Section A-Research paper
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Protein Diet Sources on the Growth and Survival Rate of Giant Gourami *(Osphronemus goramy)* Cultured in Concrete Tank

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Abstract
Giant gourami *(Osphronemus goramy)*, a giant air-breathing freshwater fish that is a good candidate for freshwater aquaculture due to its high price, high local demand and good meat quality. This study aimed to determine the growth and survival rate of Giant gourami *(Osphronemus goramy)* fed different protein diet sources. It was conducted in a freshwater concrete tanks for 60 days with three corresponding treatments: T_0 – Commercial Feeds (CF), T_1 – Mulberry Leaves (ML), and T_2 –Chicken Intestine (CI) replicated thrice. Growth increment (GI) in terms of weight, length, and width, specific growth rate (SGR), and survival rate (SR) were measured and data were analyzed using Kruskal Wallis Test at α=0.05. Results demonstrated that giant gourami fed with CI got the highest GI and SGR. In terms of survival rate, all of the treatments got 100% SR. Results showed that all treatments significantly affect the growth increment (weight, length, width) and specific growth rate but did not significantly affect the survival rate of giant gourami. In addition, giant gourami fed with chicken intestine resulted significantly the best growth among all treatments and can be recommended to be an alternative feed better growth in giant gourami aquaculture.

Keywords: *Giant Gourami, Growth Increment, Osphronemus goramy, Protein Diet Sources, Survival Rate*

Introduction

The global demand for high-protein food such as fish is increasing. With the unsustainable practices of collecting aquatic resources in the ocean, it is impossible that capture fisheries production can meet the world's increasing demand for food with the planet's ever-growing population. In the recent years, aquaculture has shown its potential to generate essential benefits to society. It has been considered one of the fastest-growing forms of food production globally, which also produces livelihood and trade (FAO, 2010). Several potential aquatic species are being cultured nowadays, especially in a freshwater environment — potential freshwater species such as carps, tilapias, catfishes, trout, and most especially, gourami.

Giant gourami *Osphronemus goramy* (Lacepède, 1801) is a large freshwater fish from the family of Osphronemidae (Gouramis) and is commercially farmed in other Southeast Asian countries, where the fish is cultured in freshwater ponds and cages (FAO, 2019). The giant gourami's omnivorous diet consists of plant matter, small fish, frogs, and snails (Ukkatawewat, 1984), or a combination of commercial fish food and raw plant material (FAO, 2019). Philippines is also one of the six countries to have reported production of the fish (FAO, 2019). It has been propagated in BFAR Technology Center, but locally, the fish is not widely cultured by fish farmers. Giant gourami is indeed a great demand in the aquaculture industry due to its high price, high local demand, good meat quality (Guerrero, 2020) and an air-breathing fish that can survive in deoxygenated areas (Baras *et al.,* 2018), making it a good candidate for freshwater aquaculture.

Feed costs account for over 50% of the production cost for most aquatic species, which reduces production profitability to marginal fisherfolks (Hasan *et al.,* 2009). In order to lessen dependence and reduce the use of commercial feeds, the rapid demand of research is important especially on exploring other organic resources that are locally available and high in crude protein. In order to achieve a more economically, environmentally friendly, and attainable production of the omnivorous giant gourami, research interest has been directed towards the evaluation and use of unconventional protein sources such as mulberry leaves and chicken intestine.

Morus alba, commonly known as mulberry, is widely distributed in cultivation for its fruits and landscaping and is now found in most warm countries. It is abundant in the country, cheaper, and highly nutritious. Its leaves are a valuable source of protein which can reach up to 30.91% (Srivastava *et al.,* 2006). Its fruits can be used for making jams, teas, and fruit powder, while its leaves are used as feeds for silkworms, poultry, and livestock. Meanwhile, poultry by-products meal like chicken intestine has considerable potential as feed ingredients in fish production systems considering that many studies are already made in the past years that partially or totally replacing fish meal with the chicken intestine. It can contain up to 45.50% crude protein. The use of chicken intestine can help lessen the dependence on commercial fish feeds, which are traditionally based on the fish meal as the primary protein source (Hardy *et al.,* 2002).

Hence, mulberry leaves and chicken intestine could be a potential feed in cultured aquatic species, especially Giant gourami since they are rich in protein source. Thus, this study aimed at determining the growth and survival rate of Giant gourami cultured in freshwater concrete tank fed with different protein diet sources. Moreover, it is believed that this study would contribute to the country's aquaculture industry to grow and increase its production to sustain the increasing demand for food.

MATERIALS AND METHODS

Research Design

The study utilized the experimental method of research to determine the growth and survival rate of giant gourami cultured in freshwater concrete tanks using mulberry leaves (*Morus alba*) and chicken intestine as a source of protein diets. This study used a single factor design laid out in Randomized Set Up using the three treatments such as; T_0 – Commercial Feeds (CF), T_1 – Mulberry Leaves (ML), and T_2 – Chicken Intestine (CI), with three (3) replications each. The study lasted for sixty (60) days.

Tank Preparation

This study was conducted at Bureau of Fisheries and Aquatic Resources - Region 7 (BFAR 7) Clarin Freshwater Fish Farm located at Caluwasan, Clarin, Bohol, Philippines. Three (3) rectangular freshwater concrete tanks were used in this study, with a dimension of 4.5 m x 1.5 m x 1 m (length, width, height). Tanks were cleaned first before installing the nets. These nets served as a division for the three compartments in each tank. There were a total of nine compartments, and each compartment has a dimension of 1.5 m x 1.5 m x 1 m (length, width, height). Each compartment contained ten (10) giant gourami fingerlings.

Stocking Density

There were ninety (90) Giant gourami fingerlings secured from BFAR 7 Clarin Freshwater Fish Farm, Clarin, Bohol, Philippines and were stocked in the freshwater concrete tank. Ten (10) samples per treatment and replication were used. After collecting the fingerlings and performed initial sampling, acclimatization was done to avoid stress. Thus, the basin that contained the samples was slowly placed in each concrete tank for at least 20 minutes for the fingerlings to adapt to the new environment. Digital weighing scale was used to measure the weight and Vernier caliper for the length.

Feeds, Feeding Preparation and Feeding

The giant gourami was fed with commercial feeds, particularly pellets that contains 27% crude protein, mulberry leaves, and chicken intestine. Mulberry leaves were sun-dried with frequent turning for 4 to 5 days. The sun-dried mulberry leaves were crushed and kept for future use in airtight plastic bags (Al-Kirshi *et al.,* 2010). Chicken intestine was cleaned and chopped which was enough so that the fish can eat the feeds and was kept in an air tight polyethylene bag and was stored in a deep freezer for further use (Nahar *et al.,* 2000).

Fingerlings were carefully weighed to determine the average body weight (ABW) in order to identify the feeding rate to be used in preparing the feeds. Feeding was done by broadcasting method thrice a day at early in the morning, noon, and late in the afternoon. The feeding process was done twice a day, early in the morning and late in the afternoon using broadcasting method.

Data Gathering

Initial weight (g), length (cm), and width (cm) of the fingerlings were obtained prior to stocking. The sampling was done every fifteen (15) days after stocking the samples to determine their growth and survival rate. Water parameters such as pH level and temperature (^{0} C) were monitored daily. Changes and improvements of the samples were noted as basis in the analysis and interpretation of the data.

The cultured gourami were counted individually and measured using digital weighing scale (weight) and Vernier caliper (length). In computing the growth increment in terms of weight, length, and width, the formula used was GI = G_2-G_1, wherein G_1 is the initial mean weight, length, or width and G_2 is the final mean weight, length, or width of cultured gourami at the end of the experiment. In getting the specific growth rate (SGR) and survival rate (SR), the following formulas were used: SGR = {(In final weight – In initial weight)/days} x 100 wherein In = natural logarithm of final and initial weight and SR = (number of survived stocks/total number of stocks) x 100. The gathered data were used for the data analysis and interpretation.

Care and Maintenance

Daily monitoring of the cultured giant gourami was done to check the condition of the species and record its changes and improvements. Scoop nets were used to remove the waste feeds found at the surface of the water, and siphons were used to remove waste feeds found at the bottom of the water. The cleaning of the freshwater concrete tanks was done every fifteen days interval through draining to renew and change the water.

Statistical Analysis

To test if there is a significant difference among the following treatments, data were subjected to Kruskal Wallis Test at α=0.05 using SPSS version 23 application. To identify the differences between independent factors once the result is significant, Post hoc Analysis was done using Tukey's HDS Test.

Results and Discussion

The growth increment (weight, length, and width), specific growth rate (SGR), survival rate (SR), and mean water quality parameters are presented in Table 1. Results showed that giant gourami fed with chicken intestine (CI) gained the highest growth increment in terms of weight, length, and width with 63.79 g, 3.11 cm, and 2.16 cm respectively and obtained the highest SGR with 106.3 % day^{-1}. Those fed with commercial feeds (CF) gained second highest growth increment in terms of weight, length, and width with 53.77 g, 2.22 cm, and 1.69 cm respectively and obtained the second highest SGR with 89.62 % day$^-$1. However, those fed with mulberry leaves (ML) gained the lowest growth increment in terms of weight, length, and width with 29.06 g, 1.63 cm, and 1.39 cm respectively and obtained the lowest SGR with 48.43 % day^{-1}In terms of survival rate, all treatments got the SR of 100 %. In terms of water quality parameters, there were no recorded fluctuations since it was noticed that water parameters such as pH level and temperature (^{0} C) were in tolerable range during the whole culture period.

Table 1. Growth, Survival, and Mean Water Quality Parameters of Giant gourami *(Osphronemus goramy)* Fed with Different Protein Diets Sources.

Parameters	Protein Diet Sources		
	T_0 Commercial Feeds (control diet)	T_1 Mulberry Leaves	T_2 Chicken Intestine
Culture Period (days)	60	60	60
Initial Mean Weight (g)	147.823	130.107	137.36
Final Mean Weight (g)	201.593	159.17	201.153
Mean Weight Gain (g)	53.77	29.06	63.79
Mean Length Gain (cm)	2.22	1.63	3.11
Mean Length Width (cm)	1.69	1.39	2.16
SGR (% BW day^{-1})	89.62	48.43	106.3
Survival Rate (%)	100	100	100
pH Level (mean)	6.8	6.8	6.8
Temperature ^{0} C (mean)	27.2	27.2	27.2

Furthermore, there was a significant difference among the three treatments in the growth increment in terms of weight, length, and width but not significant in terms of survival rate. Thus, the following treatments significantly affected the growth (weight, length, and width), but did not significantly affected the survival rate of giant gourami (Table 2).

Table 2. Kruskal Wallis Test Result for Growth Increment (Weight, Length, and Width) of Giant gourami *(Osphronemus goramy)* Fed with Different Protein Diets Sources.

Treatments	Mean Rank	H	p-value	α	Decision
Growth Increment (Weight)					
0	42.45				
1	29.85	42.287	.000	0.05	Reject H_O
2	64.20				
Growth Increment (Length)					
0	45.08				
1	26.35	32.959	.000	0.05	Reject H_O
2	65.07				
Growth Increment (Width)					
0	50.87				
1	21.38	26.556	.000	0.05	Reject H_O
2	64.25				
Survival Rate					
0	-				
1	-	-	-	0.05	Accept H_O
2	-				

Results of the study revealed that chicken intestine (T_2) got the highest growth increment and resulted best growth among all the treatments. This result agreed with the study of Nahar *et al.* (2000) in which African catfish *(Clarias gariepinus)* fed with raw chicken intestine exhibits best weight gain compared with the other treatments which showed significantly highest growth at ($p<0.05$). Moreover, chicken intestine (T_2) got the highest specific growth rate in terms of length, width and weight. This was supported with the study of Tabinda *et al.* (2013) which stated that the *Cirrhinus mirigala* fingerlings fed with 100% chicken intestine recorded significantly higher specific growth rate at ($p<0.05$) compared with the control diet (0% inclusion of CIM). In addition to that, the study of Kumar Prasun Das *et al.* (2019) which demonstrated that female mud crab *(Scylla olivacea)* fed with chicken intestine obtained highest growth rate and indicated highest average weight gain than the other two types of feeds (tilapia and apple snail meat) in crab fattening practice of 12 days. Better response of the *Cirrhinus mirigala* to treatments with 75% inclusion of chicken intestine and 100% chicken intestine may be due to the good quality of the diet ingredients used in terms of nutrient profile, their digestibility and palatability. Results on the proximate composition of chicken intestine meal showed that it has high protein content with 45.50% and crude fiber of 2.15%, as well as ether extract, 24.09%; ash, 3.42%, and moisture, 7.56% (Amusan *et al.*, 2013). This could be the reason why chicken intestine exhibits best growth compared with the other treatments. This further implied that the utilization of chicken intestine has contributed most on the growth of the Giant gourami among all the treatments.

Conclusion

To conclude, the following treatments significantly affect the growth increment and specific growth rate but did not significantly affect the survival rate of Giant gourami. Among the following treatments, giant gourami fed with chicken intestine resulted significantly highest growth increment and specific growth rate in terms of weight, length, and width. Furthermore, it can be used as an alternative feed for giant gourami aquaculture as it exhibits best growth.

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