diet of fancy carp fish result in excellent growth performance and feed utilization without any adverse effects [27]. It is proposed that decrease in fish growth with increase in nutritional utilization *(M. oleifera leaves)* above 15% [28, 29] is due to the presence of anti-nutrients (such as phylates, saponins, phenol and tannins) in meal. The reduction in growth performance may also be due to reduction of amino acids and protein contents with higher level of substitution. Replacement of *O. niloticus* diet with *M. oleifera* leaf extract increases its growth [30]. Fasakin *et al.,* supported the current hypothesis that substitution of low priced contents (*Spirodela polyrrhiza* and duckweed) support fish growth (*O. niloticus)* [31]. Puycha *et al.,* proposed that a moderate dose of MOL powder brings excellent biomass production and growth performance in Bocourtis catfish (*Pangasius bocourti)* [24]. The results of current study are in synchronization with Ajani and Adetomi study where the there was an increase in fish length (Diet A, B, C, D and E as 0% ,10% 15%, 20% and 25% increase respectively) by the addition of *M. oleifera* powder to conventional feed. Results of present study seems to have a direct link between intake of food and its palatability, may be intake is reduced when substituted with higher dose of *M. oleifera* [32]. Fasakin *et al.,* explained that tannins and saponins in Moringa extracts have a bitter taste (phenolic may bind with saliva mucopolysaccharides, chemosensory receptors and epidermal layer) that might behave as feed restraint [31, 33].

## CONCLUSIONS

The present study reveals that the inclusion of MOL powder (10%) causes excellent growth performance in *L. rohita* without any adverse effects. At the end of the 10th week of the experiment, 65.16 g of mean biomass was added as compared to 63.20 g with conventional feed (13% of total saving with MOL powder). This strategy is very cost-effective (advised ratio of MOL powder in conventional feed) that may increase fish growth at a fish farm. Despite splendid fish diversity in the aquatic ecosystem of Pakistan, this technique (Supplementation of *M. oleifera* leaf powder) is of the least concern. The addition of MOL powder in fish conventional feed may be a breakthrough to have a good economic return and cost-effective business in developing countries like Pakistan.

## Authors Contribution

Conceptualization: MAT
Methodology: MA, AMK
Formal analysis: MN, MA, MI
Writing-review and editing: MN, MI, IR

All authors have read and agreed to the published version of the manuscript.

## Acknowledgment

The authors extend their sincere gratitude to the University of Agriculture, Faisalabad, and University of the Punjab, Lahore, Pakistan for the provision of lab facilities to complete this study.

## Conflicts of Interest

The authors declare no conflict of interest.

## Source of Funding

The authors received no financial support for the research, authorship and/or publication of this article.

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