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The Suitability of *Moringa oleifera* Leaf Meal Supplementation to Commercial Diets on the Growth and Survival of *Oreochromis niloticus* Fry

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ABSTRACT

Proper fish nutrition and adequate feeding are necessary for high fish production. The study was conducted to determine the suitability of *M. oleifera* leaf meal supplementation to commercial diets on the growth performance of *Oreochromis niloticus* fry until fingerling size. Seven experimental diets were used with three replicates each arranged in a complete randomized design. Treatments 1, 3 and 5 were given commercial diets only, treatments 2, 4, and 6 with 10% *M. oleifera* leaves and 90% commercial diets. Treatment 7 was the control with

rice bran. Each treatment was stocked with 50 fry with an average weight of 1.76+0.112 and an average length of 47.65+1.78 and feed for two months. Data gathered were analyzed using the One-Way ANOVA to determine significant difference among treatments. Duncan's Multiple Range Test (DMRT) was used to determine the significant difference between treatment means. All test used 0.05 level of significance. Results showed significant differences among treatments. Treatment 4 had the highest average weight of 6.83+0.145 g, an average length of 65.97+0.251 mm, and survival rate of 86.0+2.646% after eight weeks of culture. Growth and survival of *Oreochromis niloticus* could be enhanced by adding 10% dried *M. oleifera* leaf meal supplementation to commercial diet.

Keywords — Nutrition, suitability, growth performance, *Oreochromis Niloticus*, leaf meal supplementation, *M. oleifera*, experimental design, Philippines, Asia

INTRODUCTION

Nile tilapia *(Oreochromis niloticus)* is one of the most widely cultured species of tilapia in the Philippines. It can tolerate poor water quality and can graze wide range of natural food. Out of 112.30 million tons of world production of fish in 1995, 18.97% came from the aquaculture sector while the rest came from the capture fishery (FAO, 1998). It is expected that the increase in fish production should come from aquaculture, the fastest growing food production sector of the world (FAO, 2000). In aquaculture operations, particularly in fish hatchery, the need to have good quality feed that could supply the nutritional requirements of fish for stocking in the fishpond is very necessary. The high cost and fluctuating quality of fish feed in the market (Abo-state, Hammouda, EL-Nadi & Abozaid, 2014) are variables that can result to low survival rate and eventually, low production. Because of this problem, the need to identify alternative and cheap protein sources to replace one of the ingredients in the formulation of feed for fish is very important.

One of the identified plant sources is *Moringa oleifera* (malunggay leaves), considered to be a promising plant protein sources in aquaculture (Foidl, Makkar & Becker, 2001) for inclusion in fish diets at low levels (Tagwireyi, Mupangwa, Jepsen & Mwera, 2015). It is rich in protein and has been tested in various fish species as a potential replacement for fish meal. Moringa leaf meal can be introduced in Nile tilapia diets only in limited amounts, up to 8-10% dietary

level (Abo-State et al., 2014; Yuangsoi & Charoenwattanasak, 2011; Richter, Siddhuraju & Becker, 2003; Afuang, Siddhuraju & Becker, 2003). In a diet where Moringa leaves were included at 10% to provide supplementary protein, protein digestibility was reported to range from 68% to 75%, and daily weight gain was 30% higher (Yuangsoi *et al.*, 2011).

Thus, this study is timely to be conducted to confirm previous findings on the suitability of *M. oleifera* leaves in addition to different commercial feeds as a protein source for *Oreochromis niloticus* fry.

OBJECTIVES OF THE STUDY

This study determined the suitability of *Moringa oleifera* leaf meal supplementation to commercial diets on the growth and survival of *Oreochromis niloticus* fry. Specifically, it determined the growth of *Oreochromis niloticus* fed different commercial feeds with supplementation of *Moringa oleifera* leaf meal, the survival rate of *Oreochromis niloticus* fed different commercial feeds with supplementation of *Moringa oleifera* leaf meal and significant differences among treatments.

MATERIALS AND METHODS

Experimental design

The study was conducted at the hatchery of the College of Fisheries of the University of Antique, Tario-Lim Memorial Campus. The experiment had seven (7) treatments with three (3) replicates, each arranged in a complete randomized design indicated below:

TREATMENTS	REPLICATES
Treatment 1 (B-meg) without *M. oleifera* (malunggay) leaves	3
Treatment 2 (B-meg with powdered *M. oleifera* (malunggay) leaves	3
Treatment 3 (TATEH) without M. oleifera (malunggay) leaves	3
Treatment 4 (TATEH with powdered *M. oleifera* (malunggay) leaves	3
Treatment 5 (EXCEL) without *M. oleifera* (malunggay) leaves	3
Treatment 6 (EXCEL with powdered *M. oleifera* (malunggay) leaves	3
Treatment 7 (Rice bran) (control)	3

Experimental Animal

Nile tilapia fry with an average weight of 1.76+0.112 and a length of 47.65+1.78 was used as an experimental animal for this study.

Processing of Malunggay leaves

M. oleifera leaves were taken from the hatchery of the University of Antique-TLMC and dried under the sun for one (1) day. After drying, it was ground by the used of the local grinder until it turned into powder form. The powdered malunggay leaves were mixed manually with different commercial feeds with a proportion of the 10% (0.5g) malunggay leaves and 90% (3.5 g) commercial feeds.

Cleaning of tanks and stocking of fry

A total of twenty-one culture plastic containers with a capacity of 15 liters each were used in the study. It was cleaned with freshwater and powdered detergent and rinsed with freshwater for one (1) day. All plastic culture containers were labeled based on the assigned treatments. It was filled with fresh water at about 14 liters and installed with aeration. Before stocking, Initial weights and lengths of 50 fry in each treatment were measured by the use of a General Master Model D108 weighing balance with high precision up to 0.1 g and a transparent ruler, respectively. Fry was then stocked slowly and gradually early morning to prevent stress. No feed was given after stocking, only during the next day.

Water Management

Water change was done every day at 100% of the total volume by the use of a rubber hose with a diameter of .5 inches to remove the fecal waste of tilapia and uneaten feeds in the water. The same volume of water was replaced after draining.

Feeding

Right after the water change, feeding was done three (3) times a day, once in the morning (7:00-8:00), noon time (12:00) and in the afternoon (4:00-5:00). The feeding rate was computed by the formula indicated below:

$$\textbf{\textit{Feeding Rate}} = \frac{\textit{(stocking density) (feeding ratio)(survival rate)(ABW) X 100}}{1000}$$

Moreover, feeding rate was based on the percentage body weight expressed below:

1st and 2nd week --------- 5%
3rd and 4th week -------- 4%
5th and 6th week --------- 3%
7th and 8th week -------- 2%

Monitoring of water temperature

Water temperature was monitored every morning and afternoon at 7:00 AM and 4:00 PM, respectively, after water change by the use of a thermometer. Also, a 24-hr monitoring of temperature in each treatment was done every after two hours by the use of a thermometer one day before sampling of the growth of the fish.

Sampling of growth and survival rate

A sampling of tilapia fry was done every two weeks to determine growth increment. Twenty-five tilapia fry was taken by means of a scoop net from each treatment and weighed by using the General Master Model D108 weighing balance with high precision up to 0.1. For the length (mm), a transparent ruler was used.

Harvesting

Nile tilapia was harvested after eight weeks of culture upon reaching the juvenile stage. In harvesting, the water in tanks was drained, and all the experimental animals in each treatment were harvested and measured for weight and length by the use of weighing balance and transparent ruler, respectively.

Data analysis

All data were summarized, computed for the average and subjected to One-Way Analysis of Variance to determine significant difference among treatments. Duncan's Multiple Range Test was also used to determine the significant difference between treatment means. All tests were set at 0.05 level of significance.

RESULTS AND DISCUSSION

Average Weight

Results show that after two weeks of culture (first sampling), the highest average body weight was obtained from tilapia fry fed with rice bran (treatment

7, control) followed by those fed with Tateh with *M. oleifera*. However, during the 4th (second sampling) and 8th (fourth sampling) weeks of culture, when tilapia reached the fingerling size, the average body weight was consistently highest in treatment fed with Tateh with *M. oleifera*, over other treatments.

Significant differences among treatments (p>0.05) occurred during the 6th week (3rd sampling) and 8th week (4th sampling) of culture. Significant difference among treatment means showed that Tateh with *M. oleifera* leaves obtained the highest average weight among the rest of the treatments (Figure 1).

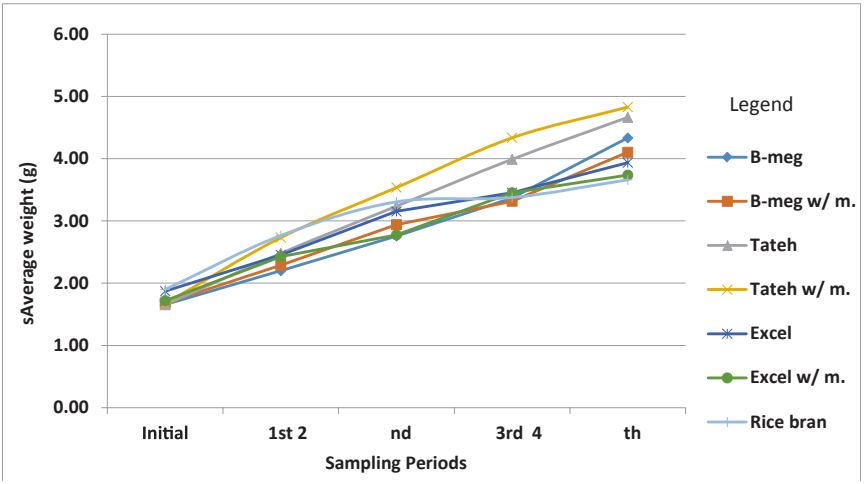

Figure 1. Average weight (grams) of tilapia fingerlings at different commercial feeds with the addition of malunggay leaves for 8th weeks of culture.

Average Length

Results show that the highest average body length of tilapia fingerlings (65.97±23 mm) after 8-week of culture was obtained in treatment fed with Tateh with *M. oleifera*. It was noted, however, that rice bran could better enhance the growth of tilapia fingerlings comparable with Tateh with malunggay leaves (59.21+.12 mm) during the 4th week of culture only. But it tapers down to the lowest average length during the last sampling period (59.65+.32 mm). Result shows significant difference among treatments at 0.05 level of significance (Figure 2).

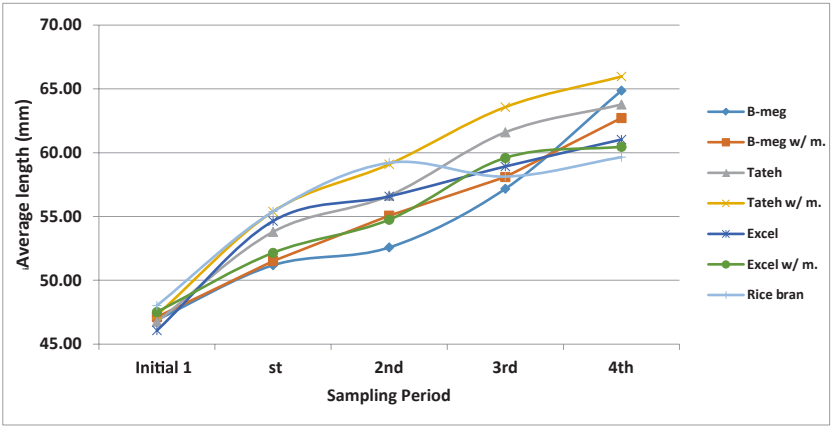

Figure 2. Average Length (mm) of Tilapia fingerlings at different commercial feeds with the addition of malunggay leaves for eight weeks of culture.

Survival Rate

Results show that highest survival rate of tilapia fingerlings from fry after 8 weeks of culture was obtained in treatment fed with Tateh with *M.* oliefera (86.00±2.646%) over other treatments. There was a significant difference among treatments at 0.05 level of significance. Duncan's Multiple Range Test also shows a significant difference among treatment means. The result is shown in Figure 3.

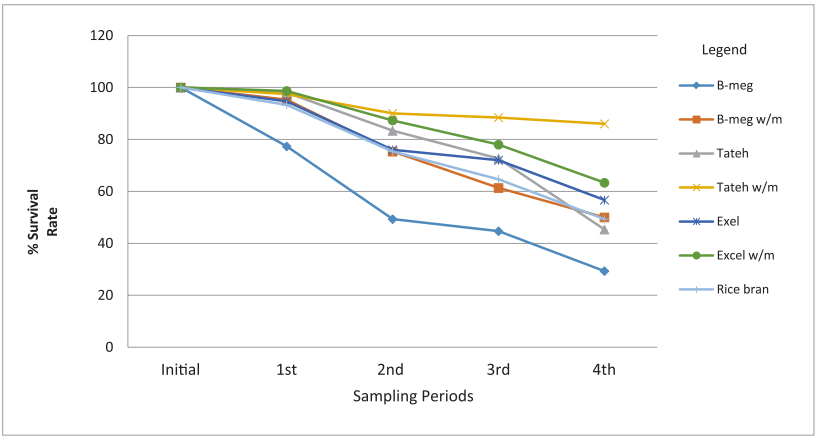

Figure 3. The survival rate of Tilapia fry at different commercial feeds with the addition of malunggay leaves for eight weeks of culture.

Daily Temperature and 24-hr monitoring

Results of the daily average temperature in each treatment in the morning ranged from 24.87°C – 25.90°C and in the afternoon ranged from 28.54°C-30.00°C. No significant fluctuations of temperature occurred throughout the duration of the experiment.

A twenty-four-hour monitoring of the temperature was done one day before sampling periods. Results of the 24-hr monitoring of temperature which was done every after two hours ranged from 21.13°C – 30.40°C.

This present study shows that tilapia fry fed with Tateh plus *M. oliefera* obtained the highest average weight over other treatments after 8th weeks of culture. This means that dried and powdered *Moringa oleifera* can enhance the growth of *Tilapia nilotica* at 10% supplementation of the total feed given. It is because *M. oleifera* contains average crude protein of 26.8% and crude fiber of 12.2%. Its average total energy is 18.8 MJ/kg DM. Protein content present in *M. oleifera* has a major role in building and repairing worn out cells and tissues of fish. Proteins are micro molecules made up of carbon, hydrogen, oxygen, nitrogen, and may also contain sulfur. Proteins occur in every living cell as compounds of tissues and organs and are major components of the fish tissue (Millamena, 1998). Moreover, aquatic animals consume protein to provide continuous supply necessary for replacing worn out tissues (maintenance) and for the synthesis of new tissues (growth and reproduction) Millamena, 2001). Furthermore, all aquatic animals require food to supply the energy they need such as muscle activity, chemical processes, nerve activity and osmotic work (Millamena, 2001). On the other hand, the role of fiber in the nutrition of fish cannot be overemphasized. It aids in the digestion and cleans out the intestines of fish. It can also prevent many diseases of the digestive tract.

The result of this study is in agreement with the study of El-Nadi (2011) in their experiment on the effect of dietary supplementation with *Moringa oleifera* leaves on the growth and performance parameters on Nile tilapia. They started feeding with Moringa leaves from fingerlings (20 g) until 56 days. Their results showed that highest weight gain was obtained in treatment fed Moringa leaves with 53.310 grams. Based on their study, Moringa leaves could be used with fish meal as a growth enhancer in tilapia feeds. Moreover, their results show that the addition of Moringa leaves at 5g/kg diet had the best performance in terms of growth performance parameters, reduce cost and maximize profit. In our present study, however, results shows that treatment fed commercial feed with the addition of 10% *M. oleifera* obtained the highest average weight of 4.83 g with a survival rate of 76% for 8 weeks of culture.

In the study of Tagwireyi *at al.* (2015) they used 10% inclusion of steam heated Moringa leaves to Nile tilapia fry, and they found better growth performance in terms of body weight gain (BWG), average daily gain (ADG), feed conversion ratio(FCR) and protein efficiency ratio (PER) than those fed boiled Moringa leaves. In another study of Yuangsui and Masumoto, (2012), it indicated that Moringa leaves could replace not over 200 g kg-1 soybean and could become an alternative plant protein source in fish to lower production cost of fish diets and add value to a plant origin. Francis, Makkar and Becker (2002) used Moringa leaf meal in *tilapia nilotica* indicated growth-reducing effects at high levels of inclusion of raw leaf meal. Richter *et al.* (2003) reported that the replacement of fishmeal in a diet for tilapia with Moringa leaf meal beyond 10% level produced poor growth and lowered the feed utilization efficiency. Afuang *et al.* (2003) found that extraction of the anti-nutrients/antimetabolites components of raw leaf meal up to 33% in tilapia diets has no any adverse effects on growth.

A number of studies in other species of fish have shown that MOL at a maximum level of 10% could be acceptable as plant protein replacement in fish based diets without adverse effects on the growth performance and health welfare of *Lates calcarifer (*Ganzon-Naret, 2014). Another study has shown that *M. oleifera* leaf meal could also be used to substitute or can be supplemented up to 10% level in *Clarias gariepinus* (Ozovehe, 2013).

CONCLUSIONS

Based on the result of this study, *M. oleifera* leaves is suitable for the growth and survival of Nile tilapia when added to commercial feeds at 10% of the total feed consumption from fry up to fingerlings size and could enhance growth and survival, reduce cost and maximize profit.

RECOMMENDATIONS

It is recommended that aquaculture fish diets may be added with *M. oleifera* leaves especially in Tateh diets that had the best growth performance parameters and survival rate based on the results of this study.

Moreover, experiment on the inclusion of *M. oleifera* in growing out commercial feeds must be tried in Nile tilapia in bigger ponds to determine if it would also enhance growth and survival and reduce the cost of feed.

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