

Growth and Survival of Tilapia (*Oreochromis niloticus*) in Aquaponic Systems With Different Plant Species

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ABSTRACT

This study aims to determine the growth and survival of tilapia in aquaponic systems with different plant species. This research was conducted from June to August 2024 at the Dryland Laboratory of Nusa Cendana University Kupang. The experiment used a completely randomized design (CRD) method with 4 treatments and 3 replicates consisting of treatment A (control), treatment B (*ipomoea reptans*), treatment C (*brassica rapa*), and treatment D (*lactuca sativa*). Each treatment consisted of 15 fish so that the total was 180 tilapia (*O.niloticus*). Parameters analyzed in this study include absolute weight, absolute length and survival. The results of the study were the treatment of different types of plants gave a significant effect on absolute growth and survival with the best treatment in the kale treatment, the survival rate gave a real effect where the kale treatment gave the best results and the absolute length of fish had no effect on each other.

INTRODUCTION

Aquaponics is a farming technology that utilizes aquaculture waste to grow aquatic organisms and plants, thereby addressing sustainable environmental issues such as water limitations, pollution, rising fertilizer costs and depletion of arable land. (Yep & Zheng, 2019). The recent development in urban agriculture of alternative crop cultivation methods can reduce dependence on soil, hence aquaponics is an alternative method used. (Dhal *et al.*, 2022). One method in aquaponics is floating rafts (Salam *et al.*, 2013).

Fish that have been culture in aquaponic systems include: tilapia. (*O. niloticus*) (Ani *et al.*, 2022 ; Babatunde *et al.*, 2022), catfish (Baßmann *et al.*, 2017), Carp (*Cyprinus carpio*) (Irhayyim *et al.*, 2020), mullet fish (Gisbert *et al.*, 2024). Fish that are culture and have been widely used are tilapia (*O. niloticus*) (Zhong *et al.*, 2024). Tilapia production is increasing every year with good growth performance, and is able to adapt to survive in the aquaculture environment (Magbanua & Ragaza, 2024). Aquaponic farming utilizes fish farming waste to produce vegetable crops while reducing the impact of environmental pollution due to aquaculture waste (Handayani *et al.*, 2020).

Some common types of plants utilized in aquaponic systems include: amaranthus caudatus (Farooq *et al.*, 2023), lactuca sativa (Gisbert *et al.*, 2024), ipomoea reptans (Wang *et al.*, 2022), and basil (Junaid *et al.*, 2023). Nutrients from aquaponics fish waste are used by plants to grow, and the plants filter the water for the fish (Mahmoud *et al.*, 2023).

Some previous studies have shown that various types of plants can increase the development and survival rate of fish. Nazlia & Zulfiadi's research, (2018) states that different plants have different effects on the survival and growth of sangkuriang catfish weight with ipomoea reptans plants and brassica chinensis plants. In contrast to the research of Simanullang *et al.*, (2023), using different types of plants on the growth of tilapia (*O. niloticus*) there is no effect but treatment using ipomoea reptans gives the highest weight gain of fish 2.21 g. herefore, a study was conducted using different plant species on the growth and survival of fish tilapia (*O. niloticus*) using a floating raft aquaponics system.

LITERATURE REVIEW

Classification and Morphology of Tilapia (Oreochromis niloticus)

Tilapia fish (*Oreochromis niloticus*) is one of the freshwater fish that is much favored by the public (Safir *et al.*, 2023). The following is classification of tilapia (Linnaeus, n.d.) which is as follows:

Kingdom : Animalia
Phylum : Chordata
Subphylum : Vertebrata
Class : Actinopterygii
Subclass : Neopterygii
Order : Perciformes
Family : Cichlidae
Genus : Oreochromis

Subject : *Oreochromis niloticus*

The morphology of tilapia is as follows, the body is grayish brown to bronze; sometimes 7-8 dark vertical stripes are visible, more prominent on the dorsal body; the dorsal fin is reddish brown with a variegated bluish color on the upper part and red stripes, as well as several dark stripes on the soft part; caudal fin essentially unmarked, although males sometimes have a few bluish spots; outer anal fin quite dark, with a few pale spots at the base; pelvic fins may become slightly elongated and have a pale reddish-brown leading edge (Genner, M.J. & Ngatunga, 2018).

Tilapia Fish Habitat (Oreochromis niloticus)

Tilapia (*O.niloticus*) is one type of freshwater fish whose natural habitat is in fresh waters such as lakes, rivers, and swamps. Tilapia can be found in waters with temperatures between 22°C and 30°C and pH between 6.5 and 8.5. In accordance with the provisions (SNI 7550: 2009), the temperature is 25-32°C, the pH value is 6.5-8.5 and DO \geq 3 mg L⁻¹ so it is suitable for tilapia rearing activities.

METHODOLOGY

This research was conducted at the Dryland Laboratory of Nusa Cendana University, and was carried out from June to August. The fish used were tilapia (*O. niloticus*) obtained from the Dryland Laboratory of Nusa Cendana University as many as 180 fish with an average weight of 27.621 g. The fish used were tilapia (*O. niloticus*). The rearing container in this study used a tarpaulin pond measuring 100x50x50 cm. Each pond was stocked with 15 fish. The feed given during the rearing period used HI-PRO-VITE 781-2. The aquaponic plants used included ipomoea reptans, brassica rapa and lactuca sativa. Plants were sown in seedling containers with a mixture of rice husks and soil until they grew and had two to three leaves. Then four seedlings were transferred into a plastic cup with a volume of 400 ml, and filled with 40 grams of arangs as plant support. The plastic cup was placed on a styrofoam measuring 40 X 40 cm, consisting of 12 holes and the styrofoam was ready to be used for floating raft cultivation. This study used a completely randomized design (CRD) method with four treatments and three replications. Treatments in this study include: Treatment without plants, ipomoea reptans plants, brassica rapa mustard plants, lactuca sativaplant treatments.

Variables Observed

Observations and measurements of fish body weight and length growth were made at the beginning and eighth week.

Absolute Growth of Fish

Absolute growth is the difference between the total body weight of the fish at the end and the beginning of rearing. Absolute fish measurements were taken on Thursday.

$$W_m = W_t - W_0$$

W_m : Average fish growth (grams)

W_t : Biomass weight at the end of the study (gram/tail)

W_0 : Biomass weight at the beginning of the study (grams/fish)

Absolute Length Growth

Absolute length growth is the size of the fish measured from the head to the tail fin.

$$L = L_t - L_0$$

Description:

L : Absolute length growth of fish kept (cm)

L_t : Length of fish at the end of maintenance (cm)

L_0 : Length of fish at the beginning of rearing (cm)

Survival Rate

Fish survival rate is the percentage of fish that successfully survive in a certain period after being stocked in the culture system.

$$SR = \frac{N_t}{N_0} \times 100\%$$

Description:

SR: Survival rate (%)

N_t: Number of fish at the end of rearing

N₀: Number of fish at the beginning of rearing

Data Analysis

Data on quantitative parameters observed in the form of absolute growth of fish, length growth and survival rate, were analyzed with Anova variance test with 95% confidence level then continued with Duncan's test.

RESEARCH RESULT

Absolute Weight Growth

Tilapia weight growth using ipomoea reptans plants produced the highest value of 8.94 g, followed by treatment without plants producing a value of 5.89 g, then followed by brassica rapa plant treatment of 5.14 g, and lactuca sativatreatment with the lowest growth value of 1.61g. The absolute weight bar chart can be seen in Figure 1.

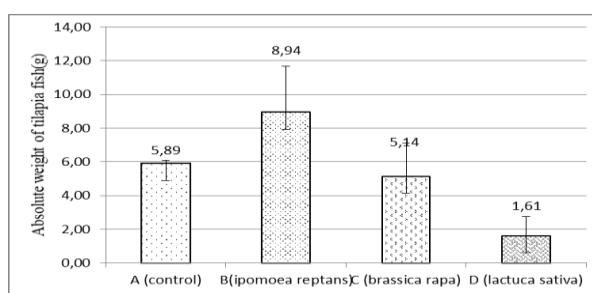


Figure 1. Absolute weight growth

The figure shows the average weight of tilapia (*O.niloticus*) in the research process. The effect of different plant species showed a significant effect on the absolute weight growth of tilapia ($p < 0.05$). The highest absolute weight growth was the ipomoea reptans treatment and showed significant differences with the treatment of brassica rapa and lactuca sativa ($p < 0.05$).

Absolute length growth of tilapia

The increase in the length of tilapia with the use of Ipomoea reptans plants produced the highest value of 6.22 cm, followed by the treatment of brassica rapa plants producing a value of 6.16 cm, then followed by the treatment of lactuca sativa plants 5.84 cm, and treatment without plants with the lowest growth value of 5.81 cm. The absolute length growth graph can be seen in Figure 2.

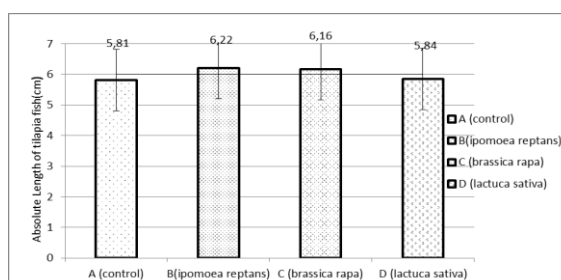


Figure 2. Graph of absolute length growth

The figure above shows the average value of tilapia (*O.niloticus*) length growth during the study. The effect of several different plants did not have a significant effect ($p > 0.05$), on the length growth of tilapia (*O.niloticus*).

Tilapia survival rate

The survival growth of tilapia (*O.niloticus*) using Ipomoea reptans plants produced the highest value of 88.88%, followed by plant treatment which produced a value of 86.66%, then followed by lactuca sativa plant treatment of 77.77%, and treatment without plants with the lowest survival value of 62.22%. The treatment of different types of plants has a significant impact on the survival of tilapia (*O.niloticus*) ($p < 0.05$). Survival was highest in Ipomoea reptan treatment and significantly different from the control, brassica rapa and lactuca sativa treatments.

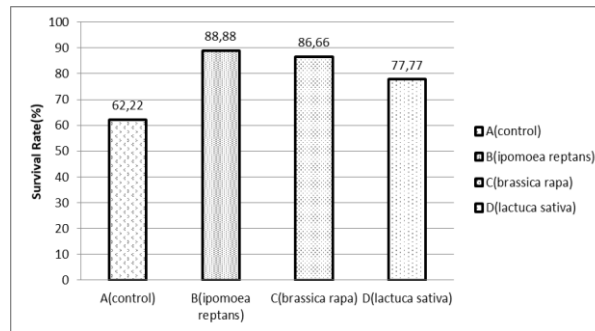


Figure 3. Survival rate

The figure above shows, the average growth value of the survival rate of tilapia using different plant species, the treatment with kale showed the highest results, while the control treatment produced the lowest results.

DISCUSSION

Research by Rini et al. (2018) also shows that the growth of tengadak fish is more optimal in the *Ipomoea reptans* treatment because it has a main root with branches. *Ipomoea reptans* roots in the aquaponic system are able to absorb waste from fish farming, so that the water absorbed by the roots becomes cleaner and water quality is maintained. The extensive roots of kale can reach ammonia levels to the bottom of the container. Thus, *Ipomoea reptans* is more effective in reducing ammonia levels (Aditya et al., 2023). Hapsari et al., (2018) showed that the use of water spinach plants gave the best results in maintaining water quality. Water quality can affect the growth of farmed fish. Aquaponic systems with better water quality management can improve the growth and survival rate of fish culture (Azhari & Tomaso, 2018). While research Rini et al., (2018), said that the taproot of *lactuca sativa* is thought to be less effective in absorbing fish waste, because the root structure is unable to filter waste from the culture process.

Research results Nazlia & Zulfiadi, (2018), said that the aquaponic system with four different treatments, namely without plants (control), using *Ipomoea reptans*, a combination of *brassica chinensis* and *Ipomoea reptans*, and *brassica chinensis*, showed no different long growth results. Aquatic plants in the aquaponic system did not affect the length of the fish on the length growth of catfish.

Research Rahmadhani et al., (2020) also shows that catfish growth is better in the *Ipomoea reptans* plant treatment than *brassica rapa* and *lactuca sativa* plants. Research Nazlia & Zulfiadi, (2018) The results also showed that Sangkuriang catfish seeds produced the highest survival rate in the *Ipomoea reptans* treatment compared to a mixture of *Ipomoea reptans* and *brassica chinensis*, *brassica chinensis* and no plants. Swardiani et al., (2022) stated that the system using kale plants had lower ammonia concentrations compared to that without pakcoy plants. *Ipomoea reptans* has a taproot system with branches that spread in all directions, allowing it to absorb more waste in the fish rearing medium, thus helping to maintain good water quality (Alfatihah et al., 2024). According to Sitompul et al., (2012) stated that the survival rate is strongly

influenced by various factors, one of which is water quality, because water is the main medium where fish live. During the maintenance period, the quality of cultured water remains in ideal conditions, thus supporting the survival of sangkuriang catfish. (Alfatihah et al., 2024).

CONCLUSIONS AND RECOMMENDATIONS

The treatment of different types of plants has an effect on growth absolute growth and survival of tilapia (*O. niloticus*). Treatment with kale plants is the best treatment by producing an average absolute growth of tilapia (*O. niloticus*) of 8.94g and survival of tilapia (*O. niloticus*) of 88.88% but the treatment of different types of plants has no effect on the absolute length of tilapia (*O. niloticus*).

ADVANCED RESEARCH

Based on the results of the research obtained, it is expected for students to conduct research using the floating raft aquaponic system on the physiology of fish and water quality that causes the growth and survival of tilapia.

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