TIK-44 Performance Growth Climbing Perch Study (Anabas testudineus) Fed Fermentation-Based Feed Kakalai Leaf (Stenochlaena palustris)

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Submission date: 18-Jun-2024 05:57AM (UTC+0700)
Submission ID: 2404219389
File name: TIK-44.pdf (525.8K)
Word count: 6830
Character count: 33557

EUROPEAN JOURNAL OF BIOMEDICAL AND PHARMACEUTICAL SCIENCES
http://www.ejbps.com

ISSN 2349-8870
Volume: 10
Issue: 1
41-50
Year: 2023

PERFORMANCE GROWTH CLIMBING PERCH STUDY *(Anabas testudineus)* FED FERMENTATION-BASED FEED KALAKAI LEAF *(Stenochlaena palustris)*

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Article Received on 04/11/2022 **Article Revised on 25/11/2022** **Article Accepted on 15/12/2022**

ABSTRACT
This study aims to analyze the nutritional value of kalakai leaf fermentation-based feed that is feasible as Climbing Perch feed and analyze the growth performance of Climbing Perch raised by fermentation-based feeding of kalakai leaves. The specific target of this study is to increase the usability and usefulness of kalakai, a typical wetland plant as a feed for wetland-specific fish that can support growth and improve the health status of the fish being kept. The study was carried out using an experimental method on the maintenance of Climbing Perch which was fed based on fermented leaves with 5 treatments and 3 tests. The parameters observed are protein content, crude fiber, water, ash, and crude fat of fermented leaves based on kalakai leaves, weight, and length growth of Climbing Perch, survival, and feed conversion ratio. The results of the research on the nutritional content of feed showed that fermented feed on kalakai leaves has a protein content of 27%-31%, crude fiber content of 4%-7%, water content of 12%-14%, ash content of 11%-13% and crude fat of 4%-6%. It was concluded that there was a decrease in fiber levels and an increase in protein levels. It happens gradually in line with the increase in probiotic dose. The results of the study on the growth performance of Climbing Perch are: absolute weight growth ranges from 1.01-1.52 with the highest data in treatment C which is 1.47 and the lowest in treatment A which is 1.06, the growth of relative weight of Climbing Perch ranges from 28.61%-64.705% with the highest data treatment C which is 64.05% and the lowest treatment A is 28.61%, absolute length growth ranges from 1.41-2.37 with the highest data on treatment C which is 2.15 and the lowest in treatment A was 1.48, the relative length growth ranged from 31.60%-45.81% with the highest data on treatment C which was 45.81% and the lowest treatment A was 31.60%, survival ranged from 98.33-100% and the feed conversion ratio ranged from 3.87-14.83 with the lowest data on treatment C which was 5.56 and the highest obtained in treatment E was 12.20. The results of the nutritional content of feed based on the fermentation of kalakai leaves show that the value of crude fiber and protein is in the recommended range. The growth of Climbing Perch shows excellent development with high survival.

KEYWORDS: Kalakai, artificial feed, growth.

INTRODUCTION
Climbing Perch is a type of fish that is easy to adapt, breed, and receive the artificial feed, disease resistance, and tolerance to environmental changes (Slamat, Thohari, and Sulistyowati, 2011). A problem that often becomes an obstacle is that the provision of feed requires costs reaching 60–70% of the components of production costs (Emma, 2006). An alternative can be done by making self-made feed by utilizing sources of raw materials that are easy to obtain, sufficient in quantity, relatively cheap, and nutritionally qualified (Akbar, 2012).

The results of research by Fatmawati and Fauzana (2016), stated that the shoots of kalakai young leaves contain higher protein (27.13%) than old kalakai leaves (26.79%). According to Wijaya et al., (2017) in Petricka, Makiyah, and Mawarti (2018), kalakai contains high Fe (41.55 ppm), CU (4.52 ppm), vitamin C (15.41 mg / 100g), beta carotene (66.99 ppm), and folic acid 11.30 ppm). The use of kalakai flour has been carried out for Climbing Perch feed (Fatmawati and Fauzana, 2016), where the composition of kalakai flour up to 30% can replace soybean flour in feed formulations.

The obstacle to the use of kalakai for fish feed is the high crude fiber content of 10.45% for young leaves and

15.62% for old leaves (Fatmawati and Fauzana, 2016), while the need for fish for crude fiber is no more than 8% (Mujiman, 2000). This improvement in nutritional value can be improved through the silage of Fauzana et al, 2021) or the fermentation of feed ingredients or feed using microbes (addition of probiotics) (Arief, Fitriani, and Surbekti, 2014). The results of Fauzana and Slamat's research (2021) the nutritional content of fresh kalakai leaves and silage of kalakai leaves with a storage period of 1-6 days contain nutrients that are very suitable for use as a feed with a moisture content of 9.49-11.55%, ash content of 0.72–0.76%, crude fiber content of 2.01-2.23%, fat content of 0.22-0.26% and protein of 26.41-31.44%.

Based on several studies on the use of feed for Climbing Perch farming, studies on the use of kalakai leaves that go through a fermentation process in feed formulations to determine their effect on the growth performance of Climbing Perch have not obtained adequate information. Kalakai will be included in the inventory of wetland-specific plants that have the potential to be developed as a source of fish feed ingredients. The objectives of this study are as follows:

1. Analyze the nutritional value of fermented feed based on kalakai leaves that are feasible as Climbing Perch feed.
2. Analyze the growth performance of Climbing Perch raised by fermentation-based feeding of kalakai leaves.

RESEARCH METHODS

Research Time

The research was conducted on March 8 – May 14, 2022, at the Faculty of Fisheries and Marine Affairs, Banjarbaru, South Kalimantan Province. The manufacture of test feed was carried out at the Nutrition and Animal Feed Laboratory, proximate analysis testing at the Venterinir Banjarbaru Hall, and the maintenance of test fish were carried out in the Wet Laboratory.

Research Tools and Materials

Tools used: aluminum baking sheet, small basin, oven, storage machine, knife, pot, pellet mold, measuring cup, Erlenmeyer, large basin, hapa, rubber rope, bottle, digital scale, digital ruler, blower, hose and stone aerator, faucet aerator, scoop net, sponge, hose, DO meter, pH meter, spectrophotometer, jar, cool box, plastic baking sheet, glass, rag, syr, inge and EDTA microtube. Ingredients used: Climbing Perch, kalakai, fish meal, bran flour, tapioca flour, vitamin and mineral mix, fish oil, EM4 probiotics, molasses, aquades, plastic bags, plastic clips, EDTA 10%, alcohol 70%, ice cubes, tissues, label paper, and tissues.

Research Procedure

1. Preparation of kalakai flour

Young leaves are separated between the leaves and the stem and then dried. The dried kalakai leaves are then mashed and filtered to produce fine kalakai flour.

2. Fermentation of kalakai flour

The flour is weighed and mixed with water until moist and steamed for 15 minutes. EM4 probiotics are activated first by adding 3% molasses (Widayati and Widalestari, 1996) which has been diluted with aquades, then added to kalakai leaf flour according to the treatment dose (Setyono et al., 2004). The homogeneous flour is then tightly closed and allowed to stand for 3 - 7 days at room temperature.

3. Making fermentation-based feed flour

The ingredients of the feed maker are mixed with the composition following Fatmawati and Fauzana (2016). All feed ingredients that have been mixed ever are only then melded into pellets and dried.

4. Preparation of maintenance containers

The maintenance container is first disinfected by soaking using water mixed with disinfectant liquid. Water quality conditions are maintained by replacing water with a 25% calling technique once a day (Akbar, 2018).

5. Preparation of test fish

Climbing Perch that are densely kept stocking fish in each basin amount to 20 heads with a water level of 25 cm. The test fish were kept in a basin for 60 days (Mujiman, 2000).

6. Fish sampling

Fish sampling was carried out at the beginning (H + 1) and every 2 weeks, namely at H + 14, H + 28 and H + 45, and H + 60 which were used for observation of parameters of relative weight growth, relative length growth, survival, and feed conversion ratio.

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The experimental design in this study used a Complete Randomized Design with 5 treatments and 3 tests, namely:

Treatment A : Kalakai flour + 0% probiotics
Treatment B : Kalakai flour + 5% probiotics
Treatment C : Kalakai flour + 10% probiotics
Treatment D : Kalakai flour + 15% probiotics
Treatment E : Kalakai flour + 20% probiotics

Observation Parameters

1. Absolute Weight Growth

Absolute weight growth is defined as the weight gain from the beginning and end of the research formulated by Effendie (1997), namely:

$$W = W_t - W_0$$

Explanation:
W : Absolute weight gain of fish (g)
Wt : Fish weight at the end of the study (g)
W0 : Fish weight at the end of the study (g)

2. Relative Weight Growth

Relative weight growth formulated by Effendie (2002), namely:

$$H = \frac{W_t - W_0}{W_0} \times 100\%$$

Explanation:
H : Relative weight (%/day)
Wt : Fish weight at the end of the study (g)
W0 : Fish weight at the beginning of the study (g)

3. Absolute Long Growth
Absolute weight growth is defined as the length gain from the beginning and end of the research formulated by Effendie (1997), namely:

$$L = L_t - L_0$$

Explanation:
L : Absolute length gain of fish (cm)
Lt : Fish length at the end of the study (cm)
L0 : Fish length at the beginning of the study (cm)

4. Relative Length Growth
Relative length growth formulated by Effendie (2002), namely:

$$P = \frac{L_t - L_0}{L_0} \times 100\%$$

Explanation:
L : Absolute length gain of fish (cm)
Lt : Fish length at the end of the study (cm)
L0 : Fish length at the beginning of the study (cm)

5. Relative Length Growth
Relative length growth formulated by Effendie (2002), namely:

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

Explanation:
SR : Survival Rate (%/)
Nt : Number of fish at the end of the study (tails)
N0 : Number of fish at the beginning of the study (tail)

6. Feed Conversion Ratio
The feed conversion ratio formulated by Parker (2012), namely:

$$FCR = \frac{F}{(D + W_t) - W_0}$$

Explanation:
F :The amount of feed given (g)
Wt :Fish weight at the end of the study (g)
W0 :Weight of fish at the beginning of the study (g)
D :Weight of dead fish (g)

7. Water Quality
Water quality measurements are carried out at the beginning (H + 1) and every 2 weeks, namely on H + 14, H + 28 H + 45, and H + 60. Temperature, degree of acidity (pH), dissolved oxygen (DO), and ammonia are the observed parameters of water quality.

Data Analysis
The data obtained are analyzed by normality test and homogeneity test. Test data that has been in the assumptions accordance with the assumptions is then carried out by a one-way ANOVA. Test results that show real/significant differences, followed by Middle-Value Difference testing.

RESULTS AND DISCUSSION

1. Nutritional Content of Feed

Table 3.1: Nutritional Content of Feed Based on Fermented Kalakai Leaves.

Treatment	Crude Protein (%)	Crude Fiber (%)	Water (%)	Ash (%)	Crude Fat (%)
A	27,83	7,96	12,84	11,74	5,11
B	28,29	7,96	12,65	11,75	4,32
C	28,54	4,88	13,28	12,12	4,98
D	30,44	5,28	13,29	12,31	4,96
E	30,90	5,42	13,22	12,26	4,74

(Source: Nutrition and Animal Feed Laboratory, 2022)

The results of the nutritional content of the feed (Table 3.1) show that there is an increase in water and ash protein and a decrease in crude fiber and crude fat. The largest increase occurred in the protein content of the E treatment at 3.07% compared to the treatment. The increase in protein levels of the E treatment is to the research of Lumbanbatu, Mulyadi, and Pamukas (2018), namely there is an increase in protein levels in each gradual treatment from 2-5% with the addition of EM4 probiotics to the feed. This is by Rachmawati, Pinandoyo, and Purwanti (2006) said that the addition of EM4 in artificial feed can increase the protein content of the feed.

The protein content in treatment A, treatment B, and treatment C is still within the protein range needed by Climbing Perch according to Kordi (2013), which is protein between 24-28%. The protein content in treatment D and treatment E according to the protein needs of fish in general ranges from 20-60%. Research on pellet feeding with different protein content (28%, 30%, and 32%) found that Climbing Perch had a length growth of 1.90 cm and a weight growth of 1.02 grams with the best results in feeding 32% protein pellets (Akbar, 2018).

The result the decrease occurred in the protein content of treatment C by 3.08% compared to treatment A and treatment B. Decrease in crude fiber occurred by the research of Lumbanbatu, Mulyadi, and Pamukas (2018) there was a decrease in crude fiber levels in each treatment gradually from 2-4% with the addition of EM4 probiotic 5-20 ml/kg in feed. The higher the dose of probiotics used, the lower the crude fiber content contained in the feed.

The crude fiber content in the study was still around the crude fiber content needed by Climbing Perch. The crude fiber content in fish feed should be below 8% (Mudjiman, 2000). The results of the crude fiber analysis of the test fish range from 2-8% which means that the test feed has a crude fiber content that suits the needs of the fish. According to Murtidjo (2011), a good percentage of coarse fiber in the content of feed for freshwater fish in the frying period is 5%, while for the enlargement period it is 6%.

The results of the feed moisture content analysis have changed in each treatment. The water content of feed in this study ranged from 12.65-13.29%, which is still higher than SNI (2006) where the quality requirements for water content that must be met are a maximum of 12%. High water content in the sample can also result in damage to the sample such as decay by microbes and chemical reactions such as fat oxidation which is influenced by the amount of water in the sample (Kemendikbud RI, 2013).

The results of the analysis of feed ash content increased in each treatment with the highest results in the E treatment with an ash content of 12.26% compared to other treatments. The ash content in the feed represents the mineral content of the feed, the corresponding content is 3-7 % (Winarno, 1997). The ash content in the test feed ranges from 11-13%. This shows a very high ash content, not by the needs of fish because it has an excess mineral content.

The results of the analysis of feed fat content decreased in each treatment. Good feed generally contains 4-18% fat, while according to Suyanto (1994), the optimal fat content in supporting fish growth is 2.57%. The fat content in this study ranged from 4-6% which is still within the optimal range of fish feed based on literature and does not exceed SNI (2006) where the quality requirements for fat content that must be met are a maximum of 12%.

The results obtained in the research on the fermentation of kalakai leaves using EM4 probiotics can be seen that giving 10% probiotics can reduce crude fiber content and increase protein content in kalakai leaves. Giving 6-8% probiotics containing cellulolytic bacteria Bacillus cereus and proteolytic Trichoderma sp and Penicillium on lamtoro leaves fermented for 7 days can reduce crude fiber content and increase protein content (Putri, Agustono, and Subekti, 2012). The application of EM4 probiotics to PF-800 commercial pellet feed for a 24-hour fermentation period at a dose of 20 ml/kg of feed experienced an increase in the protein of 5.77% and a decrease in the crude fiber of 3.16% compared to unfermented feed.

The high increase in crude protein in the E treatment is due to the large number of levels of inoculum given. The difference between each EM4 level means that there are differences in the number of microorganisms that work to remodel waste, the more microorganisms that play a role in the overhaul process, the more substrate decomposes because of which bacteria contribute a high protein compared to other treatments. The low decrease in treatments A and B compared to other treatments is because the level of EM4 use given is still small, that is so microbial activity in degrading cellulose is not optimal. This indicates that the higher the use of inoculum levels is expected to lower crude fiber, as more and more microbes can overhaul or degrade fermented materials. This is the opinion of Ratnakomala et al. (2007) in Sijabat (2016) which states that the addition of inoculum will further accelerate the fermentation process and the more the substrate is degraded.

2. Climbing Perch Growth

Table 3.1. Average Absolute Weight Growth of Climbing Perch (grams).

Repetition	Treatment				
	A	B	C	D	E
1	1,01	1,18	1,52	1,15	1,08
2	1,09	1,30	1,35	1,07	1,03
3	1,08	1,18	1,54	1,17	1,13
Total	3,18	3,66	4,41	3,40	3,24
Average	1,06 ±0,04[a]	1,22 ±0,06[a]	1,47 ±0,10[b]	1,13 ±0,05[a]	1,08 ±0,05[a]

Note: the same letter indicates no real difference

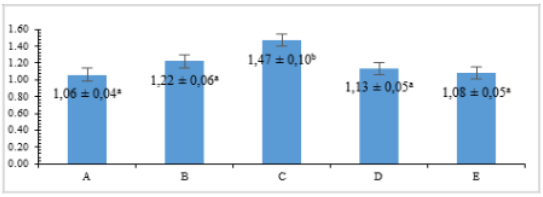

Figure 2.1: Average Graph of Absolute Weight Growth of Climbing Perch.

Table 2.3. Average relative weight growth of Climbing Perch (%).

Repetition	Treatment				
	A	B	C	D	E
1	41,01	47,46	67,84	44,59	37,20
2	38,59	51,40	56,59	33,17	26,56
3	43,75	47,78	67,72	39,42	22,06
Total	123,35	146,63	192,15	117,19	85,82
Average	41,12 ±0,03[a]	48,88 ±0,02[a]	64,05 ±0,06[b]	39,06 ±0,06[a]	28,61 ±0,08[a]

Note: the same letter indicates no real difference

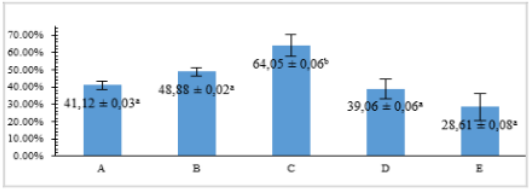

Figure 3.2: Graph of Average Relative Weight Growth of Climbing Perch.

Table 3.4: Average Growth of Absolute Length of Climbing Perch (cm).

Repetition	Treatment				
	A	B	C	D	E
1	1,47	1,46	2,37	1,41	1,41
2	1,55	1,53	2,07	1,98	1,41
3	1,41	1,64	2,01	1,87	1,71
Total	4,43	4,63	6,45	5,26	4,53
Average	1,48 ± 0,07[a]	1,54 ± 0,09[a]	2,15 ± 0,19[b]	1,75 ± 0,30[a]	1,51 ± 0,17[a]

Note: the same letter indicates no real difference

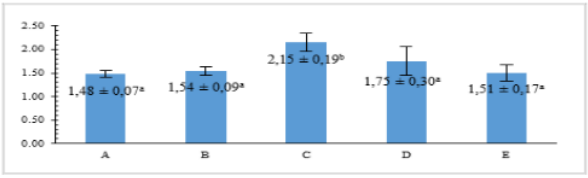

Figure 3.3: Average Graph of Absolute Length Growth of Climbing Perch.

Table 3.5: Average growth of the relative length of Climbing Perch (%).

Repetition	Treatment				
	A	B	C	D	E
1	28,61	38,28	44,94	36,26	33,81
2	31,36	36,87	46,97	35,63	31,65
3	34,82	37,46	45,51	38,87	31,27
Total	94,80	112,62	137,42	110,76	96,73
Average	31,60 ±0,03[a]	37,54 ±0,01[b]	45,81 ±0,06[c]	36,92 ±0,01[b]	32,24 ±0,01[a]

Note: the same letter indicates no real difference

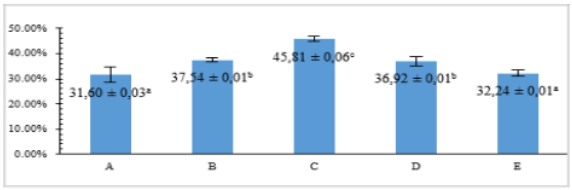

Figure 3.4: Graph of the Average Growth of the Relative Length of Climbing Perch.

The results of the ANOVA test on absolute weight growth resulted in F counting > F table 5% and 1%, meaning that fermentation-based feeding of leaves has a very noticeable effect on the growth of the absolute weight of Climbing Perch (Table 3.2). The result of the Coefficient of Diversity (1.13), then for the Middle-Value Difference test is carried out with the Honest Difference Test. The results of the BNJ test are known that treatment A, treatment B, treatment D, and treatment E are very different from treatment C.

The highest average absolute weight growth of Climbing Perch (Figure 3.1) was found in treatment C at 1.47 grams and the lowest was found in treatment A at 1.06 grams. The absolute weight growth results in this study were lower than those of Syulfia, Putra, and Rusliadi (2015), resulting in an absolute weight of 2.27 grams at the treatment of 25 Climbing Perch raised for 45 days at an initial stocking of 3-5 cm.

The results of the ANOVA test on relative weight growth resulted in F calculating > F table 5% and 1% then these results showed that fermented foliar feeding had a very noticeable effect on the growth of the relative weight of Climbing Perch (Table 3.3). The results of the Coefficient of Diversity (2.44), then for the Middle-Value Difference test are carried out with the Honest Difference Test. The results of the BNJ test found that treatment A was very significantly different from treatment C, treatment B was significantly different from C and differed very markedly from treatment E, and treatment C was very significantly different from treatment D and treatment E.

The highest average relative weight growth of Climbing Perch (Figure 3.2) was found in treatment C at 64.05% and the lowest was found in treatment E at 28.61%. The relative weight growth results in this study were higher than Torang's research (2013), namely the maintenance of Climbing Perch measuring 4-7 cm at a stocking density of 25 heads/aquarium with pellet feeding 3% / mass weight and additional feed in the form of maggots produced the highest growth of 35.6% and the lowest in the control treatment (pellet feed without maggot supplementary feed) which was 18.7%.

The results of the ANOVA test on absolute length growth resulted in F counting > F table 5% and 1% then these results showed that fermentation-based feeding of leaves had a very noticeable effect on the growth of the absolute length of Climbing Perch (Table 3.4). The results of the Coefficient of Diversity (2.20), then for the Middle-Value Difference test, it is carried out with the Honest Difference Test. The results of the BNJ test are known that treatment A is very different from treatment C, and treatment B and treatment E are significantly different from treatment C.

The highest average growth in the absolute length of Climbing Perch (Figure 3.3) was found in treatment C at 2.15 cm and the lowest was found in treatment E which was 1.51 cm. The absolute length growth of Climbing Perch in the study was higher than Wibowo and Helmizuryani (2015) Climbing Perch maintenance with a stocking density of 40 heads / waring for 3 months, long growth of 0,97 cm.

The results of the ANOVA test on relative length growth resulted in F counting > F table 5% and 1% then these results showed that fermentation-based feeding of leaves had a very noticeable effect on the growth of the relative length of Climbing Perch (Table 3.5). The result of the Coefficient of Diversity (0,97), then the Middle-Value Difference test, is carried out with the Honest Difference Test. The results of the BNJ test found that treatment A was very markedly different from treatment C and significantly different from treatment D, treatment B was very different from treatment C and significantly different from treatment E, and treatment C was very different from treatment D and E.

The highest average growth in the relative length of Climbing Perch (Figure 3.4) was found in treatment C at 45.81% and the lowest was found in treatment A at 31.60%. This is thought to be because the dose of EM4 probiotic addition contains mixed cultures of fermented microorganisms, namely lactic acid bacteria *(Lactobacillus casei)* and yeast (Saccharomyces cerevisiae). Lactobacillus bacteria function to increase the body's immunity against infections. The content of yeast is also thought to help accelerate the growth of Climbing Perch. Yeast can bind a wide variety of toxic substances that enter with food into the body and remove them through feces, so that fish can grow better because the toxics in the body dissolve in food wasted on feces (Wulandari, 2008).

The growth pattern of absolute length and weight of the D and E treatments is lower than that of the C treatment, this is suspected because the number of bacteria that enter and grow in the digestive tract of fish is more than the C treatment (Karel, Hilyana and Lestari, 2019).

3. Climbing Perch Survival Rate

Table 3.6: The average survival rate of Climbing Perch (%).

Repetition	Treatment				
	A	B	C	D	E
1	100,00	100,00	95,00	100,00	100,00
2	100,00	100,00	100,00	100,00	100,00
3	100,00	95,00	100,00	100,00	100,00
Total	300,00	295,00	295,00	300,00	300,00
Average	100 ±0	98,33 ±0,03	98,33 ±0,03	100 ±0	100 ±0

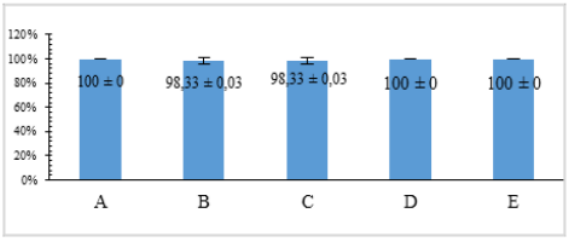

Figure 3.5: Average Survival Graph of Climbing Perch.

Table 3.6 and Figure 3.5 show that the survival growth of Climbing Perch ranges from 9833-100%, which means that each treatment gets a high survival rate. The high survival rate during the maintenance period is thought to be because to create an ideal environment is to regularly carry out water changes. Considering that not all Climbing Perch experience death, it can be ascertained that the tolerance of the Climbing Perch population both to feed and environmental conditions such as water quality are still within the range of feasibility for Climbing Perch life.

Kalakai which contains vitamins and minerals in the form of Vitamin C, Vitamin A, Fe, beta carotene, and folic acid (Wijaya, Widiputri, and Rahmawati, 2017) is a factor in the availability of quality feed in this study. Vitamin C can influence immunity, and fish resistance to disease when added to feed (Kurmaly and Guo, 1996) and improve antibody response, complement activity, and fish survival against bacterial infections (Li and Lovell, 1985). According to Jusadi and Mokoginta (2006), vitamin C plays an important role in normalizing immune function and reducing stress. Iribarren et al. (2012) stated that the use of probiotics can increase the survival rate and body resistance of fish to pathogenic infections.

4. Feed Conversion Ratio

Table 3.7. Average Feed Conversion Ratio of Climbing Perch.

Repetition	Treatment				
	A	B	C	D	E
1	8,80	8,12	3,87	8,02	8,96
2	9,64	8,17	6,82	10,58	12,81
3	8,27	6,03	6,01	8,88	14,83
Total	26,72	22,32	16,69	27,48	36,59
Average	8,91 ±0,69^{a}	7,44 ±1,22^{a}	5,56 ±1,53^{a}	9,16 ±1,30^{a}	12,20 ±2,98^{b}

Note: the same letter indicates no real difference

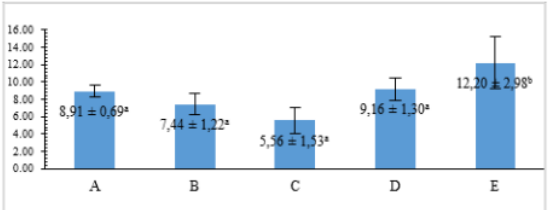

Figure 3.6: Average Graph of Climbing Perch Feed Conversion Rate.,

The ANOVA Test results in F calculating > F table 5% and 1% then these results show that fermentation-based feeding of leaves has a very noticeable effect on the feed conversion ratio of Climbing Perch (Table 3.7). Based on the results of the Coefficient of Diversity (3.99), the Middle-Value Difference test is carried out with the Honest Value Difference Test. The results of the BNJ test found that treatment B was significantly different from treatment C, and treatment E was very significantly different from treatment C.

The feed conversion ratio in this study is still around the value of the feed conversion ratio in fish. According to Mujiman (2000), the feed conversion value in Climbing Perch (Figure 3.6) ranges from 1.5-8 depending on the type of food. Plant foods have a greater feed conversion ratio than animal food. The high conversion ratio value in the E treatment is thought to be because the fish have limitations in digesting feed with high crude fiber content.

This shows that with the fermentation process with the addition of EM4 probiotics, Climbing Perch can make optimal use of the feed given compared to feed without probiotics. Sugih (2005) states that the digestive enzymes produced by microbes during the fermentation process will help in breaking down complex compounds into simple compounds so that the feed will be easily absorbed by the intestines.

The result of the feed conversion ratio in the C treatment was lower than the research of Rusminah, Fran, and Akbar (2017), namely the maintenance of Climbing Perch measuring 3-5 cm at a stocking density of 50 heads/hapa with duck weed-based feeding with a protein content of 25.84% having a feed conversion ratio of 4.2. Artificial feeding of fish meal with a protein content of 55.19% has the highest feed conversion ratio value of 3.82 and gradually decreases by 2.10 with an increase in protein content in poultry stomach content artificial feed with a protein content of 60.67% (Bhaskar, Pyne and Ray, 2015).

The feed conversion ratio of Climbing Perch is relatively high compared to other fish such as tilapia, carp, and pomfret. The high feed conversion ratio of Climbing Perch is because this type of fish is classified as omnivorous but more carnivorous, so it requires high energy for the growth process. Types of omnivorous fish that have a hard scale structure and sharp spines have great energy for their growth process (Vyas, Dinesh, and Vivek, 2012).

5. Water Quality

Table 3.8: Average Water Quality.

Parameters				
Treatment	**Temperature (^{0}C)**	**pH**	**DO (mg/L)**	**Ammonia (mg/L)**
A	26,82	7,1	6,68	1,002
B	26,62	6,82	6,36	1,176
C	26,62	6,84	6,84	1,05
D	26,4	6,98	6,74	1,548
E	26,12	7,04	6,06	1,518
Pustaka*	25-32	6-8,5	3-7	<0,016

(Source: Primary Data, 2022)
*Kordi, 2013

Measurements of water quality during the maintenance of Climbing Perch (Table 3.8) such as pH, temperature, dissolved oxygen, and ammonia should be at an optimal range by the provisions of water quality for fish farming. Drastic changes in water quality are very dangerous for fish because they can trigger stress in fish so that the metabolic rate increases (Effendie, 2002).

The results of measuring water temperature in the maintenance media of Climbing Perch fry during the study obtained temperatures in each treatment, which ranged from 26.12-26.820C. This is to the statement of Kordi (2013) which states that the optimal temperature for the growth of Climbing Perch ranges from 25-32˚C and the Ministerial Decree (2014) which states that Climbing Perch for enlargement grows well at temperatures between 15-300C.

According to Irianto (2005), aquatic organisms have a degree of tolerance to temperature with a certain range that plays a very important role in growth, incubation of eggs, feed conversion, and resistance to diseases. Kohno et al. (1986) in Pramono and Marnani (2006), reported that water temperatures that are too low can cause metabolic processes to be slow, which can affect the growth rate of fish larvae will be slow to grow. High temperatures can cause an increase in the metabolic processes of fish which increases the intensity of sewage so that the oxygen content decreases.

The results of measuring the degree of acidity (pH) in this study ranged from 6.82-7.1 in each treatment. The pH value in each such treatment is quite good for the life of the fish. The optimal pH value according to Kordi (2013), ranges from 6-8.5. Types of fish that live originally in swamps have the resistance to survive in a very low or high pH range, which is between 4-11, especially Climbing Perch. pH that is less than 6 and more than 9.5 for a long time affects the growth and reproduction of fish.

Dissolved oxygen in this study ranged from 6.06-6.84 mg/l. The oxygen level suitable for the growth of Climbing Perch according to Kordi (2013) is 3-7 mg/l and the opinion of Khairuman and Amri (2008) that the dissolved oxygen needed in fish farming is at least 3 mg/L.

The results of ammonia measurements during the study ranged from 1,002-1,176 mg/l. The optimal ammonia level for Climbing Perch farming is <0.016 mg/L (Kordi, 2013) while Haryanti (1995), stated that the growth of Climbing Perch fry is still good where ammonia levels in the water are still below the appropriate tolerance limit of 0.50 mg/L, so as not to cause disturbances in test fish. Ammonia levels above 1.5 mg/L are toxic to fish commercially (Chen, Ling, and Blancheton, 2006).

Ammonia poisoning in fish will result in increased oxygen consumption, damage to the gills, and reduce the ability of the blood to transfer oxygen. (Boyd, 1988). This condition during maintenance does not occur because ammonia levels during maintenance can still be tolerated by Climbing Perch. As the value of ammonia increases the need for oxygen will also increase. The accumulation of the above factors is one of the causes of the growth of Climbing Perch.

Ammonia management during the study was minimized by changing water with a 25% sampling technique to reduce ammonia concentrations and the aeration system can increase the supply of dissolved oxygen in the maintenance container so that death can be suppressed during the study. This can be seen from the results of dissolved oxygen which is still in the optimal range and survival is still high.

CONCLUSION

1. The content of fermentation-based feed leaves has increased protein and decreased crude fiber content, occurring gradually in line with the increase in the dose of probiotics used.
2. The best growth performance was seen in the C treatment (kalakai flour + 10% probiotics) with absolute weight growth results, relative weight growth, absolute length growth, relative length growth, survival, and the highest conversion ratio compared to other treatments.

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