Growth Performance of Orange Spotted Spinefoot Rabbitfish (*Siganus guttatus*) fed with Mulberry Leaf (*Morus alba*)

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Abstract

Aquaculture fisheries production plays an important role in food and nutritional security. Ensuring production while decreasing the cost for feeds through alternative feeds will be beneficial. Thus, this study was conducted to evaluate the growth performance of orange spotted spinefoot rabbitfish (*Siganus guttatus*) fed with mulberry leaves. The study up in 1x1x1.5m hapa net between 10m distance experimental design using four (4) treatments specifically control treatment T0 - commercial feeds, Treatment 1 T1 - 75% commercial feeds: 25% mulberry leaf, T2 - 50% commercial feeds: 50% mulberry leaf, T3 - 25% commercial feeds: 75% mulberry leaf. To test the significant difference among the treatments, One way ANOVA with Duncan Multiple Range Test was used. It was found out that there was a significant difference in the growth increment of *S. guttatus* among the treatments in length, width and weight. It was concluded that T3 is effective for the growth of *S. guttatus* as cultured in Brackish water environment and can be embedded in its management program.

Introduction

Aquaculture like fish farming is a viable, sustainable and profitable business here in the Philippines. It plays a significant role in increasing fish production to sustain people's needs and demands in various life aspects (Gonzales et al., 2018). The demand for high protein food such as fish is increasing with unsustainable practices of collecting aquatic resources in the ocean. It is impossible that capture fisheries production can meet the increasing demand for food with the planet's ever-growing population.

In addition, aquaculture in the Philippines has a long history and involves many species and farming practices in diverse ecosystems. It is growing much faster than capture fisheries. However, the global position of the Philippines in aquaculture production has decreased from fourth place in 1985 to 12th rank recently. The Philippines contribution is just over 1% of global farmed fish product (FAO, 2022).

The future growth of Philippines aquaculture may not be sustained unless new markets are developed, market competitiveness is strengthened and farming risk are reduced. With the current trend in the economy, the Philippines aquaculture industry needs to implement a development and management program with a global outlook. Developing the orange spotted spinefoot rabbitfish aquaculture sector would be

advantageous for diversification especially since it is one of the few marine herbivorous cultures species (FAO, 2022).
Siganus guttatus are medium sized fish native to the Indo-Pacific region thriving in coastal region. Some species prefer brackish water mangrove habitats while others live in and around coral reefs (FAO, 2022). It is known as *danggit* and *samaral* in the Philippines, commonly known as orange spotted spinefoot rabbitfish and is very popular and sought-after food fish. It is a high-value marine species that is cultured in ponds and cages in the Philippines. It feeds on plants and seaweeds with its rabbit like teeth in the wild, but it can also be grown by commercial feeds.

However, S. guttatus is in high demand and fetch relatively higher market price. Culturing this species can come with significant environmental impacts. Large amount of fish meal are typically used in feeds for such species, and it its estimated that at present, a quarter of all fish landed globally are destined fro the fish meal industry and incorporated in pelleted terrestrial and aquatic animal feeds (Guerrero III, 2019).

Alternative traditional fish feeds are commonly protien rich plant-based feed such as soy, corn and wheat. However, this type of feeds comes at a cost and put pressure in land farming. Therefore, selection of plant-based feeds becomes crucial. Plants that are fast growing at the same time protein rich are more preferred, such as mulberry (*Morus alba*).

Lack of feed is one of the challenging problems for most fish farmers. Otherwise, feeding of feeds during culture aims to produce the maximum weight of marketable fish within the shortest time. This is one of the most important things in culturing fish. To try to solve this issue, the researchers aimed to test the growth rate of *S. guttatus* fed with the combination of mulberry leaves and commercial feeds in varying composition.

Materials and Methods
The research used 240 pieces of 45 day old *S. guttatus*, considered as juvenile (2-3 cm) (Duray, 1998). Commercial feeds specifically fry mash feed with 32 percent crude protein (HFC, 2019) was used as a combination with mulberry leaf meal with 15.31 - 30.91% crude protein (Srivastava et al., 2006). Twelve individual fine mesh net was used as barriers, hapa net, with 1x1x1.5m as its dimensions laid out in 10m distance. Water parameters namely pH, dissolve oxygen and temperature were measured and recorded regularly.

Mulberry leaf meal was prepared by drying the mulberry leaves at 65°C for 24 hours (Arun, 2022). Afterwhich, it was processed to form powder and was sieved for consistency of size. Feeds were prepared using the following percentage: control treatment T_0 - commercial feeds, Treatment 1 T_1 - 75% commercial feeds: 25% mulberry leaf, T_2 - 50% commercial feeds: 50% mulberry leaf, T_3 - 25% commercial feeds: 75% mulberry leaf. Study area is monitored every day to check the condition of the culture species. Cleaning and inspection of net were done before the sampling period. Water parameters were measured twice a day before feeding early in the morning and late afternoon.

Specific growth rate (SGR) was computed using SGR = [(ln final weight − ln initial weight)/days] x 100. Where: ln = natural logarithm of final and initial weight and SR = (harvested stocks/total stocks) × 100 (Nicanor, 2020). Data gathered were analysed using One way ANOVA with Duncan Multiple Range Test.

Results and Discussion

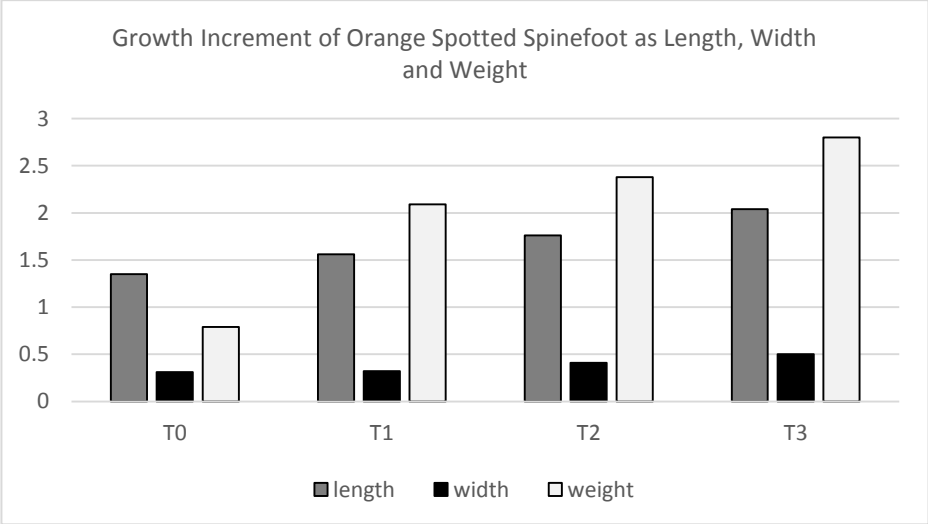
S. *guttatus* is partly dependent on the quality of media where it is grown and its tolerable level for salinity, pH and temperature is 28-31 ppt (Leopardas, 2022), 6-8.5 (Stattin, 2012) and 24-28°C (Fishbase 2022), respectively. As recorded throughout the study, water quality of rearing brackish water for *S. guttatus* demonstrated relatively stable patterns within the tolerable range as a response to salinity, pH,temperature, and dissolved oxygen as shown in Table 1.

Table 1. Average water parameters of *S. guttatus* culture

Water Parameters	Standard Range	Reading (range)
Salinity	28 - 31 ppt < low salinity	27-29 ppt
pH	6 - 8.5	7-8.1
Temperature	25.4 - 29.3°C	26 - 29 °C

The growth increment of *S. guttatus* fed with different percentage of mulberry leaf meal and commercial feed diet source was evaluated in terms of length, width and weight. Shown in Figure 1, T_3 got the highest growth increment in terms of length with 2.04 cm. T_2 and T_1 got the second and third highest growth increment in terms of length with 1.77cm and 1.56cm, respectfully. The east growth increment was recorded in T_0 with 1.35cm.

The same figure shows the growth increment in terms of width and samples fed with T_3 showed the highest increment with 0.50cm. Samples fed with T_2 and T_1 showed an increment in terms of width with 0.40cm and 0.32cm, respectively. The least increment in terms of width was recorded in samples using T_0 with 0.30cm.



The same figure also shows the growth increment in terms of weight and highest increment was manifested in samples fed with T_3 with 2.80g. Samples fed with T_2 and T_1 showed weight increment with 2.37g and 2.09g, respectively. the least weight increment was recorded in samples fed with T_0 with 1.79g.

Results revealed that samples fed with T3 recorded the highest increment in aspects, length, width and weight. These findings are similar with the study of Olaniyi et al (2016) in which used African catfish (*Clarias gariepinus*), a species with 40-50% crude protein requirement, that samples fed with 15% mulberry leaf meal showed highest growth rate. Similarly, a study conducted by Piwo et al. (2018) that used Nile Tilapia (*Oreochromis niloticus*), a species with 33% crude protein requirement, fed with enhanced diets of different levels of mulberry leaves concluded that 25% mulberry leaf meal was the most appropriate replacement to fish meal due its improved growth performance and decreased feed cost.

The specific growth rate (SGR) of *S. guttatus* cultured in brackish water was evaluated in terms of length, width and weight shown in Table 2. The results showed that samples fed with T3 obtained the highest growth rate in terms of length, width and weight of 3.40 %/day, 0.84 %/day and 4.67%/day, respectively.
Table 2. Specific growth rate in weight and length, survival of *S. guttatus*.

Treatment	SGR (length/cm) % day^{-1}	SGR (width/cm) % day^{-1}	SGR (weight/g) % day^{-1}
T_0	2.25	0.51	2.99
T_1	2.61	0.53	3.49
T_2	2.95	0.67	3.96
T_3	3.40*	0.84*	4.67*

*significant difference

The growth of *S. guttatus* can be attributed to the nutritional value in powdered dried mulberry leaf at 65°C would result to moisture ranged from 5.11 - 7.24%, crude protein (15.31 - 30.91%) total ash (14.59 - 1724%), crude fat from 2.09 to 4.93%, carbohydrates (9.70 - 29.64%) and energy (113-224 kcal/100g (Srivastava et al., 2006). In addition, the study of Bag et al. (2012) which demonstrated that mulberry leaf meal as total substitute for dietary fish meal for sting fish (*Heteropneustes fossilis*), as species with 40% crude protein requirement proved to be best in terms of growth rate.

Conclusion

Based on the results, it was concluded that using a T_3 - 25% commercial feeds: 75% mulberry leaf can be considered as alternative feed for *S. guttatus* as shown in its growth performance using protein rich plant base.

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