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Utilization of Fermented Chicken Feather Flour Using *Rhizopus* sp in Feed on the Growth of Striped Catfish (*Pangasianodon hypophthalmus*)

Pemanfaatan Tepung Bulu Ayam yang difermentasi Menggunakan Rhizopus sp dalam Pakan untuk Pertumbuhan Ikan Patin (Pangasianodon hypophthalmus)

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Abstract

This study aims to determine the effect of feeding containing fermented chicken feather flour on feed efficiency and growth of striped catfish fry. The test fish used weighted 2.85 ± 0.33 g. The containers used for observing fish growth were 15 units of floating net cages made of gauze measuring 1x1x1 m with a stocking density of 25 ind/m^3 and 5 units of aquariums measuring 60x35x40 cm as containers for observing the digestibility of feed with a stocking density of 25 ind/m^3. This research method used a one-factor Completely Randomized Design (CRD) with five treatment levels and three replications. The treatments in this study were P0 (feed without fermented feather meal), P1 (feed containing 7.5% fermented feather meal), P2 (feed containing 15% fermented feather meal), P3 (feed containing 22.5% flour fermented chicken feathers), and P4 (feed containing 30% fermented chicken feather flour). The test feed protein was about 40%. The amount of feed given is 5% of the body weight of the fish with a frequency of 3 times a day, namely morning, afternoon, and evening. Fish rearing was carried out for 56 days. Measure the digestibility of feed by giving feed containing an indicator of 0.5% chromium oxide (Cr_2O_3). Feed is offered three times a day, namely morning, afternoon, and evening, as much as 5% of the body weight of the fish. The feces excreted by the fish are then collected and dried. The collected feces were analyzed for protein content and Cr_2O_3 to obtain feed and protein digestibility data. The results of this study indicated that the best treatment was P3 (feed containing 22.5% fermented chicken feather meal), resulting in feed digestibility of 55.36%, protein digestibility of 85.39%, feed efficiency of 83.59%, protein retention of 36.33%, specific growth rate of 3.38%, and survival of 92.00%.

Keywords: Chicken feather meal, Fermentation, Fish feed.

Abstrak

Penelitian ini bertujuan untuk mengetahui pengaruh pemberian pakan yang mengandung tepung bulu ayam terfermentasi terhadap efisiensi pakan dan pertumbuhan benih ikan patin. Ikan uji yang digunakan memiliki bobot 2,85±0,33 g. Wadah yang digunakan untuk pengamatan pertumbuhan ikan adalah 15 unit keramba jaring apung yang terbuat dari kain kasa berukuran 1x1x1 m dengan padat tebar 25 ekor/m^3 dan 5 unit akuarium berukuran 60x35x40 cm sebagai wadah pengamatan kecernaan pakan dengan padat tebar 25 ekor/m^3. Metode penelitian ini menggunakan Rancangan Acak Lengkap (RAL) satu faktor dengan lima taraf perlakuan dan tiga kali ulangan. Perlakuan dalam penelitian ini adalah

P0 (pakan tanpa tepung bulu ayam fermentasi), P1 (pakan yang mengandung 7,5% tepung bulu ayam fermentasi), P2 (pakan yang mengandung 15% tepung bulu ayam fermentasi), dan P3 (pakan yang mengandung 22,5% tepung bulu ayam fermentasi) serta P4 (pakan yang mengandung 30% tepung bulu ayam fermentasi). Protein pakan uji adalah sekitar 40%. Jumlah pakan yang diberikan sebanyak 5% dari bobot tubuh ikan dengan frekuensi pemberian pakan sebanyak 3 kali sehari, yaitu pagi, siang, dan sore hari. Pemeliharaan ikan dilakukan selama 56 hari. Pengukuran daya cerna pakan dilakukan dengan memberikan pakan yang mengandung indikator 0,5% kromium oksida (Cr_2O_3). Pakan diberikan tiga kali sehari, yaitu pagi, siang, dan sore hari, sebanyak 5% dari bobot tubuh ikan. Feses yang dikeluarkan oleh ikan kemudian dikumpulkan dan dikeringkan. Feses yang terkumpul dianalisis kandungan protein dan Cr_2O_3 untuk mendapatkan data kecernaan pakan dan protein. Hasil penelitian ini menunjukkan bahwa perlakuan terbaik adalah P3 (pakan yang mengandung 22,5% tepung bulu ayam terfermentasi), menghasilkan kecernaan pakan sebesar 55,36%, kecernaan protein sebesar 85,39%, efisiensi pakan sebesar 83,59%, retensi protein sebesar 36,33%, laju pertumbuhan spesifik sebesar 3,38%, dan sintasan sebesar 92,00%.

Kata kunci: Tepung bulu ayam, Fermentasi, Pakan ikan.

1. Introduction

Striped catfish (*Pangasianodon hypophthalmus*) is a freshwater fish commodity with significant economic value because it has fast growth, is easy to cultivate, and can be maintained with low oxygen content (Muslim et al., 2009). Striped catfish is a farmed fish popular with the public because it has thick meat, a tasty taste, and does not have many thorns in the beef (Suryanti et al., 2011). A quality feed with high nutritional value is necessary to develop a good catfish culture and accelerate fish growth. Feed is one of the essential elements in aquaculture activities to support the growth and survival of fish. In aquaculture activities, commercial feed costs more than 60% of the total production cost (Sari et al., 2017). Fish feed prices continue to increase yearly because the raw materials still depend on foreign sources, such as fish meal. To reduce dependence on imported raw materials in feed, alternative ingredients that are easy to obtain, have abundant availability, have relatively low prices, do not compete with humans, and have high nutritional value are needed. Efforts that can be made to substitute fish meal in fish feed are to use agricultural and livestock waste.

Chicken feathers are one of the wastes that can be used as raw material for fish feed, which is widely available. Chicken feathers are a by-product of the chicken slaughtering industry and have the potential to be an alternative ingredient for fish feed due to their abundant availability. The protein content in the chicken feathers' dry matter is very high, reaching 84.85%, 0% ash content, 1.57% fat, 2.27% crude fiber, and 11.29% BETN (Panjaitan et al., 2017). Even though it has high protein content, the protein found in chicken feathers is classified as a type of keratin protein that is difficult to digest (Joshi et al., 2007). Keratin is the product of the hardening of the body's epidermal tissues, such as nails, hair, and feathers, composed of protein fibers (fibrous) (Sinoy et al., 2011). The digestibility of chicken feather keratin protein in the digestive organs of fish is very low, namely 5.8% (Achmad, 2001), so a technique is needed to increase its digestibility, namely fermentation.

Fermentation is a process of metabolic enzymes of microorganisms that carries out oxidation, reduction, hydrolysis, and other chemical reactions resulting in chemical changes in organic substrates (Lestari, 2001). Fermentation can reduce the keratin of chicken feathers because the microbes used produce protease enzymes that can hydrolyze keratin by breaking the cysteine disulfide bonds in the keratin, resulting in the overhaul of keratin into simple proteins (Sun & Lee, 2001). Based on the description above, the authors are interested in researching the utilization of fermented chicken feather flour using *Rhizopus* sp in feed as an alternative feed ingredient for the growth of striped catfish fry.

This study aimed to obtain the optimum amount of fermented chicken feather flour using *Rhizopus* sp to improve feed efficiency and growth of striped catfish fry.

2. Material and Method

2.1. Time and Place

This research was carried out from November 2022 to January 2023. Feed production and maintenance of test fish was carried out at the Fish Nutrition Laboratory and Reservoirs, Faculty of Fisheries and Marine, Universitas Riau. A feed proximate test was conducted at the Laboratory of Agricultural Product Analysis, Universitas Riau.

2.2. Methods

The experimental method used in this study used a one-factor Completely Randomized Design (CRD) with five treatment levels and three replications, so 15 experimental units were needed. The treatment carried out in this study refers to the research of Adelina et al. (2020) with the best treatment, namely the use of 20% fermented chicken feather meal in star pomfret feed, which resulted in the best growth performance and feed efficiency. The treatment feed in this study was:

P0 = feed without fermented chicken feather meal (control)
P1 = feed containing 7.5% fermented chicken feather meal
P2 = feed contains 15% fermented chicken feather meal
P3 = feed containing 22.5% fermented chicken feather meal
P4 = feed containing 30% fermented chicken feather meal

2.3. Procedure

2.3.1. Container Preparation and Test Fish

The containers used in this study were cages and aquariums. The 15 cages were arranged in 4 rows and four columns in the FPK reservoir with a water depth of 80 cm. Each cage was filled with 25 test fish/m^3. The container used to measure the digestibility of the feed is in the form of 5 units of aquariums. The aquarium is washed first until it is clean, then it is filled with clean water that has been settled for 24 hours with a volume of ¾ of the height of the container and aerated. The striped catfish seeds were ready to be sown in each aquarium at 25 ind/m^3.

2.3.2. Preparation and Manufacturing of Chicken Feathers

Chicken feathers were obtained from Pekanbaru's chicken slaughterhouse (RPA) seller. The chicken feathers used are fine-cut chicken feathers and white. The collected chicken feathers are washed using running water to separate impurities such as blood, skin, and others. Then, the chicken feathers are boiled for 15 minutes to remove anti-nutrients and germs attached to the chicken feathers. After that, the chicken feathers were dried in the sun until completely dry. Then, the dried chicken feathers were heated using an autoclave for 2 hours at a pressure of 20 Psi (Pounds per square inch) to soften the chicken feathers, then dried again (Papadopaulus et al., 1985). Furthermore, the chicken feathers were smoothed using a disk mill and then sieved to get fine granules of chicken feather flour.

2.3.3. Fermentation of Chicken Feather Flour using Rhizopus sp

The stages of chicken feather fermentation are chicken feather flour weighing 20 g and then adding water with a ratio of 1:1. Chicken feather flour is steamed for 15 minutes (counting from the time the steaming water boils) to kill and remove microorganisms that can interfere with the fermentation process and remove anti-nutrients in chicken feather flour. After the steaming is complete, it is then cooled. It was steaming aims to kill microbes that interfere with the fermentation process. Then, *Rhizopus* sp was added, prepared with a dose of 24% of the weight of chicken feather flour, and stirred and evenly distributed. Chicken feather powder mixed with *Rhizopus* sp is then put in a heat-resistant plastic bag perforated in several places to obtain aerobic conditions. The fermentation process occurs for 48 hours. The growth of white mushroom hyphae, a characteristic fermented aroma, and a moist texture in the fermented chicken feather flour characterize a successful fermentation process. Fermented chicken feather flour is steamed for 15 minutes to stop fermentation. Then, it is dried and ground into flour. Chicken feather flour was then analyzed for its protein content to see the success of increasing the protein of fermented chicken feather flour. The results of the proximate analysis of chicken feather meal can be seen in Table 1.

Table 1. Proximate analysis of chicken feather protein before and after fermentation

Material analyzed	Proteins (%)	Coarse fiber
Chicken feather meal	85.05%	2.47
Fermented chicken feather meal	90.85%	0.35

Source: Laboratory of Analysis of Agricultural Products, Universitas Riau

2.3.4. Manufacture of Test Feed

The ingredients needed for the manufacture of fish feed are chicken feather meal, soy flour, fish meal as a source of protein, wheat flour as a source of carbohydrates and adhesives, vitamin and mineral mix, fish oil as an attractant, as well as a source of omega three and Cr_2O_3 fats. To measure feed digestibility. All of these ingredients are weighed according to the formulation in Table 2 with the required protein content of 42%. Then, all the feed ingredients are mixed gradually, starting from the smallest amount to the most, until the feed ingredients are mixed homogeneously, and then mixed with warm water as much as 25-30% of the total weight of the material. They combine the water slowly while stirring so that the ingredients can form lumps. After that, the dough is printed into pellets using a pellet press machine and then dried in the sun until completely dry. The pellets were then analyzed proximately to determine their nutrient content. The results of the proximate analysis are presented in Table 2.

Table 2. Feed composition and proximate analysis results for each treatment

Material	Ingredient Proteins	Treatment				
		TBAF 0%	TBAF 7.5%	TBAF 15%	TBAF 22.5%	TBAF 30%
		%B	%B	%B	%B	%B
Q. Fish	48.79	80.00	62.00	40.20	18.50	0.00
TBAF	90.85	0.00	7.50	15.00	22.50	30.00
Q. Soybeans	30.81	8.40	12.50	23.80	35.00	40.00
Q. Wheat	11.23	5.60	12.00	15.00	18.00	24.00
Vit and Min mix	0	4.00	4.00	4.00	4.00	4.00
Fish oil	0	2.00	2.00	2.00	2.00	2.00
Total		100	100	100	100	100
Proteins		40.10	40.36	40.88	40.88	41.45
Fat		5.32	5.05	4.85	4.49	4.15
Coarse Fiber		6.37	6.02	5.70	5.25	4.80
Ash		3.75	3.50	3.10	2.91	2.72
Water		7.55	7.24	6.70	6.35	6.10
BETN		36.91	37.83	38.77	39.94	40.78

2.4. Parameter Observed

2.4.1. Feed Efficiency

According to Watanabe (1988), the formula for calculating feed efficiency is:

$$EP = \frac{(Bt+Bd)-Bo}{F} x\ 100\%$$

Information:

EP = Feed Efficiency (%)
Bt = Fish biomass weight at the end of the study (g)
Bd = weight of fish biomass that died during the study (g)
Bo = fish biomass weight at the beginning of the study (g)
F = amount of feed consumed by fish during the study (g)

2.4.2. Specific Growth Rate

According to Zonneveld et al. (1991), the specific growth rate is measured using the formula:

$$LPS = \frac{(LnWt-LnW0)}{t} x100\%$$

Information:

LPS = Specific growth rate (%)
Wt = average weight of fish at the end of the study (g)
W0 = average weight of fish at the start of the study (g)
t = length of research (days)

2.4.3. Survival rate

To measure the survival of the test fish, it can be calculated using the formula according to Zonneveld et al. (1991):

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

Information:

SR = Survival rate (%)
Nt = Number of live fish at the end of the study (fish)
No = Number of live fish at the start of the study (fish)

2.4.4. Water quality

Water quality parameters measured in this study were pH, temperature, ammonia (NH_3), and dissolved oxygen (DO). Water measurements and sampling were conducted at the study's beginning, middle, and end.

2.5. Data Analysis

Data obtained during the study were presented in tabular form, and then feed efficiency, protein retention, specific growth rate, and survival rate of Striped catfish fry were calculated. To determine the effect of treatment on the parameters measured, ANOVA statistics were analyzed using SPSS with Completely Randomized Design

(Hanafiah, 2005), but previously tested for homogeneity. If giving feed containing fermented chicken feather flour affects the parameters measured ($P < 0.05$), a Newman Keuls test is carried out to see differences between treatments. Feed digestibility, protein digestibility, and water quality data were analyzed descriptively.

3. Result and Discussion

3.1. Feed Digestibility and Protein Digestibility

Data on the calculation of the digestibility value of feed and feed protein for striped catfish seeds in each treatment can be seen in Table 3.

Table 3. Feed and protein digestibility (%) of Stripped catfish fry in each treatment during the study

Treatment (%TBAF)	Feed Digestibility (%)	Protein digestibility (%)
P0 (0)	41.18	74.89
P1 (7.5)	44.44	78.17
P2 (15)	43.82	78.77
P3(22.5)	55.36	85.39
P4(30)	43.18	80.22

Note: TBAF = Fermented chicken feather flour

The data in Table 3 shows that the feed digestibility value of striped catfish seeds ranges from 41.18 to 55.36%. The digestibility value of the feed, which is the digestion coefficient, describes the ability of the fish to digest the feed; it can also represent the quality of the feed consumed by the fish. The feed digestibility value describes the nutrients or energy of the feed digested by the fish and not excreted through the feces (NRC, 1993). The highest feed and protein digestibility values were found in the P3 treatment (using 22.5% fermented chicken feather meal), which was 55.36% and 85.39%, respectively. This is due to the use of *Rhizopus* sp in the fermentation process of chicken feather flour, which produces protease enzymes al, also known as peptidase proteinases, namely enzymes that catalyze the hydrolysis of peptide bonds into short oligopeptides and free amino acids in chicken feather flour (Lopez-Otin & Bond, 2008). This causes the organic compounds present in the feed to be broken down into simpler compounds by the protease enzyme in the fermentation process.

Feed P0 (without fermented chicken feather meal) had the lowest feed digestibility and protein digestibility values of 41.18% and 74.89%. Factors that influence feed digestibility are fish size, feed composition, amount of feed consumed, and physiological conditions of fish (Haetami & Sukaya, 2005). P0 feed (without fermented chicken feather meal) had a higher crude fiber content of 6.37% compared to other treated feeds. The high crude fiber in the feed makes it more difficult for striped catfish, which are carnivores, to digest. Another factor that can affect the digestibility of feed is the specific differences in the fish's digestive system (physiological status). The presence of bacteria that help the digestive process in the intestine can also affect differences in the digestibility of fish to crude fiber.

In the P4 treatment, protein digestibility decreased due to excessive use of chicken feather meal and chicken feather meal protein that had not been wholly degraded, so fish could not utilize the protein in feed efficiently. Adelina et al. (2021) stated that the high use of fermented chicken feather meal (≥20%) in pomfret fish resulted in the fish intestine experiencing congestion (blocking of blood), namely an abundance of blood in the blood vessels and hemorrhage (bleeding), namely the discharge of blood from the blood vessels which is pathologically characterized the presence of red blood cells outside the blood vessels or in the cell tissue so that the fish cannot digest the feed properly.

3.2. Feed Efficiency

The average data on the efficiency of the test fish feed during the study can be seen in Table 4.

Table 4. Feed efficiency of striped catfish fry in each treatment during the study

TBAF treatment	Test			Average
	1	2	3	
P0 (0%)	50.00	51.19	49.58	50.26 ± 0.83[a]
P1 (7.5%)	67.65	61.90	57.67	62.41 ± 5.00[b]
P2 (15%)	64.95	66.67	63.55	65.05±1.56[b]
P3 (22.5%)	87.51	83.10	80.16	83.59 ± 3.69[d]
P4 (30%)	77.91	78.69	77.20	77.93 ± 0.74[c]

Note: *Values shown are mean ± standard deviation; * Different letters in the same column indicate significant differences between treatments.

In Table 4, it can be seen that the highest feed efficiency was found in P3 (feed containing 22.5% fermented feather meal), which was 83.59%, while the lowest feed efficiency was found in treatment P0 (feed without the use of fermented feather meal) which was 50 .26%. P3 feed is the best composition in this study. Shipped catfish seeds can be used optimally. The digestibility of the feed in this treatment was the highest, so the fish could utilize the feed efficiently. Feed efficiency is also influenced by the ability of fish to digest feed. Gunadi et al. (2010) stated that feed digestibility is an indicator that determines the value of feed efficiency. The feed given to fish is assessed on the chemical composition of its nutrients and how much fish can absorb and utilize.

Feed P0 (control) is low efficiency because the feed does not use fermented chicken feather flour and contains high crude fiber, so the feed is difficult to digest. The ability of fish to utilize the feed given could be higher. This was related to feed digestibility in the P0 treatment, which had the lowest feed digestibility and protein digestibility of the other treatments, namely 41.18% and 74.89%. Craig & Helfrich (2002) stated that feed can be good if feed efficiency is more than 50% or even close to 100%, meaning that feed efficiency in this study is good because it reaches a value of 50.26-83.59%. Feed efficiency is closely related to the preference of fish for the feed given and is also influenced by the ability of fish to digest feed (NRC, 1993). Feed efficiency in the P4 treatment was lower due to the higher use of fermented chicken feather powder, resulting in lower feed intake and efficiency. In a study, Adelina et al. (2020) showed that using fermented chicken feather meal ≥20% resulted in lower feed efficiency.

3.3. Protein Retention

Data from the calculation of fish protein retention during the study can be seen in Table 5.

Table 5. Protein retention (%) of Striped catfish seeds in each treatment during the study

Treatment	Test			Average
	1	2	3	
P0 (Control)	18.11	20.91	18.20	19.07±4.18^{a}
P1 (7.5% TBAF)	27.13	23.67	23.77	24.86± 1.96^{b}
P2 (15% TBAF)	26.57	27.59	24.06	26.07± 1.81^{b}
P3 (22.5% TBAF)	38.34	34.84	35.83	36.33±1.80^{d}
P4 (30% TBAF)	31.41	32.52	32.05	31.99 ± 0.55^{c}

Note: *Different superscript letters in the same column indicate significant differences between treatments

In Table 5, it can be seen that protein retention in striped catfish ranges from 19.07 to 36.33%. The highest protein retention was found in P3 (feed containing 22.5% fermented chicken feather meal), which was 36.33%. The high protein retention is because striped catfish seeds can utilize protein in feed more optimally. This can be seen from the highest digestibility and feed efficiency values in the P3 treatment. More protein can be digested and utilized by fish. More protein is stored in the fish's body. This is the opinion of Suwarsito & Anggoro (2005), who state that fermented feed has higher nutritional value and digestibility. It allows it to be absorbed by the body more, and the available energy for fish body retention will be higher. Andriani et al. (2018) stated that the value of protein retention affects fish growth, fish growth rate, and feed efficiency.

The lowest protein retention value was found at P0 (control), namely 19.07%. The low protein retention is due to the low ability of fish to digest protein in feed. This can be seen in the feed digestibility and feed efficiency values at low P0 (control), namely 41.18% and 50.26%, which can be seen in Table 3 and Table 4. Various factors, namely protein content, influence protein retention values in feed, balance amino acids, and feed energy (Pohlenz et al., 2012).

3.4. Specific Growth Rate

The use of fermented feather meal in feed (P1, P2, P3, and P4) resulted in a different and higher increase in the weight of striped catfish compared to the treatment without fermented feather meal at P0. Fish weight growth occurs because the fish's body metabolism works well after consuming the feed given. This shows that the composition of feed P3 (using 22.5% fermented chicken feather flour in feed) is quite optimal, according to fish needs, to increase protein retention, affecting the growth rate of striped catfish.

Fish on P4 (30% fermented chicken feather meal) can produce slower growth than P3 (using 22.5% fermented chicken feather meal in feed). This is because the use of wheat flour as an adhesive in feed composition is more than other treatments that make it difficult for fish to consume feed properly. After all, the feed is more complex, so the fish are not optimal in utilizing it and need more energy to increase their body weight. Furthermore, to see the growth of striped catfish seeds specifically, it can be known by calculating the specific growth rate, which can be seen in Table 6.

Table 6. The specific growth rate of striped catfish fry in each treatment during the study

TBAF treatment	Test			Average
	1	2	3	
P0 (0%)	2.47	2.35	2.37	2.40±0.06^{a}
P1 (7.5%)	2.79	2.66	2.55	2.67±0.12^{b}
P2 (15%)	2.82	2.87	2.75	2.81±0.06^{b}
P3 (22.5%)	3.43	3.46	3.27	3.38±0.10^{d}
P4 (30%)	3.17	3.17	3.13	3.16±0.02^{c}

Note: Different superscript letters in the same column indicate a significant difference between treatments ($P<0.05$)

The specific growth rate of striped catfish reared during the study ranged from 2.40-3.38%. The highest specific growth rate was at P3 (use of 22.5% fermented chicken feather meal in feed), 3.38% and the lowest was at P0 (control), 2.40%. The high specific growth rate at P3 was due to the feed containing 22.5% fermented chicken feather meal, which is optimal for fish to increase fish growth. A fermentation process in chicken feather meal ingredients makes the nutritional content of the feed better and more accessible for fish to use so that the protein in the feed is absorbed by the fish higher to increase the body weight of the fish. Kurniasih et al. (2012) stated that the high growth rate of fish is because fish consume feed efficiently so that it can provide energy for better fish growth. High fish growth rates will follow high feed digestibility and efficiency (Soedibya, 1999).

The lowest specific growth rate was at P0 (without fermented chicken feather meal), which was 2.40%. This is because fish are not optimal in absorbing protein in feed for growth. Dani et al. (2005) state that the speed of fish growth is determined by the amount of protein that fish can adequately absorb and utilize to support fish growth. The specific growth rate is related to feed efficiency and protein retention. Feed efficiency and protein retention at P0 (control) were seen to be the lowest, so little energy was available to increase fish weight or growth.

3.5. Survival Rate

The results of the calculation of the survival of the test fish during the study are presented in Table 7.

Table 7. Survival rate of striped catfish fry during the study

TBAF treatment	Test			Average
	1	2	3	
P0 (0%)	84	96	88	89.33±6.11
P1 (7.5%)	96	88	96	93.33±4.61
P2 (15%)	96	96	88	93.33±4.61
P3 (22.5%)	92	88	96	92.00±4.00
P4 (30%)	92	96	96	94.67±2.30

Note: TBAF = Fermented chicken feather flour

Table 7 shows that the average survival rate of striped catfish fry is 89.33-94.67%. The survival rate of fish during maintenance is quite good. Mulyani (2014) stated that the survival rate of ≥50% was good, 30-50% survival was moderate and ≤30% was not good. The high survival rate of Stripped catfish indicates that the fish can adapt well to the environment and can adequately utilize the feed given. Leo et al. (2014) stated that fish survival depends on the amount of feed ingredients consumed, water quality, and other factors such as offspring, endurance, and the ability of these fish to utilize feed. Fish mortality in this study was due to the length of the process of measuring fish growth during sampling, so the fish experienced stress and eventually died.

3.6. Water Quality

In this study, the water quality was measured as the degree of acidity (pH), temperature, dissolved oxygen (DO), and ammonia (NH_3). The results of the data measurement can be seen in Table 8.

Table 8. Results of water quality measurements during striped catfish rearing

Parameter	range		
	Beginning	Middle	End
Temperature (°C)	26-30	28-30	28-29
pH	6.5-7.0	6.0-7.2	6,8-7,3
DO (mg/L)	2.7-3.5	2,1-2,5	3,1-4,3
Ammonia (ppm)	0.0017-0.0031	0.0053-0.0067	0.00432-0.00462

The temperature obtained during the study ranged from 26-30 ºC. The optimal temperature range for the survival of striped catfish is 27-32ºC; the degree of acidity (pH) ranges from 6.5 to 8.5; dissolved oxygen ranges> 3; ammonia ranges from <0.1. The ammonia value of striped catfish rearing media measured 0.0017-0.00462 mg/L. Ammonia increased from the beginning to the end of the study. The increase in ammonia content occurs due to the presence of leftover feed that fish do not eat. The concentration of ammonia (NH_3) that fish can still tolerate to live is one ppm.

4. Conclusions

Based on the results of this study, it can be seen that fermented chicken feather flour using *Rhizopus* sp affects feed efficiency and growth of striped catfish fry. The use of 22.5% fermented chicken feather meal in feed (P3) gave the best results in feed digestibility (55.36%), protein digestibility (85.39%), feed efficiency (83.59%), protein retention (36 .33%), specific growth rate (3.38%) and survival (92.00%).

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