Study on the addition of *Caulerpa lentillifera* on growth and survival rate of saline tilapia *Oreochromis niloticus*, L

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Abstract. Saline tilapia (*Oreochromis niloticus*, L) is potential to be cultured due to its high content of nutrition. This study aims to determine the optimal dosage of *Caulerpa lentillifera* meal in feed for growth and survival rate of saline tilapia. This research was conducted on August to September, 2018 at Brackish Water Aquaculture Development Center, Aceh, Indonesia. The study used an experimental method with a completely randomized design (CRD) with 5 treatments of meal dosage and 4 replications, namely; A = 0 g, B = 10 g, C = 20 g, D = 30 g, and E = 40 g *Caulerpa lentillifera* meal Kg⁻¹ feed. The observed parameters included absolute weight gain, absolute length growth, daily growth rate, feed efficiency and survival rate. The results showed that the addition of *Caulerpa lentillifera* meal in feed significantly (p <0.05) affected the growth and survival rate of saline tilapia. The optimal dosage of meal was 20 g *Caulerpa lentillifera* meal Kg⁻¹ feed at (treatment C).

1. Introduction
Saline tilapia (*Oreochromis niloticus*, L.) contains high nutrition, so it is good for consumption. Ogello et al. [1] stated that tilapia culture is widely practiced in the tropics and subtropics with an annual growth rate of 12% because tilapia has a high growth rate and disease resistance. This means potential business opportunities for fish farmers.

Feed is an important factor in the success of aquaculture activities and is often a problem due to expensive costs. Production costs of aquaculture activities for fish feed can reach ± 40-60% [2]. Expensive feed costs can be caused by the use of expensive raw materials. Therefore, it is necessary to make efforts to utilize locally available raw materials as feed ingredients to reduce the high price of feed. One of the raw materials used is *Caulerpa lentillifera*. It has a high nutritional content and as a source of vegetable protein, minerals and vitamins. The nutritional content of *Caulerpa Lentillifera* were as follows; fat (0.88 to 0.99%), moisture content (8.82-19.22%) and protein (5.63-7.55%) [3].

Research on the utilization of *Caulerpa lentillifera* in feed for the growth of milkfish (*Chanos chanos*) has been carried out by Solin [4] and obtained optimal growth at a dose of 20g Kg⁻¹ of feed. While Rahmawati [5] reported the optimum dosage of *Caulerpa lentillifera* meal in tiger shrimp feed (*Penaeus monodon*) was 30g Kg⁻¹ of feed. Nguyen [6], reports that the nutritional needs of tilapia were...
well documented. Tilapia is herbivorous fish and requires lower protein content in feed compared to carnivorous fish. This study aimed to determine the effect of the addition of *Caulerpa Lentillifera* meal in saline tilapia feed on its growth and survival.

2. Materials and methods

2.1. Materials

The materials used were saline tilapia, *Caulerpa lentillifera* meal, fish meal, wheat flour, soy meal, bran, corn meal, fish oil, vitamins and mineral mix.

2.2. Method

The research was carried out at Brackish Water Aquaculture Development Center, Aceh, Indonesia from August to September 2018. Test fish used in this study were seeds, with length of 5-7 cm and an average weight of 4 g individual. Before conducting the research, this fish was first adapted for 1 week. After the adaptation period is complete, the test fish was fasted for 24 hours.

A completely randomized design (CRD) was used with 5 treatments and 4 replications. Determination of dose was based on previous research [5]. The treatments tested in this study are as follows:

- A = addition 0 g *Caulerpa lentillifera* meal Kg⁻¹ of feed
- B = addition 10 g *Caulerpa lentillifera* meal Kg⁻¹ of feed
- C = addition 20 g *Caulerpa lentillifera* meal Kg⁻¹ of feed
- D = addition 30 g *Caulerpa lentillifera* meal Kg⁻¹ of feed
- E = addition 40 g *Caulerpa lentillifera* meal Kg⁻¹ of feed

2.3. Preparation of *Caulerpa lentillifera* meal

*Caulerpa lentillifera* obtained from Brackish Water Aquaculture Development Center were washed and air dried at room temperature for ± 3 weeks until completely dry, and then crushed 2-3 times to form powder. *Caulerpa lentillifera* meal was then mixed with other feed ingredients and stirred evenly. The protein content used in this study was 28%.

| Kind of raw materials | A   | B   | C   | D   | E   |
|-----------------------|-----|-----|-----|-----|-----|
| Fish meal (g)         | 30  | 300 | 300 | 300 | 300 |
| Soy meal (g)          | 29  | 290 | 290 | 290 | 290 |
| Corn meal (g)         | 16  | 155 | 145 | 135 | 125 |
| Bran (g)              | 10  | 100 | 100 | 100 | 100 |
| Wheat flour (g)       | 10  | 100 | 100 | 100 | 100 |
| *Caulerpa lentillifera* meal (g) | 0   | 10  | 20  | 30  | 40  |
| Vitamin mix (g)       | 10  | 10  | 10  | 10  | 10  |
| Mineral mix (g)       | 20  | 20  | 20  | 20  | 20  |
| Fish oil (mL)         | 15  | 15  | 15  | 15  | 15  |
| Total (g)             | 1000| 1000| 1000| 1000| 1000|

2.4. Growth parameter

2.4.1. Absolute growth

The absolute growth was calculated according to Effendi [7]:

\[ W = W_t - W_0 \]  

(1)

Where: \( W \) = growth (g) \( W_t \) = biomass weight at the end of the study (g) \( W_0 \) = biomass weight at the
2.4.2. *Daily weight growth rate*

The Daily Weight Growth Rate (DWGR) was calculated according to DeSilva and Anderson [8]:

$$\text{DWGR} = \frac{W_2 - W_1}{T_2 - T_1}$$  \hspace{1cm} (2)

Where: DWGR = Daily weight growth rate (g day^{-1}); W1 = fish weight at the start of the study (g); W2 = fish weight at the end of the study (g); T1 = Early time of research (day); T2 = End time of research (day).

2.4.3. *Specific growth rate*

The specific growth rate (SGR) was calculated according to DeSilva and Anderson [8]:

$$\text{SGR} = \frac{\ln W_t - \ln W_0}{t} \times 100$$  \hspace{1cm} (3)

Where: SGR = Specific growth rate (%/day); Wt = biomass weight at the end of the study; W0 = biomass weight at the start of the study; t = research time (day).

2.4.4. *Feed efficiency*

Feed efficiency (FE) was calculated according to Tacon [10]:

$$\text{FE} = \left(\frac{W_t + D}{F}\right) - W_0 \times 100\%$$  \hspace{1cm} (4)

Where: FE = Feed efficiency (%); Wt = Final fish weight (g); W0 = Initial fish weight (g); D = Dead fish weight (g); F = Feed consumed (g).

2.4.5. *Survival rate*

The survival rate (SR) was calculated according to Goddard [9]:

$$\text{SR} = \frac{N_0 - N_t}{N_0} \times 100$$  \hspace{1cm} (5)

Where: SR = survival rate (%); Nt = number of fish death during study (ind); N0 = number of fish at the start of study (ind).

3. Results and discussion

Nutritionists are forced to look for alternative raw material sources for fish feed raw materials due to high feed demand, high costs, and the unstable availability of fish meal. Furthermore, reporting on studies of the use of plant-based feed in the aquaculture sector from various parts of the world aimed at reducing production costs for the economic survival of farmers and can be additional alternative livelihoods such as seaweed cultivation [11]. ANOVA test results showed that the addition of *Caulerpa lentillifera* meal in feed affected the growth of saline tilapia (P < 0.05). The highest fish growth was obtained in treatment C (addition of 20g *Caulerpa lentillifera* meal Kg^{-1} of feed) with absolute weight growth at 13.43 g, daily weight growth rate at 0.33 g day^{-1}, specific growth rate at 3.24% day^{-1} (Table 2). *Caulerpa lentillifera* in feed was able to fulfill the fish's body requirement. Furthermore, saline tilapia can use the feed properly. Arisa et al. [12] stated that fish growth is the result of the utilization of energy derived from food consumed. According to Panggabean [13], feed that is in accordance with the needs of fish will be characterized by increased growth. The growth of
tilapia can be influenced by several factors during maintenance including the response to feed and the environment [14].

Based on the research results, it was suggested that *Caulerpa lentillifera* meal can be used as raw material for tilapia feed. In fact, several studies have also reported that some aquatic plants can be used as feed ingredients, including *Lemma* sp. [15]; *Eichornia crassipes, Salvinia molesta, Pistia stratiotes* [16].

Table 2. Absolute growth, daily weight growth rate, specific growth rate, survival rate saline tilapia.

| Treatment of Dose *Caulerpa lentillifera* meal | Absolute rate (g) | Daily weight growth rate (g/day) | Specific growth rate(% day⁻¹) | Feed efficiency (%) | Survival Rate (%) |
|-----------------------------------------------|-------------------|---------------------------------|-------------------------------|---------------------|-------------------|
| A (0 g Kg⁻¹ Feed)                             | 10.84±1.60 a      | 0.27±0.04 a                     | 2.96 ±0.24 a                  | 44.26±5.13 a        | 70.0±11.54 a      |
| B (10 g Kg⁻¹ Feed)                            | 10.99±0.66 a      | 0.27±0.02 a                     | 2.78 ±0.14 a                  | 47.97±12.26 a      | 75.0±12.90 a      |
| C (20 g Kg⁻¹ Feed)                            | 13.43±0.90 b      | 0.33±0.02 b                     | 3.24 ±0.17 b                  | 72.47±4.94 b       | 97.5±5.00 b       |
| C (30 g Kg⁻¹ Feed)                            | 12.05±0.95 ab     | 0.30±0.02 ab                    | 3.05 ±0.25 ab                 | 61.77±11.90 ab     | 82.5±9.57 ab      |
| D (40 g Kg⁻¹ Feed)                            | 10.80±1.24 a      | 0.27±0.03 a                     | 2.82 ±0.25 a                  | 45.12±16.31 ab     | 72.5±12.58 a      |

Feed efficiency is the amount of feed that enters the digestive system to carry out metabolism in the body and is used for growth. The higher the value of feed efficiency illustrates the more optimal use of feed in increasing growth and good quality feed. The results showed that the highest value of feed efficiency was in treatment C 72.49% (Table 1). According to Nugraha et al. [17], feed efficiency for saline tilapia ranges between 30.93 - 53.84%.

Survival is a very determining factor in success in fish farming activities. The survival rate of saline tilapia during the 40-day maintenance period was ranged 72.5% from 97.5% (Table 1). This proves the use of *Caulerpa lentillifera* meal in feed can fulfill the nutritional requirement of fish for their survival. Furthermore, the survival of saline tilapia is also influenced by the quality of aquaculture media. The results of water quality measurements during the study were temperature 28-33°C, pH 7.0-7.3, DO 7.9-8.8 mg L⁻¹ and salinity 28-31ppt.

4. Conclusion
*Caulerpa lentillifera* has potential as raw materials for fish feed. The optimal use of *Caulerpa lentillifera* meal in feed was at a dose of 20 g *Caulerpa lentillifera* meal Kg⁻¹ of feed.

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