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Growth Performance of *Oreochromis mossambicus* Fed with *Moringa oleifera* and *Basella alba* Leaf Powders Supplemented Feed

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Abstract: An investigation was carried out to evaluate the effect of selected plants (*Moringa oleifera* and *Basella alba*) supplemented feed on the growth parameters of *Oreochromis mossambicus.* Five experimental feeds were prepared by adding either 2.5 or 5 g of plant powder to the basal diet and one control feed without plant powder. The fishes were supplemented with these feeds for 45 days and the results were recorded for every 15 days once. The data were analyzed using one way Analysis of Variance (ANOVA). The growth parameters was significantly high ($P<0.05$) in *O.mossambicus* fed with *M.oleifera* and *B.alba* supplemented feed at two different concentration (2.5 and 5 gm/kg of feed) when compared to control group after 15th, 30th and 45th day after treatment. This study indicated that inclusion of plant ingredients in fish feed resulted in superior growth performance and the formulation of plant-based diet for fish will provide new opportunities.

Keywords: Tilapia, Plant supplemented feed, Growth, *Moringa oleifera*, *Basella alba*

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Introduction

Aquaculture contributes a significant amount of protein to human beings through their food and also shares a long history (Gui *et al*., 2018). Aquaculture, especially fisheries, plays a major role in the global food economy. It is a source of employment for about 200 million people across the world (Gareth, 2001). Feed accounts for 50% of the production cost in aquaculture. Production costs of the ingredients, which make up the major part of feed, are affected by factors such as climate, global economic growth and fuel costs. There is an increase in the cost of these feeds from 2000-2009 due to its high cost of production and demand (Rana *et al*., 2009). This eventually led to an increase in the total aquaculture production.

One of the most challenging issues faced by mankind, worldwide, is food waste. The food systems are becoming inefficient day by day such that between one-third and one-half of the food produced are lost before they reach a human

mouth (FAO, 2011). In this situation the use of food waste in aquaculture will be a sustainable strategy. This will not only provide a solution for waste management but also cut the cost of aquaculture feed. A proper combination of recycled food waste will provide sufficient nutrients for the growth of fish. This will help in the reduction of fishmeal in aqua feeds (Bake *et al*., 2009). Along with this the nutritional quality and safety of the feed should also be considered.

Feed quality can be improved by adding certain supplements according to the need. From the past decade the use of medicinal plants as growth enhancer (Asadi *et al*., 2012), immune-stimulant and antipathogenic (Yilmaz *et al.*, 2013) etc has only been increasing. *Moringa oleifera* is one of the potential protein sources that can be included in aquaculture diets (Chiseva, 2006). *Basella alba* is a branched, succulent plant with purplish to green coloured stem. Leaves and stems are the parts which are mainly used for medicinal purpose (Adhikari *et al*., 2012). The current study aims to demonstrate that food wastes could be recycled into high quality fish feeds using leaf powders of *Moringa oleifera* and *Basella alba* for culturing economically precious fresh water fish *Oreochromis mossambicus* for producing safe and quality products.

Materials and Methods

Collection and Acclimation of Experimental Animal: The experimental animal selected for present study was tilapia fish (*Oreochromis mossambicus*). *O. mossambicus* weighing 5±1 g were procured from Tamil Nadu Fisheries Development Corporation Limited, Aliyar fish farm, Pollachi, Coimbatore district, Tamil Nadu, India and were acclimatized to fresh water condition for 2-3 weeks in laboratory. Care was taken to avoid contamination.

Collection of Plants: Fresh leaves of *M. oleifera* and *B. alba* were collected from Nirmala College for Women, Redfields, Coimbatore district, Tamil Nadu, India. The plant samples were identified and validated by botanist in the Botanical Survey of India, Southern Regional Centre, Coimbatore, Tamil Nadu, India.

Preparation of Plant Powder: Fresh leaves of *M. oleifera* and *B. alba* were collected, washed, shed dried and ground into fine powders and used for preparation of feed.

Preparation of Fish Feed: Balanced feed was prepared with approximately 36% protein content to serve as feed by using wheat flour, coconut oil cake and soya bean meal. The feed was prepared by following the Pearson square method. Experimental feeds have been prepared by supplementing the balanced feed with *M.oleifera* and *B.alba* leaf powder at various concentrations (2.5 and 5 g/ kg of feed) on dry weight basis (Table 1).

Experimental Setup: The fresh water edible fish, *O. mossambicus* (5 ± 1 g) were introduced in 50 L aerated plastic troughs. The fishes were divided into five experimental groups (C – control and T_1 to T_4 – four different treatments) of 10 fishes in triplicate (5 x 10 x 3 = 150 fish). This experiment was carried out for a period of 45 days. During experimental period the fishes were fed with their respective feed at 5% of their body weight, once in a day. The unutilized feed and faecal matter were collected every day before feeding and kept for further analysis. The medium (water) was changed daily in order to prevent microbial contamination by replacing one-third of the water in the tanks daily throughout the experimental period after siphoning out the unutilized feed and faecal matter. The plastic troughs were washed and cleaned once in fifteen days when the fishes were removed from troughs for weighing. The survival rate was monitored during experimental period.

Determination of growth parameters: The weight of *O. mossambicus* in the control and four different treatments were measured individually and values were noted. The fishes were weighed by using digital electronic balance with mg sensitivity. The fingerlings were released into water after body measurements (Hasan and Khan, 2013). The

Table 1: Composition of balanced feed supplemented with leaf powders (g/kg)

Feed ingredients	Control	T_1	T_2	T_3	T_4
Wheat flour	300	300	300	300	300
Coconut oil cake	300	300	300	300	300
Soya bean meal	400	400	400	400	400
Moringa oleifera	-	2.5	5	-	-
Basella alba	-	-	-	2.5	5

Table 2: Growth characteristics of *O. mossambicus* fed with *M. oleifera* and *B. alba* leaf extracts at four different concentrations (15 DAT)

Treatments	Initial weight (g)	Final weight (g)	Weight gain (g)	Weight growth rate (g/day)	Average daily growth rate (g/day)	Relative growth rate (%)	Specific growth rate (%/day)	Survival rate (%)
C	5.0±0.0	5.1±0.1	0.1±0.01	0.0013±0.001	0.0066±0.001	2±0.1	0.0573±0.001	100
T1	5.0±0.0	5.21±0.1	0.21±0.01	0.0028±0.001	0.014±0.001	4.2±0.1	0.1191±0.001	100
T2	5.0±0.0	5.62±0.1	0.62±0.01	0.0082±0.001	0.0413±0.001	12.4±0.1	0.3384±0.001	100
T3	5.0±0.0	5.45±0.1	0.45±0.01	0.006±0.001	0.03±0.001	9±0.1	0.2495±0.001	100
T4	5.0±0.0	5.94±0.1	0.94±0.01	0.0125±0.001	0.0626±0.001	18.8±0.1	0.4987±0.001	100

Results are the mean value of triplicates ± Standard Deviation with significant difference at $P<0.05$.

weight of individual fish was recorded initially and then at 15 days interval for 45 days. BW, FW, WG, GR, DWG, SGR and RGR were calculated as follow in the control and treated fishes by using standard formulae (Petursewiez and Macfutyen, 1970):

- Final weight (FW)(g)
- Weight gain (WG) (g) = FW(g) – IW (g)
- Growth rate (GR)(g.day^{-1})= FW(g) – IW (g)/No. of days* IW
- Average daily growth rate (g.day^{-1}) = FW(g) – IW (g)/ No. of days
- Relative growth rate (RGR) (%)= 100 x [FW (g) – IW (g)] / IW (g)
- Specific growth rate (SGR) (% day^{-1}) = 100 x [In FW (g) – In IW (g)] /No. of days.
- Survival rate (%) = 100 x Initial number of fishes – final number of fishes

Where, IW – Initial Weight of fishes; FW – Final Weight of fishes.

Statistical Analysis: The data on growth parameters were transformed into arc sine values before subjecting to ANOVA. To find out the significance of comparative efficacy of different leaf extract on length, weight and specific growth rate, one way analysis of variance was used.

Results

The leaf powders of *M. oleifera* and *B. alba* at two different concentrations (2.5 and 5 g/kg of feed) were given as feed supplement to *O. mossambicus* for 45 days. The growth parameters such as BW, GR, RGR, SGR and SR of *O. mossambicus* in the control and four different treatments were observed initially and on 15th, 30th and 45th days after treatment and the results obtained are presented in Tables 2-4. From the data obtained, the maximum increase in the growth parameters was shown by fishes in T4 treatment. At the end of 15th, 30th and 45th days fishes in T4 treatment have attained a weight of 5.94±0.1 g, 6.51±0.1 g and 7.38±0.1 g, respectively. The least growth was shown by fishes of control. During the experimental period the T4 fishes have gained a

Table 3: Growth characteristics of *O. mossambicus* fed with *M. oleifera* and *B. alba* leaf extracts at four different concentrations (30 DAT)

Treatments	Initial weight (g)	Final weight (g)	Weight gain (gm)	Weight growth rate (g/day)	Average daily growth rate (g/day)	Relative growth rate (%)	Specific growth rate (%/day)	Survival rate (%)
C	5.0±0.0	5.43±0.1	0.43±0.01	0.0028±0.001	0.0143±0.01	8.6±0.1	0.1194±0.01	100
T1	5.0±0.0	5.57±0.1	0.57±0.01	0.0038±0.001	0.019±0.01	11.4±0.1	0.1562±0.01	100
T2	5.0±0.0	6.07±0.1	1.07±0.01	0.0071±0.001	0.0356±0.01	21.4±0.1	0.2807±0.01	100
T3	5.0±0.0	5.78±0.1	0.78±0.01	0.0052±0.001	0.026±0.01	15.6±0.1	0.2098±0.01	100
T4	5.0±0.0	6.51±0.1	1.51±0.01	0.01±0.001	0.0503±0.01	30.2±0.1	0.382±0.01	100

Results are the mean value of triplicates ± Standard Deviation with significant difference at P<0.05.

Table 4: Growth characteristics of *O. mossambicus* fed with *M. oleifera* and *B. alba* leaf extracts at four different concentrations (45 DAT)

Treatments	Initial weight (g)	Final weight (g)	Weight gain (g)	Weight growth rate (g/day)	Average daily growth rate (g/day)	Relative growth rate (%)	Specific growth rate (%/day)	Survival rate (%)
C	5.0±0.0	5.6±0.1	0.6±0.1	0.0026±0.001	0.0133±0.001	12±0.1	0.1093±0.01	100
T1	5.0±0.0	5.76±0.1	0.76±0.1	0.0033±0.001	0.0168±0.001	15.2±0.1	0.1365±0.01	100
T2	5.0±0.0	6.68±0.1	1.68±0.1	0.0074±0.001	0.0373±0.001	33.6±0.1	0.2795±0.01	100
T3	5.0±0.0	6.3±0.1	1.3±0.1	0.0057±0.001	0.0288±0.001	26±0.1	0.223±0.01	100
T4	5.0±0.0	7.38±0.1	2.38±0.1	0.0105±0.001	0.0538±0.001	47.6±0.1	0.3757±0.01	100

Results are the mean value of triplicates ± Standard Deviation with significant difference at P<0.05.

total weight of 2.38±0.1 g and showed an average daily growth rate of 0.0538±0.001 g/day whereas fishes in control has only gained 0.6±0.1 g in total and shows an average daily growth rate of 0.0133±0.001 g/day. For other parameters like growth rate, relative growth rate and specific growth rate also maximum result was observed in T4 and minimum in control. The survival rate during the experimental period was high in all the treatments (T_1-T_4) and control. The growth parameters were significantly high (P<0.05) in *O. mossambicus* fed with *M. oleifera* and *B. alba* supplemented feed at two different concentration (2.5 and 5 g/kg of feed) when compared to control group after 45 days of treatment.

Discussion

In the present study, there is a notable increase in the growth parameters of the treated fishes which reflects the influence of leaves of *M.oleifera* and *B.alba* as a feed supplement. The improved feed efficiency may also be due to the supplement (*M.oleifera* and *B.alba* leaf powders) added to the feed. This may be due to the flavor changing that will influence the feeding pattern, secretion of digestive enzymes and total intake of feed as reported by Lee and Gao (2012).

Extracts of herbs and spices have the ability to stimulate the secretion in the gut region thus improving the performance of animals. Sometimes it also stimulates the secretion of the digestive enzymes and protein synthesis (Citrarasu, 2010). This may be the reason for the improved growth and feed efficiency seen in the treatment groups.

Many varieties of feed additives are being used to improve the growth performance, feed efficiency, and disease resistance in fishes. To minimize the use of chemicals, in the latest years the use of medicinal herbs and plants as substitute has been increased (Mohamed *et al*., 2003). Plants being the natural source of chemical has proved to be a safer option for feed additives. It also has proved to have properties like anti stress, tonic,

antimicrobial etc (Citarasu *et al*., 2001; Citarasu *et al*., 2002).

M. oleifera leaves has always been a part of traditional medicines. With its high crude protein, it can be used as growth promoters. In *C. carpio* fingerlings, Moringa leaves and its extract has also shown growth promoting properties (Khalil and Korni, 2017). Feed supplemented with 5% *M.oleifera* has shown significant increase in weight and specific growth rate of *O. mossambicus* (Karpagam and Krishnaveni, 2014).

B. alba is rich source of vitamin A and C (Bakr and Gawish, 1997). It has also known for its use in Ayurvedic medicine. From the present study, treatment fed with *B.alba* supplement has shown an increased growth performance and feed utilization followed by treatment fed with *M. oleifera*.

Conclusion

The treatment with *B. alba* as supplement has shown a greater feed efficiency than control followed by treatment with *M. oleifera*. From the result obtained, feed with higher concentration of leaf powders show increased performance which may indicate the activity of leaf on fish to be positive. So, it can be concluded that the food processing waste can be used as a high-quality fish feed by adding leaf powders as feed supplement.

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