Growth performance of *Trachinotus blochii* (silver pompano) fed with commercial meal substituted with different levels of *Moringa oleifera* (malunggay) leaf

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Abstract

A six-week feeding trial was conducted to determine the effects in the growth performance of *Trachinotus blochii* juveniles when fed with commercial meal substituted with different levels of the *Moringa oleifera* plant. A total of 120 *t. blochii* juveniles were fed with four varying diets of *M. oleifera* meal at 0%, 5%, 10%, and 15% replacement indicating Diets 1, 2, 3, and 4, respectively. Ten juveniles were stocked in a tank of 250 liters each and the diets were replicated three times. At the end of the feeding trial, the growth parameters determined were specific growth rate (SGR) and feed conversion ratio (FCR). The results clearly showed that *T. blochii* juveniles fed 5% replacement level of *M. oleifera* leaf meal was not significantly different with the control indicating that it can replace fish meal at 5% without significantly affecting the growth performance.

Keywords: *Trachinotus blochii, Moringa oleifera, growth performance, specific growth rate (SGR), feed conversion ratio (FCR)*

Introduction. Feed is considered to be one of the major inputs in aquaculture production, and fish feed technology is one of the least developed sectors of aquaculture [1] in developing countries. Feed culture is growing rapidly, with reports of an annual increase of approximately 10% [2]. Feed production needs to grow at the same rate to meet the requirements of the sector.

Fish meal, the main protein source for fish feeds, constitutes one of the highest operating expenditures in intensive practices and sustained production which makes it no longer guaranteed because of the decreasing catch from the wild [2,1]. As a result, its price is constantly rising, which then affects the profitability of aquaculture enterprises. Therefore, it becomes necessary to explore and assess other alternative protein sources for fish feed formulation. The development of new species-specific diet formulations supports the aquaculture industry as it expands to satisfy increasing demand for affordable, safe, and high-quality fish products [3].

Moringa oleifera (malunggay) is a fast-growing plant widely available in the Philippines with several economic and medicinal uses. It has been identified that the *M. oleifera* plant holds the potential to contribute to fish nutrition with the possibility of reducing the total dependence of fish farming on fish meal [1]. Nutritional advantages include high crude protein (CP) content and amino acid variability, in which the leaves can offer as much as 43% CP [4]. This study, however, will focus on the suitability of processed *M. oleifera* leaf meal as substitute for commercial meal in the diet of *Trachinotus blochii.*

T. blochii (silver pompano) is a euryhaline and omnivorous fish with quality meat. This species is easy to domesticate and breed under controlled conditions; thus, it is ideal for mariculture because of its fast growth rate and easy weaning to feed pellets [5]. The pompano species can also tolerate a wide range of salinities, and are resistant to low-dissolved oxygen, which make them excellent candidates for aquaculture in a variety of systems [6].

The goal of this study is to compare the growth of *T. blochii* (silver pompano) fed with fish meal replaced with different concentrations of *M. oleifera* (malunggay) leaves. It specifically aims to:

(i) Evaluate the performance parameters by calculating the specific growth rate (SGR), feed conversion ratio (FCR), and the proximate analysis of the fish feeds; and,

(ii) Test the efficiency of *M. oleifera* as alternative for fish food diet by measuring the weight of *T. blochii.*

Methods. The amount of *M. oleifera* substitution varies between meals at certain intervals. The meals were all subjected to proximate analyses for further evaluation. The duration of the study was 6 weeks, as the purpose of the study was to determine the effects of substituted fish meal on fish growth during the given time period.

Experimental Site. The study was carried out at the Fish Feed Laboratory, Aquaculture Department of SEAFDEC/AQD in Tigbauan, Iloilo for a period of six weeks.

Experimental Animal and Design. A total of 120 *T. blochii* juveniles were acquired from SEAFDEC/AQD, Tigbauan, Iloilo. The fish were acclimatized for a week before these were exposed to the experimental diets. Juveniles were placed in four 250-L tanks with each tank having 10 fish. Tanks were provided with seawater via flow-through system and arranged in a completely randomized design. The experiment was done in triplicates; thus, 12 tanks were prepared and used in the study.

Experimental Diets. The *M. oleifera* leaves were obtained from a residential area in Zarraga, Iloilo. The leaves were left dried in an oven overnight. Four diets of 25% crude protein were formulated with *M. oleifera* leaf meal replacing fish meal at 0% (Setup 1), 5% (Setup 2), 10% (Setup 3), and 15% (Setup 4), with Setup 1 as the control diet. The ingredient composition of diets can be found in Table 1.

Table 1. The table presents the composition (g/100g diet) of the experimental diets for *T. blochii* incorporated with different levels of *M. oleifera.*

Ingredients	Diet 1	Diet 2	Diet 3	Diet 4
Fish meal	38.0	33.0	28.0	23.0
Squid meal	5.0	5.0	5.0	5.0
Shrimp meal	10.0	10.0	10.0	10.0
Soybean (defatted)	13.0	13.0	13.0	13.0
Wheat flour	8.0	8.0	8.0	8.0
Rice bran	14.0	14.0	14.0	14.0
Soybean oil	2.5	2.5	2.5	2.5
Cod liver	2.5	2.5	2.5	2.5
Mineral mix	3.0	3.0	3.0	3.0
Vitamin mix	3.0	3.0	3.0	3.0
CMC	1.0	1.0	1.0	1.0
M. oleifera	0.0	5.0	10.0	15.0

Feeding and Management of the Juveniles. The daily feeding was done by the hand-fed method to apparent satiation twice a day (0800H and 1600H) for six weeks. Both the individual and total fish weights were recorded every two weeks.

Data Collection. The parameters measured were the Feed Conversion Ratio (FCR) and the Specific Growth Rate (SGR). Each of these parameters was measured at 2 weeks interval. The formulas used are the following:

$$\text{Specific growth rate (SGR \% /day)} = \frac{100[\ln(final\ fish\ weight) - \ln(initial\ fish\ weight)]}{length\ of\ feeding\ trial\ (days)}$$

$$\text{Feed conversion ratio (FCR)} = \frac{total\ feed\ fed\ (g)}{net\ weight\ gain\ (g)}$$

Data Analysis. The data gathered were subjected to One-Way Analysis of Variance (ANOVA) and Tukey's Test as post hoc analysis. Differences were considered significant at $p<0.05$.

Safety Procedure. The study used a meat grinder in producing feed pellets. This equipment should not be handled alone and must be supervised by an expert as this consisted of blades and other materials capable of grounding meat well as bones.

Results and Discussion. All feeds of the diets were accepted at the start of the feeding trial; however, the amount of feeds was reduced for the next feeding trial based on the calculations of the current total weights per tank of the *T. blochii* fish. The average weights per tank were then calculated to obtain the SGR and FCR values. Proximate analyses of the feeds given were also analyzed to determine the crude protein, crude fat, ash content, and moisture content of the diets.

Results showed that there was a significant difference ($p<0.05$) in the protein level, ash content, and moisture content of all diets. However, there was no significant difference ($p>0.05$) in the crude fat of all diets except diet 2 (5% replacement level).

Table 2. The table presents the proximate analyses of the different diets fed to *T. blochii* juveniles. The values presented are mean and standard error of the mean.

	0%	5%	10%	15%
Moisture content	2.40± 0.07	1.50± 0.07	1.87± 0.07	5.62± 0.07
Crude protein	51.58± 0.19	45.88± 0.19	43.66± 0.19	38.44± 0.19
Crude fat*	10.37± 0.18	8.92± 0.18	10.21± 0.18	10.35± 0.18
Ash content*	12.78± 0.04	12.61± 0.04	12.27± 0.04	12.11± 0.04

*Percent-dry basis

The values for specific growth rate (SGR) and feed conversion ratio (FCR) of diet 1 (control) and diet 2 (5% replacement level) were not significantly different ($p>0.05$), while the values of diet 1 (control) & diet 3 (10% replacement level) and fish fed with diet 1 (control) & diet 4 (15% replacement level) were significantly different ($p<0.05$). The graphical representation for the SGR and FCR can be seen in Figure 1.

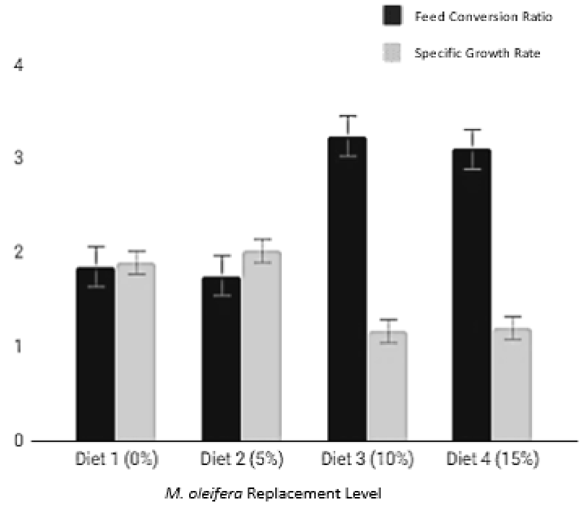

Figure 1. The figure presents the specific growth rate (SGR) and feed conversion ratio (FCR) of fish fed with diets substituted with different replacement levels of *M. oleifera.*

The specific growth rate (SGR) values of fish fed with diet 1 (control) and diet 2 (5% replacement level) were not significantly different ($p>0.05$), while fish fed with diet 1 (control) & diet 3 (10% replacement level) and fish fed with diet 1 (control) & diet 4 (15% replacement level) were significantly different ($p<0.05$). The highest SGR value was observed in fish fed with diet 2 (5% replacement level) while the lowest SGR value was observed in fish fed with diet 3 (10% replacement level).

This study demonstrated that *M. oleifera* leaf meal (MLM) is a good replacement for fish meal as a protein source for *T. blochii* diets based from the SGR and FCR values. The results obtained from the study clearly showed that the optimum replacement level of MLM in terms of growth was determined to be 5% of the *T. blochii* diet. Further increasing the replacement level of MLM resulted in a statistically significant decrease in the growth performance of the fish.

In the present study, the fish fed at 5% replacement level (Diet 2) had the highest average SGR, with lowest at 10% replacement level (Diet 3). A high SGR indicates that the feeds are effective in promoting good growth performance of the fish. However, the present study has also shown that the fish start experiencing negative effects when the replacement level exceeds 5%. This was seen in fish fed with 10% replacement level (Diet 3) and 15% replacement level (Diet 4). This might be due to the processing technique involving drying at room temperature that might have not reduced the anti-nutrients present in the diets with high replacement levels of *M. oleifera* leaf meal [1]. These findings did not correspond with those of Olaniyi et al. [7] and Tagwireyi et al. [8], where they found the ideal replacement level for *M. oleifera* to be 12.5% and 10%, respectively. This can be attributed to the use of different species of fish in the experiments. It can also possibly be that different species require different replacement levels.

Higher concentration of MLM increases the amount of fiber in a meal, which can lead to indigestibility [1]. This is also in agreement to the claim of Lochmann et al. [9] that leaf meals have low nutrient digestibility as compared to soybean meal. Fiber is indigestible to fish which could reduce the overall energy and nutrients available from the diet.

The fish which were the most efficient feed consumers were those fed at the 5% replacement level (Diet 2) with the least efficient being the fish fed at the 10% replacement level (Diet 3). A lower FCR indicates a good performance of the feeds when given to the *T. blochii* fish. According to USAID-HARVEST [10], when feed has a low FCR, it takes less of the feed to produce a certain weight compared to that of feeds having a higher FCR. A low FCR is a good indicator of a high-quality feed. Thus, the diet with 5% *M. oleifera* replacement level can be considered as a good quality feed being able to produce the lowest FCR among the diets.

Although the results of the proximate analysis showed that the protein level of Diet 2 (5%) replacement level) was lower than the protein level of the Diet 1 (control), both diets had comparable results in terms of SGR and FCR. A pattern was found when the level of *M. oleifera* in the diets increased, the protein level decreased. This showed that despite *M. oleifera* having a lower protein level than fish meal, it can be a feasible substitute for fish meal as long as the replacement does not exceed 5%.

Error Analysis. Possible errors during the experiment would be the maintenance of fish in the tanks because other parameters such as pH, salinity, and temperature of the water were not monitored throughout the experiment.

Conclusion. From the results obtained, Diet 2 with 5% replacement level had the best performance in terms of both the FCR and SGR. Therefore, it can be concluded that fish meal can be replaced with *M. oleifera* leaf meal up to only 5% level in the diet of *T. blochii* juveniles.

Recommendations. It can be recommended that fish farmers should replace fish meal with *M. oleifera* leaf meal up to 5% to reduce the cost and also to maximize the profit. Further research can also be conducted on the growth performance of the *T. blochii* fish fed with *M. oleifera* meal as the results of the present study (5% replacement level) do not coincide with the results of a previous study where the proposed *M. oleifera* replacement level is 12.5% [7]. Moreover, it is recommended for future research, particularly those focusing on other potential source of nutrition, to be done on the use of *M. oleifera* in replacing the fish meal in the diets of other species of fish and fish at different growth stages, as different species of fish and fish at different stages of maturity have different nutritional requirements.

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