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THE EFFECT OF SUBSTITUTING SUCKERMOUTH CATFISH MEAL WITH LOCAL FISH MEAL ON THE GROWTH OF TILAPIA (*Oreochromis niloticus*)

Pengaruh Substitusi Tepung Ikan Sapu-sapu dan Tepung Ikan Lokal Terhadap Kualitas Nutrisi Pakan dan Pertumbuhan Ikan Nila (*Oreochromis niloticus*)

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ABSTRACT

Tilapia in Sidenreng Rappang Regency has the potential to be cultivated, because it is popular in the community. However, there is a problem in tilapia production, namely the high cost of feed. Raw materials for feed are one of the causes of the high price of feed, So an alternative is needed to use local raw materials that are cheap and easy to obtain, namely using broomstick fish meal. This study aims to determine the effect of increasing tilapia production through substitution of fish meal with Suckermouth catfish meal in artificial feed on nutritional quality, growth rate, feed consumption level, and hepatosomatic index. This study was conducted in January - February 2025. Located at the Unhas Education Pond, Bojo District, Barru Regency, South Sulawesi Province. This research used a completely randomized design (CRD) with 5 treatments and 3 replications, so that there were 15 research containers filled with 15 individuals per container weighing 3 grams. The treatments given were treatment A = 100% local flour and 0% suckermouth catfish meal, treatment B = 75% local fish meal and 25% suckermouth catfish fish meal, treatment C = 50% local flour and 50% suckermouth catfish meal, treatment D = 25% local fish meal, 75% suckermouth catfish meal, treatment E = 0% local fish meal, 100% suckermouth catfish meal. Data were analyzed using a comparison of the mean analysis of variance (ANOVA). Based on the results of the study, the treatment with the best value in the proximate analysis of feed, growth parameters and feed consumption was treatment E with a crude protein value of 32.81%, growth (3.810 ± 0.18a) and feed consumption value (13.23 ± 1.57a). In the Hepatosomatic Index parameter, the treatment with the highest value was treatment D with a value of (0.15 ± 0.00a).

Key words: feed substitution, suckermouth catfish

ABSTRAK

Ikan nila di Kabupaten Sidenreng Rappang berpotensi untuk dibudidayakan, karena digemari dimasyarakat. Namun terdapat masalah dalam produksi ikan nila, yaitu tingginya biaya pakan. Bahan baku pakan menjadi salah satu penyebab mahalnya harga pakan, sehingga dibutuhkan alternatif penggunaan bahan baku lokal yang murah dan mudah didapatkan, yaitu

menggunakan tepung ikan sapu-sapu. Penelitian ini bertujuan untuk mengetahui pengaruh peningkatan produksi ikan nila melalui substitusi tepung ikan dengan tepung ikan sapu-sapu dalam pakan buatan terhadap kualitas nutrisi, laju pertumbuhan, tingkat konsumsi pakan, dan *hepatosomatic indeks.* Penelitian ini dilaksanakan pada bulan Januari - Februari 2025. Bertempat di Tambak Pendidikan Unhas, Kecamatan Bojo, Kabupaten Barru, Provinsi Sulawesi Selatan. Penelitian ini menggunakan rancangan acak lengkap (RAL) dengan 5 Perlakuan dan 3 ulangan, sehingga terdapat 15 wadah penelitian yang diisi 15 ekor per wadah dengan berat 3 gram. Perlakuan yang diberikan adalah perlakuan A = 100% tepung lokal dan 0% tepung ikan sapu-sapu, perlakuan B = 75% tepung lokal dan 25% tepung ikan sapu-sapu, Perlakuan C = 50% tepung lokal dan 50% tepung ikan sapu-sapu, perlakuan D = 25% tepung ikan lokal, 75% tepung ikan sapu-sapu, perlakuan E = 0% tepung ikan lokal, 100% tepung ikan sapu-sapu. Data dianalisis menggunakan perbandingan rerata analisis ragam (ANOVA). Berdasarkan hasil penelitian menunjukkan perlakuan dengan nilai terbaik pada analisis proksimat pakan, parameter pertumbuhan dan konsumsi pakan adalah perlakuan E dengan nilai protein kasar 32,81%, pertumbuhan (3,810±0,18^{a}) dan nilai koonsumsi pakan (13,23 ± 1,57^{a}). Pada parameter Hepatosomatik Indeks perlakuan dengan nilai tertinggi adalah perlakuan D dengan nilai (0,15 ± 0,00^{a}).

Kata Kunci: ikan sapu-sapu, substitusi pakan

INTRODUCTION

Tilapia (*Oreochromis niloticus*) is a fish that has great potential to be cultivated in all types of waters because it has euryhaline properties so that it can adapt to a wide range of salinity (Tiyana *et al.,* 2023). Tilapia is also a fishery commodity that is very popular among the community because it has thick meat and a delicious taste when consumed, is rich in nutrients and has a high economic value on the market. This is what causes the high demand for tilapia and people choose to cultivate this fish (Putra *et al.,* 2017).

Based on data from the South Sulawesi Marine Affairs and Fisheries Department, South Sulawesi is one of the provinces that has experienced a significant increase in the field of tilapia fish farming production. Tilapia production in South Sulawesi in 2020 increased by 9,529.59 tons, compared to 2019 which was recorded at 8,594.11 tons, so there was an increase in production of 935.48 tons or 10.9%. Indonesia is known to have various types of fish, not all of which are utilized commercially. One example is the suckermouth catfish (*Pterygoplichthys pardalis*), which although its population is abundant, especially in the waters of West Java and South Sulawesi has not been utilized optimally. This fish is a non-cultivated species that lives in public waters, has the ability to survive in low oxygen conditions, often sticks to nets, rocks, and the bottom of the waters, and reproduces easily without intensive care. The janitor fish also competes with local species in its habitat (Tisasari *et al.,* 2016; Wu *et al.,* 2011; Wahyudewantoro, 2018).

The availability and abundance of suckermouth catfish indicate that this commodity has the potential as a raw material for fishmeal, which is one of the most expensive components in feed production. The animal feed and fish farming industries generally use fishmeal in their feed formulations, thus requiring a stable supply and affordable prices (Ardiansyah, 2022). The use of suckermouth catfish is also supported by its nutritional content, especially because of its fairly high protein content, making it an alternative source of animal protein that can support fish growth in cultivation. The nutritional value of suckermouth catfish includes protein of 36.23%; fat of 15.00%; carbohydrates of 5.42%; water of 13.00%; and ash content of 6.00%

(Hutasoit *et al.,* 2015). According to research that has been conducted (Sumaidi *et al.,* 2023), the results of testing the proximate content of suckermouth catfish (*Pterygoplichthys pardalis*) have a crude protein content (91.11%), crude fat (0.74%), crude fiber (0.39%), BETN (1.17%), ash (6.59%), water (16.87%).

The suckermouth catfish has complete nutritional content, including protein, fat, crude fiber, BETN, and water, so it is worthy of being recommended as a source of nutrition and raw material for fish and livestock feed. The protein content in janitor fish meal ranges from 47.85-55.57%, almost equivalent to fish meal in general (Ruslaini *et al.,* 2023). This shows that suckermouth catfish meal has the potential to be a source of animal protein that can be utilized in feed formulations. (Andriani & Pratama, 2023) explained that feed ingredients from animal and plant sources can be used for fish and shrimp, as long as the nutritional content (such as proximate, amino acids, and digestibility) and anti-nutritional factors have been identified. According to Yanuar (2017), the manufacture of high-quality fish feed that is rich in nutrients can absorb around 50-70% of the total production costs. Every year, aquaculture producers face the challenge of increasing feed costs without being offset by an increase in the selling price of farmed fish. Therefore, efforts are made to find alternative feed ingredients that are more affordable, highly nutritious, easily obtained, and have an abundant population, one of which is by utilizing suckermouth catfish processed into flour. This study aims to determine the effect of increasing tilapia production through substitution of fish meal with suckermouth catfish meal in artificial feed on nutritional quality, growth rate, feed consumption level, and hepatosomatic index.

RESEARCH METHODS

Time and Place

This research was conducted in January - February 2025. Located at Tambak Pendidikan Unhas, Bojo District, Barru Regency, South Sulawesi Province.

Tools and Materials

The tools and materials used in the study were plastic basins, sieves, aerators, measuring cups, digital scales, spoons, cameras, catfish flour, local fish flour, fresh water, soybean flour, fish oil, tilapia, wheat flour and shrimp head flour.

Research Procedure

Fish were kept using 25-liter containers. The research containers used were 15 units. Before the research began, the fish went through an acclimatization stage for about 30 minutes. After acclimatization, the weight of the fish was carefully weighed, then placed in containers that had been prepared according to the research plan. Maintenance lasted for 30 days with strict monitoring of environmental conditions and feeding. Feed was given twice a day, at 07.00 and 17.00 WITA, to maintain a regular fish diet. The amount of feed given was adjusted to the total weight of the fish, which was 6%.

Research Procedure

This research was an experimental study using a completely randomized design (CRD) with 5 treatments, 3 replications were carried out in each container, so that there were 15 containers filled with 15 test animals weighing 3 grams, the treatments given were as follows:

Treatment A = 100% fish meal and 0% suckermouth catfish meal;
Treatment B = 75% fish meal and 25% suckermouth catfish meal;
Treatment C = 50% fish meal and 50% suckermouth catfish meal;
Treatment D = 25% fish meal and 75% suckermouth catfish meal; And
Treatment E = 0% fish meal and 100% suckermouth catfish meal.

Test Parameters

The parameters observed in the study were proximate feed, growth, feed consumption rate and hepatosomatic index.

Proximate Feed

Proximate analysis is a long-standing feed material analysis test that can be used to estimate the nutritional value and energy value of feed materials or mixtures derived from the component parts of the feed material. The level of proximate feed test can be seen in the formula (Isharyudono *et al.,* 2018).

Growth Rate

The daily relative growth rate of tilapia seeds observed in the study was calculated using the formula (Mulqan *et al.,* 2017), namely:

$$SGR = \frac{(LnWt - LnW0)}{t} \; X \; 100\%$$

Description:
SGR : Daily weight growth rate (%/day);
W0 : Average fish weight at the beginning of maintenance (g);
Wt : Average fish weight at the end of maintenance (g); and
t : Maintenance time (days).

Feed Consumption Level

Calculated using the formula (Pereira et al., 2007) as follows:

$$TKP = F1 - F2$$

Description:
TKP : Feed consumption level;
F1 : Initial amount of feed given (g); and
F2 : Amount of remaining feed (g).

Hepatosomatic Index

Hepatosomatic index is obtained by weighing the total weight of the fish sample and then carefully dissecting it so that the liver is not damaged. The liver is weighed using a 0.01 g digital scale. Then the HSI is calculated using the Nikolsky formula (1969):

$$HSI = \frac{Wh}{W} \; X \; 100\%$$

Description:
HSI : Hepatosomatic Index (%);
Wh : Liver weight (g); and
W : Fish body weight (g).

Data Analysis

Data on growth rate, feed consumption level and hepatosomatic index were analyzed using analysis of variance or Analysis of Variance (ANOVA) test. If the results showed a significant effect, it was continued with the W-Tukey test.

RESULT

Proximate Analysis of Feed

Proximate analysis of feed is a chemical test to determine the nutrient content of a feed or feed material, proximate analysis is divided into six nutrient praxis, namely water content, ash, crude protein, crude fat, crude fiber and non-nitrogen extract (BETN) (Saroh *et al.,* 2019). The results of the proximate analysis of feed can be seen in table 1.

Table 1. Results of proximate analysis of feed

Treatment	Chemical Composition					
	Water	Crude protein	Crude fat	Crude fiber	BETN	Ash
A	27,29	30,51	21,85	7,9	10,8	28,94
B	29,87	30,96	21,46	8,92	10,48	28,18
C	27,64	31,06	22,24	7,23	12,97	26,5
D	28,08	32,6	23,91	6,47	12,51	24,51
E	28	32,81	23,65	6,51	12,73	24,3

Absolute Growth

The absolute growth of tilapia after being fed with fish meal and Suckermouth catfish meal substitutes with different treatments (100% fish meal and 0% Suckermouth catfish meal, 75% fish meal and 25% Suckermouth catfish meal, 50% fish meal and 50% Suckermouth catfish meal, 25% fish meal and 75% Suckermouth catfish meal and 0% fish meal and 100% Suckermouth catfish meal) is shown in table 2.

Table 2. Average absolute weight of tilapia during the study

Treatment	Parameter ± Std
	Growth (%/day)
A	$3,383 \pm 0,05^{ab}$
B	$3,143 \pm 0,19^{b}$
C	$3,256 \pm 0,20^{b}$
D	$3,580 \pm 0,14^{ab}$
E	$3,810 \pm 0,18^{a}$

Note: Different superscript letters in the same column indicate significant differences between treatments at the 95% confidence level ($P<0.05$).

Feed Consumption

Feed consumption of tilapia with the provision of fish meal and suckermouth catfish meal substitute feed with different treatments (100% fish meal and 0% suckermouth catfish meal, 75% fish meal and 25% suckermouth catfish meal, 50% fish meal and 50% suckermouth catfish meal, 25% fish meal and 75% suckermouth catfish meal and 0% fish meal and 100% suckermouth catfish meal) is shown in table 3.

Table 3. Average feed consumption of tilapia during the study

Treatment	Parameter ± Std
	Feed Consumption
A	6,40 ± 1,13[b]
B	5,30 ± 1,48[b]
C	5,54 ± 2,68[b]
D	12,44 ± 2,94[a]
E	13,23 ± 1,57[a]

Note: Different superscript letters in the same column indicate significant differences between treatments at the 95% confidence level (P<0.05).

Hepatosomatic Index

Hepatosomatic index of tilapia fish with substitution feed of fish meal and suckermouth catfish meal with different treatments (100% fish meal and 0% suckermouth catfish meal, 75% fish meal and 25% suckermouth catfish meal, 50% fish meal and 50% suckermouth catfish meal, 25% fish meal and 75% suckermouth catfish meal and 0% fish meal and 100% suckermouth catfish meal) is shown in table 4.

Table 4. Average hepatosomatic index of tilapia fish during the study

Treatment	Parameter ± Std
	Feed Consumption
A	0,11 ± 0,01[bc]
B	0,13 ± 0,00[ab]
C	0,10 ± 0,01[c]
D	0,15 ± 0,00[a]
E	0,09 ± 0,10[c]

Note: Different superscript letters in the same column indicate significant differences between treatments at the 95% confidence level (P<0.05).

DISCUSSION

Proximate Analysis of Feed

Water content

Based on the analysis of water content that has been carried out, the lowest storage capacity is treatment A, which is 27.29%, while the highest percentage of formulation is treatment B, which is 29.87%. However, the value of the analysis results obtained is a high value, this can affect the quality of the feed. Water content is the high or low water content in the feed. The drier the feed, the better the quality of the feed because the feed will not easily become moldy if the water content is high, the feed will easily become moldy. The maximum limit of water content is 12%. The higher the dry matter content produced during ensilage, the higher the loss of water content (Setiyawan & Thiasari, 2017).

Water content analysis aims to determine the storage capacity of a feed. According to the results of Ismed's research (2016), low water content is effective in making products have a longer shelf life. This happens because low water content can inhibit the performance of microbes that can damage feed.

Protein

Based on the results of the proximate feed carried out, it was found that treatment E contained 32.81% crude protein, this result was higher compared to other treatments, followed by treatment D at 32.6%, treatment C at 31.06%, treatment B 30.96% and treatment A 30.51%. This value is good compared to the proximate analysis of catfish according to Irfak *et al.*

(2013), the crude protein contained in catfish is 18.14%. Based on the results obtained, the protein content value in the feed is good for the growth of tilapia, this is explained by (Wulanningrum *et al.,* 2019).

The feed needed for the growth of tilapia contains 25-35% protein. Fish that have a high protein content in feed are very beneficial for the health and growth of fish, and function as tissue building substances in the body and as a source of energy (Silvia, 2022)

Crude Fat

Based on the proximate results of the feed carried out, treatment A contained 21.85% crude fat, treatment B 21.46%, treatment C 22.24%, treatment D 23.91% and treatment E 23.63%. This value is classified as high-fat fish >5%, in general the fat content in the body of the fish ranges from 1-20% (Hasnidae et al., 2021). Based on the test data, the fat content in suckermouth catfish is higher. According to (BSN, 2013). The maximum use of fat in feed raw materials is no more than 12%.

Fat acts as a source of energy, a solvent for vitamins and as an essential fatty acid (Evi *et al.,* 2020). In addition, fat has an important role in feed besides being a source of energy, namely as a source of essential fat for the growth and defense processes of the body and also helps the absorption of certain minerals (Mikdarullah *et al.,* 2020).

Crude Fiber

Based on the results of proximate analysis of the feed tested, it is known that treatment A contains 7.9% crude fiber, treatment B 8.92%, treatment C 7.23%, treatment D 6.47%, and treatment E 6.51%. These values are still within the appropriate range to be used as raw materials for fish feed, because the crude fiber content still meets the nutritional needs of fish, especially in cultivation. The crude fiber content of the broomstick fish is 0.39 percent. Fiber is a food component that is difficult to digest and absorb by the digestive system, has low nutritional value, and cannot be replaced by other substances (Hasnidar, 2021). Relaxes the peristalsis of the digestive tract and the microbial media in the appendix that produces vitamins K and B12 (Hasrianti *et al.,* 2022). However, crude fiber is still needed in limited amounts to help the feces excretion process. If the crude fiber content exceeds 10%, it can reduce digestibility, reduce nutrient absorption, increase metabolic waste, and reduce water quality. In tilapia, the optimal crude fiber content to support growth ranges from 4–8%. Thus, the results of the crude fiber content analysis in the test feed ranging from 6.51% to 8.92% can still be considered in accordance with the range of fish needs, especially in fish types such as tilapia.

BETN

Based on the results of the proximate feed conducted, treatment A contained BETN of 10.8%, treatment B 10.48%, treatment C 12.97%, treatment D 12.51% and treatment E 12.73%.

The results above are the same as the proximate feed results obtained by Deslianti et al., 2016, namely with a BETN value of 10.79%.

Ash

Based on the results of proximate analysis of feed, it is known that the ash content in treatment A was 28.94%, treatment B was 28.18%, treatment C was 26.5%, treatment D was 24.51%, and treatment E was 24.3%. These values are relatively high when compared to the SNI 01-2354-2006 quality standard for fresh fish, which is an ash content of less than 2%. Ash is an inorganic substance left over from the combustion of organic materials, which reflects the total amount of minerals in a food ingredient. Total ash content is also an important parameter in determining the nutritional value of an ingredient (Evi *et al.,* 2020). According to Mustika (2022), the high ash content obtained can be caused by the drying process at high temperatures, which causes more water to evaporate from the material, so that the relative ash content becomes higher.

Absolute Growth

The results of the analysis of variance showed that the provision of fish meal and suckermouth catfish meal substitute feed had a significant effect on the growth of tilapia (P<0.05). The W-Tukey test showed that the fish meal and suckermouth catfish meal substitute feed in treatment E was different from treatments B and C but the same as treatments A and D.

The results showed that tilapia had the highest growth value, namely in treatment E with a substitution of 0% fish meal and 100% suckermouth catfish meal with a value of 3.810±0.18%, then treatment D with a value of 3.580±0.14%, treatment A with a value of 3.383±0.05, treatment C with a value of 3.256±0.20 and the lowest growth was in treatment B with a value of 3.143±0.19.

In treatment E which used 0% fish meal and 100% suckermouth catfish meal, the highest growth results were obtained compared to other treatments. This is due to the use of suckermouth catfish flour which has a high protein and fat content so that it can be utilized by fish. According to Asnidar et al., 2022, it explains that feeding with the use of suckermouth catfish flour as a source of protein in feed and the use of commercial feed in shrimp toadstool maintenance shows that its use of 35% tends to be better than the use of 25%; 30% and commercial feed treatment (control).

The same thing was also explained by Salgado *et al*. (2022), combining the use of sardine fish meal (IT) and suckermouth catfish meal (IS), namely IT:IS as follows: 50:50%; 60:40%; 70:30%; 80:20%; 90:10% and 100%:0 showed that there was no significant difference in growth, protein and fat digestibility. Suckermouth catfish meal can replace sardine fish meal up to 100% in tilapia feed.

In treatment B, the lowest growth results were obtained compared to other treatments, where treatment B used 75% fish meal and 25% suckermouth catfish meal, this is thought to be related to the quality of fish meal, age and adaptation of fish to feed (Andriani, 2023).

Feeding suckermouth catfish flour substitute with local fish flour in tilapia obtained significantly different results on tilapia growth. The balance of feed nutrition in the treatment caused the fish to respond well, the high content of both proteins in the feed. Feeding fish is a way for fish to obtain nutrients, one of which is protein. High protein content can accelerate the growth of tilapia. The protein requirement of tilapia for optimal growth ranges from 28-35 (Zulkhasyni *et al*., 2017).

In addition to protein, fish also require various additional nutrients in feed to grow optimally. According to Hasnidar *et al*. (2021), suckermouth catfish has a wet protein content of 15.20%; fat 6.27%; crude fiber 2.14%; ash 4.74% and water content 67.19%. After becoming flour, the protein content becomes 38.95%. Complete nutritional content can meet the needs of fish in feed, this greatly affects fish growth.

Feed Consumption Level

The results of the analysis of variance showed that the provision of fish meal and suckermouth catfish meal substitute feed had a significant effect on tilapia feed consumption (P<0.05). The W-Tukey test showed that the fish meal and suckermouth catfish meal substitute feed in treatments D and E were the same but different from treatments A, B and C.

The results showed that the feed consumption value of tilapia (*Oreocromis niloticus*) which was maintained for 30 days by providing fish meal and suckermouth catfish meal substitute feed with different treatments. The highest to lowest feed consumption level values obtained were treatment E with a value of 13.23±1.57, then treatment D with a value of 12.44±2.94, treatment A with a value of 6.40±1.13, treatment C with a value of 5.54±2.68 and treatment B with a value of 5.30±1.48.

The provision of substitute feed for fish meal and suckermouth catfish meal which have different treatments can cause different consumption levels. The difference in feed

consumption values by fish between treatments is caused by the high and low protein and energy requirements absorbed by fish in each treatment (Kirana *et al.,* 2022).

In treatment E, where the level of feed consumption of test animals is the highest level of consumption compared to other treatments, this can be influenced by several factors, one of which is the protein content in balanced feed so that it can affect the level of feed consumption in fish. Other factors that can affect the level of feed consumption in fish are the smell, taste, size and color of the feed (Handayani *et al.,* 2019)

In treatment B, the level of feed consumption of test animals has the lowest value caused by several factors including the accumulation of leftover feed that is not utilized by fish due to excessive feeding causing a decrease in water quality so that it can reduce feed utilization by fish. In addition, this difference is also caused by differences in size and growth rate in fish. According to Rahmatia *et al.* (2016), the total amount of feed consumption of large fish is twice the feed consumed by small and medium fish. This is because the larger the body size, the energy needs will increase, so that the feed needs will also increase. With the support of the digestive organs, the feed capacity will be greater and higher.

Hepatosomatic Index

The results of the analysis of variance showed that the provision of fish meal and suckermouth catfish meal substitute feed had a significant effect on the hepatosomatic Index of tilapia ($P < 0.05$). The W-Tukey test showed that the fish meal and suckermouth catfish meal substitute feed were significantly different for each treatment.

The results showed that the hepatosomatic Index of tilapia (*Oreocromis niloticus*) which was maintained for 30 days with the provision of fish meal and suckermouth catfish meal substitute feed with different treatments. The highest to lowest Hepatosomatic Index values obtained were in treatment D with a value of 0.15 ± 0.00 then treatment B with a value of 0.1 ± 0.00, treatment A with a value of 0.11 ± 0.01, treatment C with a value of 0.10 ± 0.01 and treatment E with a value of 0.09 ± 0.10.

The highest value was found in treatment D with a value of 0.15 ± 0.00, this was influenced by the accumulation of fat in the liver by the test animals. Azizi et al. (2022), explained that fish liver plays an important role in metabolism and energy storage, including fat. If tilapia fish get feed with high fat content or experience stress, fat accumulation in the liver will increase, so that HSI also increases. The HSI value increases along with the vitellogenesis process which stimulates the liver to work more than its normal state. Hepatosomatic Index (HSI) is the ratio between liver weight and fish body weight, which is used as an indicator of energy reserves in the liver. According to Yusran, et al., explained that another factor that causes the HSI value is the occurrence of the highest vitellogenesis activity compared to other treatments (Yusran *et al.,* 2018).

In treatment E with a value of 0.09 ± 0.10, it is the lowest hepatosomatic Index value, this is thought to be due to nutritional imbalance or poor feed quality so that it can inhibit growth and cause a decrease in HSI. According to Solhi *et al.* (2021), explained that increasing metabolic rate will increase energy and cell nutrition, thus triggering increased liver cell proliferation. Another factor that causes low HSI values is that fish consume fat reserves to reproduce. Changing HSI values can indicate liver enlargement due to increased metabolic needs or stress, which is often associated with plant-based diets that require the liver to metabolize higher levels of carbohydrates.

CONCLUSION

From the results of the study, it can be concluded that suckermouth catfish flour can be one of the local raw materials that can be used as a source of protein in fish feed. Of all the treatments, Treatment E with 0% fish flour and 100% suckermouth catfish flour had the best results which contained a high protein value of 32.81% so that it became one of the supporters of high growth rates and feed consumption levels in tilapia. This combination percentage is superior in increasing growth and feed consumption levels in tilapia.

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