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Procedia
of Philosophical and Pedagogical Sciences

1st International Conference on
"Community Education, Psychology and Social Studies"

Effectiveness of Trichanthera gigantea (Madre de Agua) Micro Pellets on Oreochromis niloticus (Nile Tilapia) Growth

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Abstract. The primary purpose of this study was to use Trichanthera gigantea (Madre de Agua) micro pellets to determine its effectiveness on the growth of Oreochromis niloticus (Nile Tilapia). Anthropometric measurement was used to gather data on the length and weight before feeding the fish, and to calculate the growth of the samples after being fed with different treatments of Madre de Agua micro pellets. Data were analyzed online using One-Way Analysis of Variance (ANOVA) Calculator. The analysis of data was presented using frequency count, sum, mean, and standard deviation. Tests for p-value of length and weight of the fish were set to significance level 0.05. Results of the study showed that different treatments of Madre de Agua micro pellets increased the length and weight of Nile Tilapia samples. Nile Tilapia fed with treatment four (1.5g of Madre de Agua micro pellet and 4.5g Tateh Aquafeeds Surfer Commercial Feeds) had the highest mean length and weight. Nile Tilapia fed with treatment five (6g Tateh Aquafeeds Surfer Commercial Feeds) followed, then treatment three (3g of Madre de Agua micro pellet and 3g Tateh Aquafeeds Surfer Commercial Feeds), treatment two (4.5g Madre de Agua micro pellet and 1.5g Tateh Aquafeeds Surfer Commercial Feeds), and lastly, treatment one (6 grams of Madre de Agua micro pellet) with the lowest mean length and weight among fish samples. There is a significant difference of growth between the initial measurement and final measurement of Nile Tilapia in terms of Madre de Agua treatments.

Key words: Madre de Agua, Nile Tilapia, Anthropometric Measurement.

Introduction

In the Philippines, the average cost of commercial feed is about ₱34 to ₱36 per kilogram, which amounts to about ₱1.6 million when providing for one hectare of high- density tilapia

pond culture in a year, and only returns a value of ₱21,862 to farmers (Southeast Asian Fisheries Development Center/Aquaculture Department, 2021). Nile Tilapia (*Oreochromis niloticus*) serves as one of the most common cultured freshwater fish in the Philippines, identified as an affordable animal protein and source for income among fish farmers. As part of aquaculture, this sector contributes outstandingly to the country's food security, employment ventures, and earnings in the foreign trade market (Food and Agriculture Organization of the United Nations, 2021).

According to the Philippine Statistics Authority (2019), tilapia is the second species of fish with the highest production volume from aquaculture, with the first being milkfish or more locally known as "Bangus". The data in the "Fisheries Statistics of the Philippines" reported 279,385.87 metric tons of tilapia was produced by the country in

2019, with a 19.1% contribution to the total value of aquaculture production in the same year.

The Bureau of Fisheries and Aquatic Resources (2018) in the Philippines submitted that the emergence of the particular species of Nile Tilapia was due to its hard texture, resistance to diseases, breeding capabilities, growth rate, good taste, and tolerance to diverse environmental conditions that include temperature and salinity. In the Cultured Aquatic Species Information Programme of the Food and Agriculture Organization of the United Nations (2021), Nile tilapia is described as a tropical species that prefer to live in shallow water. Environments suitable for cultivation include ponds, cages, and tanks. Deadly temperatures in the upper and lower parameters for Nile tilapia are 11 to 12 °C and 42 °C respectively, while the ideal temperature within sites ranges from 31 to 36 °C. In terms of feeding, the fish is an omnivorous grazer that consumes phytoplankton, periphyton, aquatic plants, small invertebrates, benthic fauna, detritus, and bacterial films associated with detritus. Feed accounts for 60-75 percent of total poultry production costs (Chiba, 2014).

In promoting the growth of the aquaculture industry, utilization of quality, affordable feed resources from a locality opens an opportunity for farmers to replace fish meals (Tacon and Forster, 2010). A study conducted by Al-Thobaiti, Ghanim, Ahmed, Suliman, and Mahboob (2018) entitled "Impact of replacing fish meal by a mixture of different plant protein sources on the growth performance in Nile Tilapia (*Oreochromis niloticus* L.) diets" recommended that the replacement of fish meal can be feasible up to 20% with other plant protein sources without negatively affecting Nile Tilapia health. As a suitable replacement under plant protein sources, Madre de Agua (*Trichanthera gigantea*) suggests an inexpensive solution for commercialized feed products. *Trichanthera gigantea* is a non-leguminous multi-purpose tree species (MPT) commonly employed in Caribbean small ruminant production systems (Heuzé et al. 2017). It was introduced by the BAI (Bureau of Animal Industry) to the Philippines back in 1997. Due to its protein content, it is considered a viable alternative for Nile Tilapia growth. The crude protein content of *Trichanthera gigantea* ranges from 12 to 22 percent, with significant weight gain and carcass weight impacts (Libatue, 2020).

As the aquacultural sector is relied on heavily in the Philippines, Nile Tilapia (*Oreochromis niloticus*) is a commodity that is significantly valued for its contribution and significance to the country. In reason of this, advancements in the factors that affect the production of the species are required to account for the cost and return value of the fish. The researchers

noticed the demanding prices for the use of commercialized feeds in the growth of Nile Tilapia and the low income garnered by fish farmers in comparison. Madre de Agua (*Trichanthera gigantea*), in the form of micro pellets, hints at a plant protein alternative that supplements an affordable way of growing the fish. Internationally, Madre de Agua has been identified as a contributor to the growth of other animals and poultry products, but little to no evidence is implied with regards to fish, with Nile Tilapia in particular.

Nile Tilapia identifies as a common fish that supply the Filipino household. Similarly, Madre de Agua shares the same commonality with the fish in accessibility and significance. The researchers observed that both parties, Nile Tilapia and Madre de Agua, are much of relevance and familiarity in the Philippines, leading to the scientific process in which this study was generated. Observations included the variables being available within the locale, the benefit in investigating the impact of the notable plant, and other observations from the personal affiliations of the researchers in the field of fisheries, which resulted in the questions regarding tilapia feed thereafter.

Given the aforementioned concerns, the primary purpose of this study was to determine the effectiveness of *Trichanthera gigantea* (Madre de Agua) micro pellets on the growth of *Oreochromis niloticus* (Nile Tilapia).

Statement of the Problem and Hypothesis

The study's primary purpose was to determine the effectiveness of "Farenheat" in reducing the heat experienced inside the house during the daytime, which was tested on a 60cm x 60cm x 70cm house model.

Specifically, the study aimed to answer the following questions:

1. What are the changes in the temperatures of the house model before and after applying “Farenheat”?
2. Is there a significant difference between the changes in the temperatures of the house model before and after applying “Farenheat”?

Based on the statement of the problem mentioned above, a hypothesis was tested:

1. There is no significant difference between the changes in the temperatures inside the house model before and after applying “Farenheat”. It is represented as: $\mu_d \geq 0$.

Methodology

Experimental Research Design and Layout

Completely Randomized Design was used as the research design in this study, where treatments were assigned to experimental units or plots in a completely random approach. It incorporates only two basic principles of experimental design: randomizationand replication, making it the simplest research methodology for comparison trials (Salkind, 2010).

The independent variable of the study was the different composition of treatments of *Trichanthera gigantea* (Madre de Agua) micro pellets and commercial feeds. The dependent variable was the growth of *Oreochromis niloticus* (Nile Tilapia) in terms of length and weight.

The statistical tool that was used in this study is One-Way ANOVA. This design is designed to examine the impact of a single factor on a single response variable, ensuring that each experimental unit receives an equal chance of getting any of the treatments.

The experimental design for how the samples were randomly assigned to their individual treatments is shown in the table in the preceding page. The samples and procedures were conducted at container temperature.

Table 1. *Distribution of Oreochromis niloticus samples using Complete Randomized Design (CRD) for length and weight evaluation*

TREATMENTS	R1	R2	R3	MEAN
1	X	X	X	X
2	X	X	X	X
3	X	X	X	X
4	X	X	X	X
5	X	X	X	X

Legend:

Treatment	Composition
1	6 grams *Trichanthera gigantea* micro pellet
2	4.5 grams *Trichanthera gigantea* micro pellet & 1.5 grams Tateh Aquafeeds Surfer Commercial Feeds
3	3 grams *Trichanthera gigantea* micro pellet & 3 grams Tateh Aquafeeds Surfer Commercial Feeds
4	1.5 grams *Trichanthera gigantea* micro pellet & 4.5 grams Tateh Aquafeeds Surfer Commercial Feeds
5	6 grams Tateh Aquafeeds Surfer Commercial Feeds

Data Collecting Tools

The researchers used Anthropometric measurement to gather initial raw data before feeding the fish, and to calculate the growth of the samples after the *Trichanthera gigantea* (Madre de Agua) converted into fish feed micro pellets have been administered to the *Oreochromis nitolicus* (Nile Tilapia). Anthropometry, a subfield of morphometry, is the systematic measuring of the physical qualities of the human body; the study of the size and shape of biological form components and their changes in populations (Sawarkar, 2021). In fishes, Morphometric- based condition indices are commonly used to measure fish proximate body composition and, by extension, feeding and living conditions. Silva, et al. (2005); Hariri and Thibault (2010) emphasized the importance of reliable methods for determining the body composition of species such as animals in understanding how the body responds to nutritional intake, as well as nutritional and physiological research that employ animal models to study the consequences of obesity and nutrient deficits.

In this study, Anthropometric measurement was used to determine both length and weight gain of fishes fed with the different treatments of *Trichanthera gigantea* (Madre de Agua) micro pellets. For each sample group (five in total), Treatment 1 will be fish feed micro pellets containing 6g of pure Madre de Agua. Treatment 2 consists of 4.5g Madre de Agua

and 1.5g Tateh Aquafeeds Surfer commercial fish feeds. Treatment 3 consists of 3g Madre de Agua and 3g commercial fish feeds. Treatment 4 contains 1.5g Madre de Agua with 4.5g commercial fish feeds. The Control Group was fish feed micro pellets made entirely of Tateh Aquafeeds Surfer commercial fish feeds. Growth was measured at the end of each month, for the past three months of the study's duration. A ruler was used to determine the length of the samples (from the tip of the snout to the posterior end of the last vertebra or the posterior end of the mid-lateral portion of the hypural plate), and a digital weighing scale was used to determine the weight of each sample. To record and tabulate the results of each test, the researchers used tally sheets.

Results and Discussions

Descriptive Data Analysis

Length (mm) and Weight (g) of Oreochromis niloticus

(Nile Tilapia) in Initial and Final

Anthropometric Measurement

Table 2 below shows the growth of male and female *Oreochromis niloticus* (Nile Tilapia) in terms of length (mm) and weight (g) recorded from the initial anthropometric measurement to the final anthropometric measurement for the duration of this study. The results indicate that 1.5g of *Trichanthera gigantea* (Madre de Agua) micro pellets combined with 4.5g of Tateh Aquafeeds Surfer Commercial Feeds (T4) had the highest mean length and weight of 156.65mm and 63.00g respectively as the final measurement of the fishes. 6g Tateh Aquafeeds Surfer Commercial Feeds (T5) identified second with a mean of 145.50mm and 51.40g, then fishes fed with 3g Madre de Agua micro pellets and 3g Tateh Aquafeeds Surfer Commercial Feeds (T3) followed at 141.35mm and 50.30g, while 4.5g Madre de Agua micro pellets and 1.5g Tateh Aquafeeds Surfer Commercial

Feeds (T2) came next at 128.50mm and 37.75g. Pure 6g of Madre de Agua micro pellets (T1) administered the lowest mean length and weight at 119.50mm and 33.55g at the final measurement of the fish samples.

Table 2. Length (mm) and Weight (g) of Oreochromis niloticus (Nile Tilapia) in Initial and Final Anthropometric Measurement

Treatments	Length (mm)		Weight (g)	
	Before	After	Before	After
1	109.35	119.50	25.55	33.55
2	111.30	128.50	26.65	37.75
3	113.00	141.35	27.15	50.30
4	122.85	156.65	36.40	63.00
5	120.15	145.50	34.55	51.40
Overall	**115.33**	**138.30**	**30.04**	**47.20**

Treatment	Composition
1	6 grams *Trichanthera gigantea* micro pellet
2	4.5 grams *Trichanthera gigantea* micro pellet & 1.5 grams Tateh Aquafeeds Surfer Commercial Feeds
3	3 grams *Trichanthera gigantea* micro pellet & 3 grams Tateh Aquafeeds Surfer Commercial Feeds
4	1.5 grams *Trichanthera gigantea* micro pellet & 4.5 grams Tateh Aquafeeds Surfer Commercial Feeds
5	6 grams Tateh Aquafeeds Surfer Commercial Feeds

All treatments affected a significant amount of growth in *Oreochromis niloticus* (Nile Tilapia). Treatment 4 comprising of 1.5g *Trichanthera gigantea* (Madre de Agua) micro pellets and 4.5g Tateh Aquafeeds Surfer Commercial Feeds had the highest mean length and weight at the end of the two-month period of anthropometric measurement of fish samples. Although Madre de Agua identifies as an inexpensive resource suitable in feeding animals such as Nile Tilapia, it does not clearly satisfy the markers of growth and cultivation of the species itself. Since T1 (6g Madre de Agua micro pellets) had the lowest mean length and weight gain among the treatments, implications of this study would suggest Madre de Agua as a food supplement in fish meals, not just the only source of food and inhibitor of growth.

The results of this study are in line with the general findings of Ogello, Munguti, Sakakura, and Hagiwara (2014) in their study "Complete replacement of fish meal in the diet of Nile tilapia (*Oreochromis niloticus L.*) grow-out with alternative protein sources. A review", which concluded that plant proteins could be supplemented with alternatives like cheap minerals instead of expensive amino acids to produce adequate results in growth performance of the fish. A similar notion was concluded in a study by Magbanua and Ragaza (2022) where plant-based proteins were identified to partially or completely replace fishmeal. The researchers determined that including dietary plant-based proteins provides sufficient fish growth while reducing the total feed costs of Nile Tilapia. Lastly, a study by Hassan, et al., (2018) named "Effects of Some Herbal Plant Supplements on Growth Performance and the Immune Response in Nile Tilapia (*Oreochromis Niloticus)*" also aligns with the results of this study wherein supplementation of natural plants in turmeric (*Curcuma longa*), rosemary (*Rosmarinus officinalis*), and thyme (*Thymus vulgaris*) as feed additives significantly increased ($P<0.05$) weight gain, specific growth rates and protein efficiency ratio (PER) compared to those in the control group.

Difference between Growth of Oreochromis niloticus

(Nile Tilapia) Before and After

Table 3 below presents the data analysis in length (mm) and weight (g) of *Oreochromis niloticus* (Nile Tilapia). For the length, the *f*-ratio value is 7.16741. The *p*-value is .000149. Therefore, the result is significant at $p < .05$. In terms of weight, the *f*-ratio value is 10.15031. The *p*-value is <.00001. Similarly, the result is significant at $p < .05$.

Table 3. One-Way Analysis of Variance on the Growth of Oreochromis niloticus (Nile Tilapia)

Test	Variation	SS	MS	df	F	p-value
Length	Treatments	3893.85	973.46	4	7.16	0.001
	Error	6111.81	135.82	45		
	Total	10005.66	1109.28	49		
Weight	Treatments	2662.06	665.52	4	10.15	0.001
	Error	2950.47	65.57	45		
	Total	5612.53	731.08	49		
p value@ .05 alpha level of significance						

As observed in the study, the length and weight of *Oreochromis niloticus* (Nile Tilapia) significantly differed respectively from the initial and final mean values. Data analysis on the growth of the fish samples resulted as significant at $p < .05$. Therefore, there is a significant difference of growth between the initial measurement and final measurement of *Oreochromis niloticus* (Nile Tilapia) in terms of *Trichanthera gigantea* (Madre de Agua) treatments. In this case, the null hypothesis is rejected. Growth is attributed to the different compositions of the *Trichanthera gigantea* (Madre de Agua) in each treatment. The result of this study is consistent with the study of Maundu (2014) where either pure fishmeal or fishmeal containing a mixture of 25% of plant proteins diets lead to similar growth performance in *O. niloticus*. Similar to this study, fishmeal containing the mixture of plant proteins remarkably reduces the production costs and achieves higher profits than when pure fishmeal is used.

Conclusions

The following conclusions were made based on the results of the study:

1. *Oreochromis niloticus* (Nile Tilapia) fed with treatment four (1.5g of *Trichanthera gigantea* micro pellet and 4.5g Tateh Aquafeeds Surfer Commercial Feeds) had the highest mean length and weight. *Oreochromis niloticus* (Nile Tilapia) fed with treatment five (6g Tateh Aquafeeds Surfer Commercial Feeds) followed, then treatment three (3g of *Trichanthera gigantea* micro pellet and 3g Tateh Aquafeeds Surfer Commercial Feeds), treatment two (4.5g *Trichanthera gigantea* micro pellet and 1.5g Tateh Aquafeeds Surfer Commercial Feeds), and lastly, treatment one (6 grams of *Trichanthera gigantea* micro pellet) with the lowest mean length and weight among fish samples. In conclusion, all *Oreochromis niloticus* (Nile Tilapia) samples fed with different treatments of *Trichanthera gigantea* (Madre de Agua) micro pellets showed an increase in length and weight, with T4 being the highest while T1 was the lowest. This may indicate that *Trichanthera gigantea* (Madre de Agua) is more effective as a food supplement for *Oreochromis niloticus* (Nile Tilapia) growth rather than a pure plant protein alternative to commercial fish feed.

2. Both results for length and weight are significant at $p < .05$. Therefore, there is a significant difference of growth between the initial measurement and final measurement of *Oreochromis niloticus* (Nile Tilapia) in terms of *Trichanthera gigantea* (Madre de Agua) treatments, hence, the null hypothesis is rejected. This suggests that *Trichanthera gigantea* (Madre de Agua) makes as a feasible ingredient for *Oreochormis niloticus* (Nile Tilapia)

growth.

Recommendations

Based on the study's findings and conclusions, the following recommendations are offered:

1. For the aquaculturist, it is suggested to gather some information about the food, environment, and behavior of the aquatic animal species they intend to cultivate before buying them. Moreover, they should choose the best brand of feed that can give the fish the right amount of nutrients for their diet and faster growth. Aquaculturists may enhance their knowledge about aquatic animal species by reading credible studies and research.

2. It is recommended to the Fish Feeds Suppliers and Manufacturers that they may make a pellet that is organic and rich in protein and crude fiber which can help the faster growth of fish. They may use *Trichanthera gigantea* leaves to hint at a plant protein alternative that supplements an affordable way of growing the fish.

3. For the Bureau of Fisheries and Aquatic Resources (BFAR), it is recommended to invent more types of feeds that can help the growth of aquatic animals by doing more research on alternative sources of protein from the different organic resources in the Philippines. In addition, they may use natural resources that are abundant in their locality and can be obtained at a low cost.

4. It is suggested to the Department of Environmental and Natural Resources (DENR) that they may find other potential uses of the *Trichanthera gigantea* plant by examining its different parts. Moreover, they may examine the leaves of the *Trichanthera gigantea* plant to see if it really can retain intestinal blockages in domestic animals and retained cow placenta. *Trichanthera gigantea* is a fodder tree that proliferates amid plantation crops and adapts well to tropical conditions.

5. For the Southeast Asian Fisheries Development Center / Aquaculture Department (SEAFDEC/AQD), it is suggested that they may do more research about the survival, growth, and farming of *Oreochromis niloticus*, which is the most widely cultivated freshwater fish in the Philippines. With this, they may experiment if *Oreochromis niloticus* can survive independently in an ecosystem or they are dependent to each other.

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