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Efficiency of Low-Cost Formulated Feed for Molobicus Saline Tilapia Hybrid Fry (*Oreochromis niloticus* X *O. mossambicus*) in Aquaria

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Abstract - The study evaluated the growth performance and survival rate of Molobicus tilapia (*Oreochromis niloticus* X *O. mossambicus*) fry fed with low-cost formulated diet and a commercial feed in a two-month culture period in aquaria. Results revealed that absolute weight, length, and body depth gains were higher in Treatment 2 (formulated diet) compared to Treatment 1 (commercial diet). Results of the t-test, however, revealed no significant difference in both treatments. In terms of survival rate, the fish fed with formulated diet obtained a higher mean survival rate of 93.33% (Treatment 2) than those fed with a commercial diet (Treatment 1) with 88.33%. In terms of water stability, the formulated diets were generally more stable in water than the commercial diet, which translates to less wastage and pollution effects. The formulated diet was estimated to cost 15.145 pesos per kg whereas the commercial diet costs PhP 30/kg. Since the cost of commercial feed is more expensive and the FCR being closely similar between the two schemes, it will be more profitable to farmers to produce their own feeds.

Key words: Molobicus; Growth performance; Feed Conversion Ratio

INTRODUCTION

Molobicus is a coined word to describe a complex tilapia hybrid developed from a programmed crossbreeding between *Oreochromis niloticus* and *O. mossambicus*, hence its name. Molobicus combined two desired production traits of two parental species, fast growth of *O. niloticus* and high salinity tolerance of *O. mossambicus* [1].

The Bureau of Fisheries and Aquatic Resources – National Integrated Fisheries Technology Development Center (BFAR – NIFTDC) started the Molobicus program in 1999 in collaboration with CIRAD – French Government and the Philippine Council for Aquatic and Marine Research Development – Department of Science and Technology (PCMARD – DOST). The program was divided into two phases. Phase 1 involved the crossbreeding and backcrossing of *O. niloticus* and *O. mossambicus*. These two tilapia species are commonly found and cultured in the Philippines. *Oreochromis niloticus* is considered to be one of the best species of tilapia for culture because of its excellent growth whereas *O. mossambicus* is usually used in many hybridization programs because of its high salinity tolerance. After developing the hybrid, Phase 2 involved a selection process in improving the growth rate of the hybrid in succeeding generations. This phase of R&D on growth selection was done in earthen ponds and concrete tanks to produce two different strains – extensive and intensive strains. The extensive strain was developed in ponds with low stocking density and natural food whereas the intensive strain was developed in concrete tanks utilizing high stocking density and fed with commercial feeds with aeration and flow-through water management. Both strains were cultured for 5 months after which the heaviest individuals in each family were selected and used as breeders of the next generation [2]. The progenies of the selected breeders were the subject of different

studies on salinity tolerance, survival, and growth performance of Molobicus.

One of the gaps in the culture of Molobicus tilapia was on the feeds and feeding. Developing an efficient and low-cost formulated feeds was a challenge in its culture and that of other fish species as well. Feed constitutes more than 50% of the inputs in aquaculture. Thus, reducing feed cost would undoubtedly increase income and would make fish culture more lucrative. Hence, the study aimed to determine the efficiency of a low-cost formulated feed for Molobicus tilapia fry as compared to a commercial diet in terms of growth performance and survival rates.

MATERIALS AND METHODS

Experimental Treatment and Lay-Out

The study employed the experimental method of research to determine the efficiency of a formulated low-cost feed compared to a commercial diet for Molobicus tilapia fry in terms of growth performance (absolute growth in terms of weight, length, body depth, and condition factor), feed conversion ratio, and survival rates which consisted of two experimental treatments with three replicates each which were arranged in a completely randomized design (CRD). The experimental units consisted of six aquaria with two treatments and three replicates each.

Each aquaria measured 64 X 36.5 X 36 cm in size and filled with water at 30 cm depth. They were provided with aeration and salinity maintained at 20 ppt.

Location of the Study

The formulation of the low-cost diet and its water stability testing were conducted at the Pangasinan State University –Binmaley Campus whereas the actual experimental feeding was done at the BFAR – NIFTDC in Bonuan – Binloc, Dagupan City.

Experimental Fish

Molobicus saline tilapia hybrid fry with an initial size of 1.16-1.32 cm produced by the tilapia crossbreeding and backcrossing program of the BFAR – NIFTDC Molobicus Project in Bonuan-Binloc were used in the experiment.

Feed Preparation

Table 1 shows the feed ingredients used and the corresponding crude protein contents of the two treatments used in the study.

Table 1. Feed ingredients used and the corresponding crude protein contents of the two treatments used in the study.

Treatments	Ingredients/Feedstuff	Inclusion Rate	Crude Protein Content	Calculated Protein Contribution
1 (Commercial)	Based on label	Based on label	Based on label	Based on label
2 (Low-Cost Formulated Diet)	Fish meal (Blackchin tilapia	415 g	48.60	20.17
	Corn bran	100 g	7.50	0.75
	Rice bran	185 g	12.90	2.59
	Dried pulverized malunggay leaves	200 g	27.1	5.42
	Cassava	100 g	-	-
	Total	1000 g		28.93

The steps included in feed preparation and formulation include grinding the ingredients until fine particles were obtained, sieving the ground ingredients using a mesh size of 425 µm, weighing and mixing the dry ingredients, and squeezing the dough using a meat grinder to obtain suitable size pellets. The obtained pellets were cut to desired lengths and sun-dried, cooled, and stored in covered plastic jars in a cool, dry place.

Stocking, Feeding, Maintenance, and Sampling

Each aquarium was stocked with 20 individuals of Molobicus tilapa fry with initial sizes ranging 1.16-1.32 cm. Before stocking, the initial data on mean total length, weight, and body depths were taken and recorded. Length and body depth were taken using a Vernier caliper whereas weight was taken using a digital weighing scale. During sampling, 25% of fish in each aquarium were sampled every 15 days until the end of the 60-day culture period.

Fish were fed at 5% of their body weight throughout the experimental culture period. Feed ration per day was divided into four and feeding was done 4 times a day at 9:00 am, 11:00 am, 1:00 pm, and 4:00 pm.

Maintenance of the aquaria was done by siphoning the bottom of the tanks three times a week every morning (8:00 am) to remove feces and unconsumed feeds prior to feeding the stocks and at the same time 50% of the total volume of the water was changed. Basic water quality parameters such as temperature, salinity, dissolved oxygen, and pH were monitored daily at 8:00 am.

Growth Performance and Survival Rate Analysis

The following formula were used to assess the growth performance:

Weight

Mean weight gain = Final weight (g) – Initial weight (g)

Length

Mean length gain = Final total length (cm) – Initial total length (cm)

Body Depth (BD)

BD = Final body depth (cm) – Initial body depth (cm)

Specific Growth Rate

SGR = [(Ln Final weight – Ln Initial weight)/days) X 100]

where Ln = natural log

Condition Factor

The plumpness of the test fish before, during, and after two months of culture were determined using the coefficient of condition factor (k)

$K = BW/BL^3 X 100$

where BW = body weight (g) and BL = body length (cm)

Survival Rate (SR)

SR = Final number of stock/Initial number of stock X 100

Water Stability and Feed Conversion Ratio

Because feed is expensive, water stability and feed conversion ratio (FCR) were also determined. Water stability test was done by recording the time that the feed will disintegrate from the time they were dropped in the water. The stability test was done for both the formulated and the commercial feed. Meanwhile, FCR is an

indicator commonly used as an indicator how efficient a feed or the feeding strategy. The FCR is a mathematical relationship between feed input and weight gain of the fish. Generally, the lower the FCR, the higher the weight gain obtained from the feed.

FCR = Feed consumed (g)/Weight gain (g)

Treatment and Analysis of Data

Results were subjected to simple t-test analysis because there were only two treatments to determine the significant differences in growth performance, survival rate, FCR, and condition factor.

RESULTS AND DISCUSSION

Weight Gain

As shown in Table 2, Molobicus tilapia fry in Treatment 1 grew from 0.11 g to 3.40 g whereas those in Treatment 2 grew from 0.16 to 4.40 g in body weight. The absolute weight gain was higher in treatment 2 (formulated diet) compared to Treatment 1 (Commercial feed). However, the t-test revealed no significant difference (P>0.05) between the two treatments. In terms of specific growth rate, data showed that the mean SGR of stocks fed with commercial diet was higher by 0.35% compared to those with the formulated diet.

Length Gain

Table 3 shows the mean length, absolute length gain, and computed SGR in terms of length of Molobicus tilapia fed with commercial and formulated diet for 60 days. The body length in Treatment 1 increased from 1.16 to 5.64 cm and those in Treatment 2 increased from 1.32 to 6.64 cm. After the feeding experiment, the absolute length gain was found to be higher in Treatment 2 (Formulated diet) than Treatment 1 (Commercial) with mean values of 5.32 and 4.48 cm, respectively. However, the t-test failed to show significant difference between the absolute length gains in the two treatments.

Table 2. Growth of Molobicus tilapia fry fed with commercial and artificial diets in terms of weight gain in a two-month experimental culture period.

Treatments/ Replicates	Culture Period (Days)					Absolute Weight Gain	SGR
	Day 0	Day 15	Day 30	Day 45	Day 60		
Commercial Diet							
T1R1	0.11	0.31	0.82	1.54	2.01	1.94	4.40
T1 R2	0.11	0.44	1.28	2.50	3.61	3.50	4.96
T1 R3	0.11	0.87	1.87	3.33	4.88	4.77	5.26
Mean	0.11	0.54	1.32	2.45	3.51	3.40	4.94
Formulated Diet							
T2R1	0.17	0.51	1.22	2.13	3.63	3.46	4.26
T2R2	0.15	0.65	1.47	2.92	4.62	4.47	4.69
T2R3	0.16	1.08	2.22	3.71	5.44	5.28	4.79
Mean	0.16	0.74	1.64	2.92	4.56	4.40	4.59

T1 = Commercial diet; T2 = Formulated diet; R = Replicate

Table 3. Growth of Molobicus tilapia fry fed with commercial and artificial diets in terms of body length gain in a two-month experimental culture period.

Treatments/ Replicates	Culture Period (Days)					Absolute Length Gain	SGR
	Day 0	Day 15	Day 30	Day 45	Day 60		
T1R1	1.14	2.70	3.02	4.50	4.89	3.75	1.37
T1 R2	1.16	2.92	3.58	4.48	5.52	4.36	1.46
T1 R3	1.20	3.40	3.88	5.62	6.50	5.30	1.57
Mean	**1.16**	**3.10**	**3.49**	**4.86**	**5.64**	**4.48**	**1.48**
T2R1	1.34	3.08	3.16	4.94	6.08	4.74	1.32
T2R2	1.36	3.48	3.84	5.70	6.70	5.34	1.39
T2R3	1.26	3.64	4.38	6.04	7.14	5.88	1.58
Mean	**1.32**	**3.40**	**3.79**	**5.56**	**6.64**	**5.32**	**1.43**

T1 = Commercial diet; T2 = Formulated diet; R = Replicate

The present study was similar to an earlier study conducted at PSU – Binmaley Campus [3]. In that study, the growth performance of GET EXCEL tilapia using feeds containing different levels of corn cobs was evaluated in a 60-day culture period. Results revealed that all the three experimental diets they used gave comparable growth rates in terms of length as compared with a commercial diet as statistical analysis showed no significant differences among the treatments (P>0.05).

Body Depth

Table 4 shows the growth in terms of body depth of Molobicus tilapia fry fed with a commercial and formulated diet in a 60-day culture trial. Body depth gain was found to be higher in Treatment 2 (formulated feeds) having a mean of 1.92 cm as compared to Treatment 1 (commercial) with a value of 1.70 cm. However, no significant difference was observed in the two treatments based on a t-test (P>0.05).

Table 4. Growth of Molobicus tilapia fry fed with commercial and artificial diets in terms of body depth gain in a two-month experimental culture period.

Treatments/ Replicates	Culture Period (Days)					Absolute Body Depth Gain	SGR
	Day 0	Day 15	Day 30	Day 45	Day 60		
T1R1	0.10	0.90	0.98	1.36	1.68	1.58	4.36
T1 R2	0.12	0.58	1.20	1.62	1.86	1.74	4.15
T1 R3	0.12	1.10	1.26	1.78	1.90	1.78	4.17
Mean	**0.11**	**0.86**	**1.14**	**1.59**	**1.81**	**1.70**	**4.27**
T2R1	0.18	0.51	1.08	1.60	1.92	1.74	3.51
T2R2	0.16	1.12	1.28	1.76	2.16	2.00	3.62
T2R3	0.20	1.02	1.53	1.94	2.21	2.01	3.48
Mean	**0.18**	**0.88**	**1.30**	**1.77**	**2.10**	**1.92**	**3.60**

T1 = Commercial diet; T2 = Formulated diet; R = Replicate

Survival Rate

Table 5 shows the mean survival rates of Molobicus tilapia fry fed with commercial and formulated diets in the 2-month experimental culture period. The fish fed with formulated diet obtained a higher mean survival rate of 93.33% (Treatment 2) than those fed with a commercial diet (Treatment 1) with 88.33%.

Table 5. Survival rates of Molobicus tilapia fry fed with fed with commercial and formulated diets in the 2-month experimental culture period.

Treatment	Replicate	Survival Rate (%)
1	1	85.00
1	2	95.00
1	3	95.00
	Mean	88.33
2	1	100.00
2	2	100.00
2	3	80.00
	Mean	93.33

Water Stability Test

Based on the water stability test done, it took a mean of 13 minutes for pellets in Treatment 2 to start disintegrating as compared to only 10 minutes for the commercial diet. On the other hand, it took a mean of 30.47 minutes for the formulated diet to fully disintegrate in the water as compared to only 25.48 minutes for the commercial diet. In other words, the formulated diets were generally more stable in water than the commercial diet, which translates to less wastage and pollution effects.

Feed Conversion Ratio and Condition Factor

As shown in Table 6, the computed FCR was found to be higher on the fish fed with commercial diet having with a mean value of 1.43 as compared to 1.37 for fish fed with the formulated diet.

Feed conversion ratio (FCR) refers to the amount (kg) of feed needed to produce a kg of fish [4]. This means that to produce a kg of fish, 1.37 to 1.43 kg of feed is needed to achieve that growth requirement.

The condition factor (K) varied from 1.55 to 1.89. The values for both the commercial and formulated diets were comparable. The condition factor of the Nile tilapia, *Oreochromis niloticus* fed with different levels of maltose varied from 1.64 to 1.79 [5]. This was similar to that obtained in the present study. The condition factor of fish can be affected by many factors such as stress, sex, season, availability of feeds, and water quality parameters [6].

Table 6. Computed feed conversion ratio and condition factor of Molobicus Tilapia fry fed with commercial and formulated diets in a 60-day culture period.

Treatment	Total Feed Consumed (g)	Total Weight Gain (g)	FCR	Condition Factor (k)
1	62.22	38.84	1.60	1.75
1	96.95	70.04	1.38	2.15
1	132.51	95.36	1.39	1.78
Mean	97.23	68.08	1.43	1.89
2	90.13	69.16	1.30	1.62
2	116.17	89.40	1.30	1.54
2	154.83	105.64	1.47	1.49
Mean	120.38	88.04	1.37	1.55

Water Quality Parameters

During the culture period, temperature ranged from 26-27°C, which had been reported to be within the optimum range for tilapia growth and yield [7]. Salinity was maintained at 20 ppt throughout the experiment considered to be within optimum range for Molobicus tilapia. In previous experiments, good growth was achieved at 15-35 ppt. Molobicus salinity tolerance is comparable to *O. mossambicus* and better than *O. niloticus*, the two parental species used in the Molobicus program [1]. Dissolved oxygen was observed to be above 5 ppm for both treatments. DO is one of the most important parameters in fish culture. Maintaining high levels of DO in water is essential for successful production since DO has a direct influence on feed intake, disease resistance, and metabolism and therefore important to keep DO at optimum levels above 4 ppm [8]. Lastly, the pH values had mean of 7.35. Tilapia can survive in pH ranging from 5-10, but they do best in pH range of 6-9 [9]. It is important to maintain a stable pH at a safe range because it affects metabolism and other physiological processes of cultured organisms.

Cost of Feed Production

Table 7 shows the estimated cost of producing the formulated diet as compared to the cost of the commercial feed. Formulated diet resulted to a lower feed cost of 15.145 pesos per kg whereas the commercial diet costs PhP 30/kg.

Since the cost of commercial feed is more expensive and the FCR being closely similar between the two schemes, it will be more profitable to farmers to produce their own feeds. Hence, it is important for the Pangasinan State University – Binmaley Campus to implement an extension training program to educate the local fish growers on how to formulate and produce their own fish feed.

Table 7. Estimated cost of producing formulated and commercial feeds.

Treatment 1 Commercial Feed		**Treatment 2 Formulated Diet**	
Cost of feed/sack (PhP)	750.00	Cost of feed/sack (PhP)	378.625
Cost of feed/kg (PhP)	30.00	Cost of feed/kg (PhP)	15.145
		Ingredients:	
		Fish meal (Blackchin tilapia)	15.00
		Malunggay leaves	5.00
		Corn meal	12.00
		Rice bran	16.00
		Cassava	15.00

REFERENCES

1] Rosario et al. (Undated). Development of saline tilapia Molobicus. National Integrated Fisheries Technology Development Center- Bureau of Fisheries and Aquatic Resources. A pamphlet published by the Asian Fisheries Academy. 4 p.

[2] Rosario, W.R., Georget C., Chevassus-Au-Louis, B., Morissens, P., Muyalde, N.C., dela Cruz, A.E., Vera E.D., and J.-P. Poivey. 2004. Selection from an interspecific hybrid population of two strains of fast growing and salinity tolerant tilapia. p. 73. In: RB Bolivar, G.C. Mair and K. Fitzsimmons (Editors), *Proceedings of the 6th International Symposium on Tilapia in Aquaculture*, Philippine International Convention

Center Roxas Boulevard, Manila, Philippines, September 12-16, 2004.

[3] Toledo, C.F. and H.C. David. 2014. Growth, survival and yield of GET EXCEL Tilapia fingerlings fed with home-made feeds containing various levels of corncobs. *Dayew*, The Pangasinan State University – Binmaley Campus Research Journal 2(1): 14-20.

[4] Nadaf, S.B., Bhilave, M.P. and V.Y. Deshapande. Growth performance and feed conversion ratio of freshwater fish fed on formulated feed. *Journal of Aquatic Biology* 25: 181-185.

[5] Ighwela, K.A., Ahmad, A.B. and A.B. Abol-Munafi. 2011. Condition factor as an indicator of growth and feeding intensity of Nile tilapia fingerlings (*Oreochromis niloticus*) feed on different levels of maltose. *American-Eurasian Journal of Agricultural and Environmental Sciences* 11(4): 559-563.

[6] Khallaf, E.A., Galal, M. and M. Authman. 2003. The biology of *Oreochromis niloticus* in a polluted canal. *Ecotoxicology* 12: 405-416.

[7] Meske, C.P.B. and F. Vogt. 1985. Fish Aquaculture: Technology and Experiments. Pergamon Press. 237 pp.

[8] Abdel-Tawwab, M., Hagras, A.E., Elbaghdady, H.A.M. and M.N. Monier. 2015. Effects of dissolved oxygen and fish size on Nile tilapia, *Oreochromis niloticus* (L.): growth performance, whole-body composition and innate immunity. *Aquaculture International* 23: 1261-1274.

[9] Popma T. and M. Masser. 1999. Tilapia, life history and biology. *Southern Regional Aquaculture Center (SRAC) Publication* No. 283.