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EFFECT OF ADDING BIOACTIVE COMPOUNDS FROM BROWN ALGAE (*Sargassum* sp.) IN FEED ON GROWTH PERFORMANCE OF SIAMESE CATFISH (*Pangasius hypopthalmus*) SEEDS

Pengaruh Penambahan Senyawa Bioaktif dari Alga Cokelat (*Sargassum* sp.) Pada Pakan Terhadap Performa Pertumbuhan Benih Ikan Patin Siam (*Pangasius hypopthalmus*)

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ABSTRACT

This research aims to determine the effect and determine the dose of adding *Sargassum* sp. extract. optimal feed for the growth performance of Siamese catfish (*Pangasius hypopthalmus*) fry. Results of ANOVA analysis, the addition of bioactive compounds from *Sargassum* sp. very significant effect on fish growth performance (Fhit>Ftab). Addition of *Sargassum* sp. extract in feed at a dose of 20 g/kg had an effect on increasing the growth performance of Siamese catfish (*Pangasius hypopthalmus*) fry which was more optimal than other treatments (0 g/kg, 10 g/kg, 15 g/kg), as indicated by an increase in the percentage value of absolute length growth (6 .7 cm), absolute weight (114.33 g), SGR (2.85%), FCR (1.05%), FUE (95%), HSI (0.51%), and SR (100%) . Water quality values during fish rearing are in the optimum range including temperature (26-28°C), pH (6.2-7.6), and DO (5.3-7 mg/L).

Keywords: Bioactive Compounds, Catfish, Growth, *Sargassum* sp.

ABSTRAK

Penelitian ini bertujuan untuk mengetahui pengaruh dan menentukan dosis penambahan ekstrak *Sargassum* sp. yang optimal pada pakan terhadap performa pertumbuhan benih ikan patin siam. Hasil analisis ANOVA, penambahan senyawa bioaktif dari ekstrak *Sargassum* sp. berpengaruh sangat nyata terhadap performa pertumbuhan ikan (Fhit>Ftab). Penambahan ekstrak *Sargassum* sp. pada pakan dengan dosis 20 g/kg memberikan pengaruh terhadap peningkatan performa pertumbuhan benih ikan patin siam yang lebih optimal dari perlakuan lain (0 g/kg, 10g/kg, 15 g/kg), ditunjukan dengan peningkatan nilai persentase pertumbuhan panjang mutlak (6,7 cm), bobot mutlak (114,33 g), SGR (2,85%), FCR (1,05%), EPP (95%), IHS (0,51%), dan SR (100%). Nilai kualitas air selama pemeliharaan ikan berada pada kisaran optimum meliputi suhu (26-28°C), pH (6,2-7,6), dan DO (5,3-7 mg/L).

Kata Kunci: Patin Siam, Pertumbuhan, *Sargassum* sp., Senyawa Bioaktif

INTRODUCTION

Siamese catfish (*Pangasius* sp.) is a type of freshwater fish that is very popular with the public and has important economic value in the world of aquaculture, so *the Food and Agriculture Organization* (FAO) places catfish in fifth place (Hendrik, 2020). In Indonesia there are 14 species of catfish (*Pangasius* sp.), but the one that is widely cultivated is the Siamese catfish from Thailand, namely the Siamese catfish (*Pangasius hypothalamus)* (Iskandar *et al.,* 2022). Madjading *et al.,* (2023) stated that this fish has the advantage of being easy to cultivate in various rearing media. Catfish cultivation is inseparable from the problem of poor environmental conditions which cause the fish to experience stress and stunted growth . An alternative strategy that can be used to support optimal cultivation of Siamese catfish is improving feed quality by adding natural ingredients. The natural material that has the potential to be used is brown algae (*Sargassum* sp). The main component of the nutritional content of *Sargassum* sp. namely 64.67% carbohydrates and other components 30.4% water, 2.08% ash, 2.08% protein and 0.81% fat (Sumarni, 2022).

Sargassum sp. It can be added to feed as *a feed supplement* in extract form because it has quite complete nutritional content and has healthy bioactivity for the fish's body. Its addition to feed can increase optimal feed absorption for the growth process due to phenolic compounds (Puspita *et al.,* 2017). In addition, the bioactive compound *Sargassum* sp. Others contained are saponins, flavonoids, tannins, phenols, alkaloids and steroids (Noyanti *et al.,* 2023). Flavonoid and alkaloid compounds act as antioxidants which are able to protect body cells from the oxidation process so that free radicals do not cause cell damage (Udlhi *et al.,* 2023). In Pratiwy & Rosidah (2022) research on tilapia, the addition of *Sargassum* sp extract. proven to show an increase in absolute growth performance, feed consumption, and good feed utilization efficiency.

Based on the potential of the *Sargassum* sp. extract. above, research is needed regarding the effect of adding bioactive compounds from *Sargassum* sp extract. in feed which is expected to influence the growth performance of Siamese catfish (*Pangasius hypopthalmus*) fry.

METHODS

The research was carried out from November to December 2023, in the Aquaculture Laboratory, Building 4, Faculty of Fisheries and Marine Sciences, Padajajaran University. The materials used consisted of 300 Siamese catfish seeds (*Pangasius hypopthalmus*) measuring 6 ± 7 cm long with a weight of around 2 ± 2.3 g, brown algae extract (*Sargassum* sp.), commercial feed PF-1000, distilled water, and a binder in the form of progol. The tools used are digital scales with an accuracy of 0.01, blender, 2 L glass jar, 1000 ml measuring cup, Rotary vacuum evaporator, Whatman 42 filter paper, small plastic funnel, 16 units 40x25x25 cm^3 aquariums, fiber tub, aeration , heater , mercury thermometer with an accuracy of 0.1°C, DO , pH meter, 100 ml spray, millimeter block, and a ruler with an accuracy of 0.1 cm.

Sargassum sp. extract carried out in the Aquaculture Laboratory Building 2, Faculty of Fisheries and Marine Sciences, Padajajaran University. The brown algae (*Sargassum* sp.) obtained were first washed with running water until clean and then dried under sunlight for ± 3 days. Once dry, blend it to make simplicia. Simplicia, put into a container (jar) and add 70% ethanol solvent. The maceration process is carried out for 3x24 hours protected from light and direct sunlight. Next, the maceration results are filtered using filter paper and stored tightly in a liter jerry can. The filtrate obtained was combined, then concentrated using *a vacuum rotary evaporator* to produce a thick extract (Sumantri, 2022).

The test fish were first acclimatized for 7 days in a fiber tank to adjust to the new environment and rearing media. During the acclimatization process, feed is given (without the addition of *Sargassum* sp. extract) with a frequency of 3 times a day, then the fish's body weight

is weighed to determine the initial weight and dose of feed that will be given at the rearing stage. The next stage, the test fish were stocked into 16 aquariums which were equipped with aeration and *heater devices* . Each aquarium contains 15 fish or a density of 1 fish/liter (Merpaung, 2017).

Fish rearing lasts for 40 days. Once every 10 days, sampling is carried out including measuring water quality, weighing and measuring body length along with weighing the feed that will be given to adjust the amount of feed in the next rearing period. During maintenance, the feed given is test feed in the form of commercial feed with *Sargassum* sp. extract added. *Sargassum* sp. extract previously dissolved in 60 ml of distilled water then given a binder and put into a spray, shaken until homogeneous then mixed evenly over the entire surface of the feed using the spraying method (Yuliana *et al.,* 2021). After being evenly distributed, the test feed was air-dried for ± 1 hour at room temperature. Then, store it and close it tightly in a ziplock bag, add silica gel to keep the food from getting damp or moldy. Feed is given 3 times a day, namely at 07.00 WIB, 12.00 WIB and 17.00 WIB. The amount of feed given is 5% of the fish biomass. The treatment given is as follows:

Treatment A : 100% commercial feed (without the addition of *Sargassum* sp. extract)
Treatment B : Commercial feed + 10 g/kg *Sargassum* sp. extract.
Treatment C : Commercial feed + 15 g/kg *Sargassum* sp. extract.
Treatment D : Commercial feed + 20 g/kg *Sargassum* sp. extract.

Research Parameters

Survival Rate (SR)

Survival rate according to Fadhillah *et al.,* (2023) can be calculated using the following formula:

$$SR = \frac{Nt}{No} x\ 100\%$$

Information:
SR = Survival (%)
Nt = Final number of fish (fish)
No = Number of initial fish (fish)

Absolute Length Growth (L)

According to Hidayat *et al.,* (2013) absolute length growth can be calculated using the formula:

$$L = Lt - Lo$$

Information:
L = Absolute length growth (cm)
Lt = Length of fish at the end of rearing (cm)
Lo = Length of fish at the start of rearing (cm)

Absolute Weight Growth (W)

According to Hidayat *et al.,* (2013) absolute weight growth can be calculated using the formula:

$$W = Wt - Wo$$

Information:
W = Absolute weight growth (g)
Wt = Final rearing fish weight (g)
Wo = Initial fish weight of rearing (g)
T = Duration of research (days)

Specific Growth Rate (SGR)

Parameter is used to determine the percentage increase in average fish weight per day. Calculated using the formula (Ricker, 1975):

$$\text{SGR}\ (\%) = (\text{Wt} - \text{Wo})/\text{t}$$

Information:
SGR = Individual daily Growth Rate (%/day)
Wt = Average weight of test fish at the end of the study (g)
Wo = Average weight of test fish at the start of the study (g)
T = Duration of research (days)

Feed Conversion Ratio (FCR)

This parameter aims to compare the amount of feed consumed with fish biomass, so as to find out how effective the increase in fish biomass weight is after being fed during maintenance and it can be seen that the suitability of the feed with the fish influences the growth in biomass weight of that group of fish. Calculated using the Effendie (1997) formula below:

$$\text{FCR} = \frac{\text{F}}{(\text{Wt} + \text{D}) - \text{WO}}$$

Information:
FCR = Feed conversion ratio
Wo = Biomass weight of test fish at the start of the study (g)
Wt = Biomass weight of test fish at the end of the study (g)
D = Weight of dead fish (g)
F = Weight of Feed given (g)

Feed Utilization Efficiency (FUE)

This parameter is to determine the level of efficiency of feed use on fish growth development after being treated with test feed. Calculated using the formula of Setiyowati *et al.,* (2022) below:

$$\text{FUE} = \frac{\text{Wt} - \text{Wo}}{\text{F}}\ \text{X}\ 100\%$$

Information:
FUE = Feed utilization efficiency (%)
Wt = Biomass of test fish at the end of the study (g)
Wo = Test biomass at the start of the study (g)
F = Amount of fish feed consumed during the study (g)

Hepatosomatic Index (HSI)

Hepatosomatic Index (HSI) is defined as the ratio of liver weight to body weight (Tresnati *et al.,* 2018). This index value provides an indication of the status of energy reserves in animals. The hepatosomatic index value is calculated based on the formula of Alamsyah *et al.,* (2019) are as follows:

$$\text{HSI}\ (\%) = \frac{\text{BH}}{\text{BT}}\ \text{X}\ 100$$

Information:
HSI = Hepatosomatic Index (%)
BH = Heart Weight (g)
BT = Body Weight (g)

Water Quality

Observations of water quality parameters are carried out every 10 days, used as supporting data in determining the optimum conditions for raising test fish, including water temperature, dissolved oxygen (DO), and pH.

Data Analysis

Data on growth parameters and hepatosomatic index (HSI) were analyzed using statistical analysis of variance (F test) ANOVA/Analysis of Varience with a confidence level

of 95%, then Duncan's further test was carried out to see the effect between treatments. Data on survival rates and water quality were analyzed descriptively.

RESULT

Survival Rate (SR)

The survival rate (SR) values are presented in Table 1. Addition of *Sargassum* sp. extract. in feed did not affect the survival rate of Siamese catfish seeds, each treatment showed the same percentage, namely 100%.

Table 1. Survival Rate of Siamese Catfish Seeds

Treatment	Survival Rate/SR (%)
A (Without the addition of *Sargassum* sp. extract)	100
B (10 g/kg *Sargassum* sp. extract)	100
C (15 g/kg *Sargassum* sp. extract)	100
D (20 g/kg *Sargassum* sp. extract)	100

Growth

Sargassum sp. extract in feed affects the growth performance of Siamese catfish fry (Table 2). The results of statistical analysis using the ANOVA test with a confidence level of 95%, each growth parameter shows a value (F count > F table) which states that the addition of *Sargassum* sp. in feed has an influence on the growth of Siamese pastin fish seeds. Based on the results of the Duncan Test, each treatment, namely treatments A, B, C and D, was significantly different from each other.

Sargassum sp. extract with a dose of 20 g/kg in feed, the fish growth increased significantly ($P<0.05$) compared to other treatments, indicated by an increase in absolute length of 6.76 ± 0.094 cm and resulting in an absolute weight growth of 114.33 ± 1.78 g, then significantly reduced the feed conversion ratio (FCR) value by 1.05 ± 0.026% and the lowest HSI value, namely 0.51%.

Table 2. Growth Performance of Siamese Catfish Seeds

Mark Variable	Treatment			
	A	B	C	D
Absolute length (cm)	4.83 ± 0.034^{a}	5.46 ± 0.040^{b}	6.11 ± 0.034^{c}	6.76 ± 0.094^{d}
Bobot Mutlak (g)	52.18 ± 1.59^{a}	69.70 ± 0.93^{b}	$85,03 \pm 2,76^{c}$	114.33 ± 1.78^{d}
SGR (%/day)	1.30 ± 0.040^{a}	1.74 ± 0.023^{b}	2.13 ± 0.069^{c}	2.86 ± 0.044^{d}
FCR (%)	1.76 ± 0.038^{d}	1.43 ± 0.022^{c}	1.28 ± 0.044^{b}	0.91 ± 0.023^{a}
FUE (%)	57 ± 0.012^{a}	70 ± 0.011^{b}	78 ± 0.027^{c}	95 ± 0.023^{d}
HSI (%):				
-before treatment	0.63 ± 0.0002^{a}	0.63 ± 0.0002^{a}	0.63 ± 0.0002^{a}	0.63 ± 0.0002^{a}
-after treatment	0.70 ± 0.0001^{d}	0.61 ± 0.0001^{c}	0.58 ± 0.0002^{b}	0.51 ± 0.0001^{a}

*Different letters (notation: a, b, c, d) on the same line indicate significantly different effects between treatments
Information:
(A): Feed without the addition of *Sargassum* sp. extract. (B): Commercial feed + 10 g/kg *Sargassum* sp. extract.
(C): Commercial feed + 15 g/kg *Sargassum* sp. extract. (D): Commercial feed + 20 g/kg *Sargassum* sp. extract.

Sargassum sp. extract in feed was able to increase the specific growth rate (SGR) significantly compared to feed with the addition of extract (treatment A) with an FUE value

reaching 95 ± 0.023%, and showed that the FUE value was classified as good (close to 100%), (Linayati *et al.,* 2024) (P<0.05). Then it gives an SGR value of 2.86 ± 0.044%/day (Figure 2).

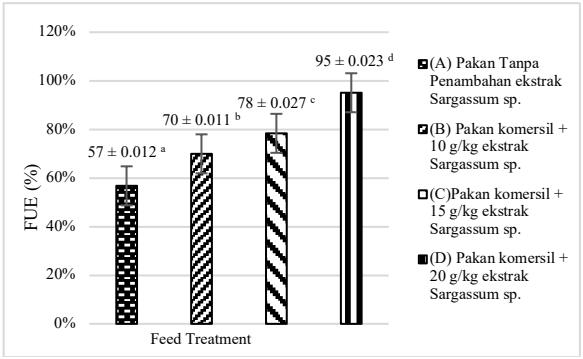

Figure 1. Feed Utilization Efficiency

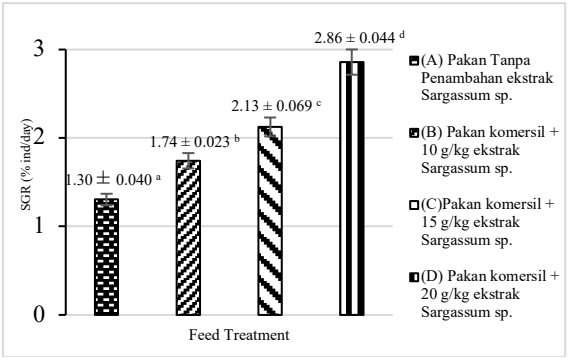

Figure 2. Specific Growth Rate

Water Quality

The results of measuring water quality parameters during the research are presented in Table 3 below.

Table 3. Water Quality Range During The Study

Parameter	Treatment				Optimum Range (SNI 01-6483.5-2002)
	A	B	C	D	
Temperature (°C)	26-27.9	26.2-28	26.5-28.4	26-28	23 - 30
pH	6-7.5	6.6-7.9	6.4-7.6	6.2-7.6	6.5 – 8.5
DO (mg/L)	4.3-6.9	5.8-7	4.6-7	5.3-7	>4

Information:
(A): Feed without the addition of *Sargassum* sp. extract. (B): Commercial feed + 10 g/kg *Sargassum* sp. extract. (C): Commercial feed + 15 g/kg *Sargassum* sp. extract. (D): Commercial feed + 20 g/kg *Sargassum* sp. extract.

DISCUSSION

Based on the results obtained (Table 1) there was no real effect of adding *Sargassum* sp. extract on feed on the survival of Siamese catfish fry. This is thought to be because the fish have adapted well to the rearing media. Helina & Widayarti (2020) states that fish survival is very dependent on the fish's adaptability to food, the environment and the fish's health status. Several factors that play a role in fish survival rates are stocking density, feed supply, disease and quality of cultivation media (Arzad *et al.,* 2019). In this study, the stocking density of fish was 1 fish/liter, where the stocking density stated by Merpaung (2017) was the optimal stocking density for rearing Siamese catfish. Each treatment in the rearing container is filled with ten fish, this is a supporting capacity for the survival of the fish because catfish have the characteristic of grouping together to take food, so that the more fish stocked can increase their appetite and response to the pellets given. In line with the statement of Folnuari *et al.,* (2017) that low stocking densities in cultivation containers result in fish usually being afraid to respond to food, the fish are reluctant to take or approach the food distributed in rearing containers, so that the quality of fish eating is poor. Efforts to maintain the quality of the cultivation media during fish rearing are by using a heater so that the temperature remains stable, and replacing and siphoning the water, then the feed supply as one of the factors for fish survival during the rearing period is given with a frequency of three times a day at the appointed time.

Feed treatments B, C and D (addition of *Sargassum* sp. extract 10 g/kg, 15 g/kg, 20 g/kg) had higher average absolute length growth values compared to feed treatment A (without addition of *Sargassum* sp. extract). This is thought to be due to the influence of the *Sargassum* sp. extract content. in feed, one of which is phenolic compounds. Puspita *et al.,* (2017) said that

feed with a high phenolic compound content has healthy bioactivity and increases optimal feed absorption for the growth process. Sumantri (2022) states that the increase in fish body length is very dependent on growth factors and the health of fish bones. Phenolic compounds are reported to have high antioxidant activity (Erniati *et al.,* 2024). Antioxidants have the function of preventing the emergence of oxidative reactions related to free radicals, reducing or preventing tissue damage and can fight reactive oxygen species (ROS), thereby reducing oxidative stress. Oxidative stress can affect bone index (Israyani *et al.,* 2023). The bioactive compounds contained in the extract of *Sargassum* sp. (such as alkoloids, phenolics, fucoidan) are known to stimulate osteoblastic differentiation and bone mineralization in vitro (Yamaguchi, 2013). In the research of Kim *et al.,* (2021), the bioactive compounds contained in *Sargassum horneri* extract have been proven to be able to suppress the osteoclast process in bones, and stimulate alkaline phosphatase and bone morphogenic protein 2 (BMP2) which play an important role in the mineralization process of osteoblast cells in bones, then osteoblasts will stimulate cell proliferation growth-tissue cells, stimulate alveolar bone and accelerate fish bone growth.

Treatment with the addition of *Sargassum* sp. extract in feed had an effect on increasing fish body weight compared to treatment without the addition of *Sargassum* sp. extract (control). This is in line with research by Pratiwi & Rosidah (2022), tilapia fish measuring 10-12 grams were given the addition of *Sargassum* sp. extract in commercial feed with a dose of 0 g/kg extract, the lowest weight gain for fish was obtained, while 2 g/kg of extract added was the optimal treatment for increasing the weight of tilapia fish. However, the increase in weight shown can be said to be still low from this study, which explains the dose of *Sargassum* sp extract. 20 g/kg is the most optimal treatment as evidenced by the absolute weight value obtained, namely 114 g (Treatment D) (Table 2). The higher the addition of *Sargassum* sp. extract given shows that the absolute weight growth of Siamese catfish seeds is getting bigger, because more nutrients are obtained and digested by the fish. The bioactive ingredients (terpenoids and alkaloids) contained in the extract of *Sargassum* sp. becomes a factor in adding nutrients to feed which functions as enrichment of feed nutrients (enrichment). Nutrient enrichment with bioactive ingredients can influence the acceptability and pallatability or the level of feed digestion in fish seeds to be better, so that the better the rate of fish digestion, the impact on increasing fish weight growth (Nurhajar, 2021).

The specific growth rate value is closely related to absolute weight growth, which means that the optimal increase in fish weight in a unit of time can increase the SGR value (Nurkartika, 2023). This can be proven by Treatment D (20 g/kg *Sargassum* sp. extract) which showed the highest increase in body weight compared to other treatments, and treatment A (control) gave the lowest increase in body weight. Addition of *Sargassum* sp. extract . in feed has a very real influence on the SGR value of fish, this shows that during rearing catfish fry are able to utilize feed with the addition of *Sargassum* sp. extract to grow optimally. The growth of catfish fry can be seen from the increase in body weight and specific growth rate (SGR) values during the 40 day rearing period. Addition of *Sargassum* sp. extract. The feed has a mechanism to increase fish weight based on the bioactive compound components contained in the extract (tannins, alkoloids, saponins) as antioxidants. In the research of Nurhalimah *et al.,* (2023) the addition of microalgae flour (*Chlorella vulgaris*) has an antioxidant effect and has been proven to increase the growth and SGR value of catfish seeds by 1.56%. The results obtained show a low value from the use of *Sargassum* sp. extract which explains that the use of *Sargassum* sp. extract added to feed can produce higher SGR values, and a dose of 20 g/kg *Sargassum* sp. extract in feed is the optimal dose (Figure 2).

The feed conversion ratio (FCR) value *shows* the efficiency of utilization of feed nutrients by fish. Based on the research results, the FCR value obtained shows a decreasing trend. Treatment A obtained an FCR value of (1.76%), treatment B (1.43%), C (1.28%), and

treatment D showed the lowest value, namely (1.05%). The low FCR value is thought to be due to the influence of the quality of the feed provided. As stated by Ahmad *et al.,* (2020), that the presence of microalgae as a feed additive can improve the development of digestive tract morphology thereby optimizing digestibility and nutrient absorption. So extract *Sargassum* sp. believed to have an influence on feed quality. Arief *et al.,* (2014) said that good feed quality is influenced by the composition of the nutrients that make up the feed, as well as the ability of the fish to digest and absorb feed nutrients. Providing food in minimal quantities but capable of providing a maximum response to fish seed growth is an indication that the food is of good quality (Anis *et al.,* 2019). The lower the feed conversion value produced indicates the more efficient use of the feed (Purnomo *et al.,* 2015). Therefore, it can be concluded that the extract of *Sargassum* sp. in feed affects the quality of the feed so that it can produce growth and influence the FCR value of the fish, and a dose of 20 g/kg is the most optimal dose.

Feed treated with the addition of *Sargassum* sp. extract. able to provide high feed utilization efficiency values compared to feed without treatment (control) (Figure 1). This is believed to be due to feed with the addition of *Sargassum* sp extract. able to maximize the appetite of Siamese catfish seeds and add nutrition to the feed provided. *Sargassum* sp. extract contains bioactive ingredients (flavonoids and alkoloids) which are able to provide protection against pathogenic bacteria when fish consume treated feed, so that fish can digest food to be utilized more optimally in their digestive system. Syarpin *et al.,* (2018) and Hardi (2016) stated that the flavonoid and alkoloid content can act as probiotics or supplements in the digestive tract of fish feed, which ultimately can increase growth and feed efficiency. In the research of Syakirin *et al.,* (2022) The presence of flavonoid and alkoloid compounds in feed can be antagonistic to pathogenic bacteria so that the fish's digestive tract is better at digesting and absorbing feed nutrients. The high value of feed utilization efficiency shows that the feed can be utilized well and results in weight gain, and indicates that the feed is of good quality (Aliyah *et al.,* 2019). In Sahara (2017), commercial feed with the addition of 20 g/kg of brown algae (*Sargassum* sp.) flour showed an FUE value for catfish of 73.5%. Based on these results, the addition of *Sargassum* sp. in extract form produces a much higher FUE value and a dose of 20 g/kg of extract in feed is the optimal dose marked by the value given reaching 95% (Table 2). The higher the value of feed utilization efficiency, it means that the feed management provided is better, and can avoid waste in the amount of feed and production costs spent on feed. Feed with appropriate nutritional value will be optimally used by fish to increase growth. Growth will occur if there is excess energy from the feed consumed after the minimum energy requirements (for basic life have been met, such as respiration, movement activities, metabolic processes and care/maintenance), (Pratama *et al.,* 2017).

The liver is an organ that functions to store fat and as a place to store nutrient reserves (Asma, 2016). The hepatosomatic index value in feed supplemented with *Sargassum* sp. extract (treatments B, C and D) obtained the result that the HSI value tended to decrease. The lowest value was found in treatment D, namely the addition of 20 g/kg *Sargassum* sp. extract. on feed. Ahmad *et al.,* (2020) stated that the presence of *Sargassum* sp. which is marine macroalgae as a feed additive can improve the development of digestive tract morphology thereby optimizing digestion and absorption of nutrients. The occurrence of a low HSI value indicates low fat accumulation due to the majority of these nutrients being used as an energy source which will further increase growth (Setiawati *et al.,* 2016). Based on this, the existence of *Sargaasum* sp. It is believed to maximize nutrient absorption so that growth is optimal and fat accumulation in the liver is not stored as much. This is indicated by the low HSI value given. Nurhalimah *et al.,* (2023) explained that low HSI values can occur due to the breakdown of non-protein nutrients in meeting energy needs so that protein can be stored for fish growth.

Based on data from measurements of water quality parameters (Table 3), the water quality range values between treatments A, B, C and D did not experience significant

differences because the four treatments were carried out in the same place and environmental conditions (homogeneous). The water temperature in the maintenance medium ranges from 26-28°C. Referring to SNI, this temperature range is still within the normal threshold value recommended for Siamese catfish seeds. The pH value obtained during the research ranged from 6-7.9. This pH value is within the optimal range for maintaining Siamese catfish in accordance with SNI 01-6483.5-2002. Fujiana *et al.,* (2020) stated that catfish seeds have a long tolerance value for pH, namely 5-9 and an optimum at pH 7. The dissolved oxygen (DO) levels obtained during maintenance are around 4.3-7 mg/L. The optimum range of dissolved oxygen recommended based on SNI is >4 mg/L. Low dissolved oxygen content will cause reduced appetite which will later affect the growth rate of the fish. According to Islama *et al.,* (2022) for the growth of catfish, the appropriate oxygen level is around 3-7 mg/L. Therefore, the research results show that dissolved oxygen (DO) levels are in accordance with the recommended values and are within normal limits.

CONCLUSION

The conclusion of this research is that the addition of *Sargassum* sp. extract in feed has a very real influence on increasing the growth performance of Siamese catfish fry. Addition of *Sargassum* sp. extract a dose of 20 g/kg is the most optimal treatment as proven based on an increase in the percentage value of growth in absolute length (6.7 cm), absolute weight (114.33 g), daily growth rate (2.85%), reduction in FCR value to (1.05%), as well as hepatosomatic index (0.51%), feed utilization efficiency reached (95%), and fish survival rate (100%).

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