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EVALUATION OF FERMENTED CORN COB MEAL AS A CARBOHYDRATE SOURCE IN CARP (*Cyprinus carpio*)

Evaluasi Tepung Bonggol Jagung yang Difermentasikan Sebagai Sumber Karbohidrat pada Ikan Mas (*Cyprinus carpio*)

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ABSTRACT

Carp (*Cyprinus carpio*) is one of the freshwater commodities with the highest production and is widely cultivated in Indonesia. From 2010 to 2017, carp production increased by 33,954 tons. This increase in production will be accompanied by an increase in feed demand in fish farming. The high price of feed is a constraint in the cultivation process. Therefore, other alternatives are needed to reduce feed production costs, such as the utilization of agricultural waste. The agricultural waste used was corn cobs fermented using cow rumen fluid. The study was conducted with the aim of analyzing the use of fermented corn cob meal as a carbohydrate source for carp (*Cyprinus carpio*). The method used in the study was an experimental method using a Completely Randomized Design (CRD) with 5 treatments with different doses and 3 replications. The treatments given consisted of P1 (control, without corn cob meal), P2 (25% TBJ substitution), P3 (50% TBJ substitution), P4 (75% TBJ substitution), and P5 (100% TBJ substitution). The results showed that the substitution of corn meal with corn cob meal had a significant effect on P5 with an absolute weight value of 3.57 g, and an absolute length of 1.30 cm. Meanwhile, the survival rate parameter of 73.3% had no significant effect between treatments. So, the use of fermented corn cob meal up to 100% can be used to increase carbohydrate utilization without reducing growth performance in carp.

Keywords: Carbohydrate, Carp (Cyprinus carpio), Corn Cob Meal, Cow Rumen, Fermentation

ABSTRAK

Ikan mas *(Cyprinus carpio*) merupakan salah satu komoditas air tawar dengan produksi tertinggi dan banyak dibudidayakan di Indonesia. Dillihat dari tahun 2010 hingga 2017, ikan mas mengalami peningkatan sebesar 33.954 ton. Peningkatan produksi ini akan disertai dengan meningkatnya kebutuhan pakan pada budidaya ikan. Mahalnya harga pakan menjadi kendala dalam proses budidaya. Oleh karena itu, diperlukan alternatif lain untuk menekan biaya produksi pakan, seperti pemanfaatan limbah pertanian. Limbah pertanian yang digunakan berupa bonggol jagung yang difermentasi menggunakan cairan rumen sapi. Penelitian dilakukan dengan tujuan untuk menganalisa penggunaan tepung bonggol jagung yang difermentasikan sebagai sumber karbohidrat pada ikan mas (*Cyprinus carpio*). Metode yang digunakan dalam penelitian adalah metode eksperimental menggunakan Rancangan Acak Lengkap (RAL) dengan 5 perlakuan dengan pemberian dosis yang berbeda dan 3 kali ulangan. Perlakuan yang diberikan terdiri dari P1 (kontrol, tanpa tepung bonggol jagung), P2 (substitusi TBJ 25%), P3 (substitusi TBJ 50%), P4 (substitusi TBJ 75%), dan P5 (substitusi TBJ 100%). Hasil penelitian menunjukkan bahwa substitusi tepung jagung dengan tepung bonggol jagung berpengaruh nyata terhadap P5 dengan nilai bobot mutlak 3,57 g, dan panjang mutlak 1,30 cm, Sementara itu, parameter *survival rate* 73,3% tidak berpengaruh nyata antar perlakuan. Sehingga penggunaan tepung bonggol jagung terfermentasi hingga 100% dapat digunakan untuk meningkatkan pemanfaatan karbohidrat tanpa menurunkan performa pertumbuhan pada ikan mas.

Kata Kunci: Fermentasi, Ikan Mas (*Cyprinus carpio*), Karbohidrat, Rumen Sapi, Tepung Bonggol Jagung

INTRODUCTION

Carp (*Cyprinus carpio*) is a freshwater fish with the highest production and is widely cultivated in Indonesia. Carp are one of the most widely cultivated freshwater fish species due to their high adaptability to environmental conditions and available food sources. The development of carp varieties, such as the punten carp, mustika carp, sinyonya carp, raja danu carp, majalaya carp, and ornamental carp, demonstrates significant progress in carp cultivation (Sinaga et al., 2020). According to data from the Directorate General of Aquaculture (2018), carp production increased by 33,954 tons from 2010 to 2017. This increase in production is accompanied by an increase in feed demand for fish farming (Akbarurrasyid et al., 2020).

Feed is a crucial component in the fish farming process, playing a role in fish growth, reproduction, and survival. In fish farming, production increases are significantly influenced by commercial feed (pellets). However, the high price of pellets is a major obstacle in the cultivation process, as feed costs account for approximately 60-70% of total production costs (Hariani & Purnomo, 2017). This high feed price is due to the fact that the raw materials used by pellet factories are imported commodities, requiring fish farmers to incur significant costs. The high price of feed prevents goldfish farmers from maximizing profits and may even incur losses (Mutafiah, 2020). Therefore, to reduce feed production costs, alternative methods are needed to address the feed requirement problem. One relatively easy and feasible method is to make your own pellet feed using locally available ingredients locally or in the market.

When preparing feed, nutritional considerations are crucial. Nutrition can significantly impact fish health, growth, and reproduction. Nutrient deficiencies can reduce growth rates and lead to disease, while excess nutrients can inhibit growth. Therefore, the nutritional composition of feed ingredients must be tailored to the nutritional needs of each cultivated organism. Fish require a variety of nutrients, including protein, fat, carbohydrates, vitamins, and minerals (Putra et al., 2022).

Carbohydrates are one of the macronutrients in feed. In freshwater fish feed, carbohydrates are typically used in amounts of 30-47%. Carbohydrates come from plant-based ingredients such as corn, rice, bran, wheat flour, tapioca, sago, and so on (Devani, 2015). Corn is one commodity that plays a role and offers potential for development due to its status as a primary source of carbohydrates. However, corn prices have consistently increased (Al-Qarazi et al., 2021). Therefore, efforts to reduce dependence on corn require development, such as producing homemade feed using corn waste.

Corncobs are a part of corn. They are agricultural waste that is not optimally utilized. However, corncobs can be utilized because corncob flour is a potential source of carbohydrates in fish feed. The nutrient content of corncobs consists of 3.42% protein, 9.55% fat, 5.42%

water, 4.41% ash, and 74.51% carbohydrates (Olagunju et al., 2013). One problem with using corncobs as fish feed is their high crude fiber content. Corncob crude fiber ranges from 32.36% to 54.48%. This crude fiber consists of 29.35% neutral cellulose (NDF), 36.3% acid cellulose (ADF), 31-33% hemicellulose, 40-44% cellulose, and 16-18% lignin (Fauzan, 2021). Crude fiber is one of the antinutrients that affects feed digestibility. Therefore, to address the problem of utilizing these various materials as feed ingredients, particularly for fish feed, processing technology is necessary. Fermentation is one emerging method of processing raw feed materials (Astuti et al., 2020).

Fermentation is a processing process that utilizes microorganisms as the main component. Furthermore, fermentation can result in increased protein content and decreased crude fiber in various types of plant materials (Aman et al., 2022). Cattle rumen fluid is used as a fermentation agent to produce raw feed materials. Rumen fluid is a waste product from cattle slaughter, containing a variety of microbes that produce enzymes such as amylase, protease, xylanase, mannanase, cellulase, and phytase. These enzymes have been found to improve the quality of the feed, allowing test organisms to digest it more easily (Safir et al., 2023). The diverse microbes present in cattle rumen fluid can secrete various cellulolytic enzymes, which aid in the decomposition of food particles for easier absorption in the fish digestive tract. Therefore, fermentation with cattle rumen fluid is expected to improve the quality of feed ingredients (Hudha, 2020).

Based on the above description, research is needed on the use of corn cob flour as a substitute for corn flour to address corn waste and help reduce dependence on imported feed ingredients. Therefore, this research is necessary regarding the use of fermented corn cob flour as a carbohydrate source for carp (*Cyprinus carpio*).

METHODS

Time and Location

This research was conducted over 45 days from June to July 2025 in the Fish Production and Reproduction Laboratory, located in the Aquaculture Study Program, University of Mataram. Proximate testing will be conducted in the Animal Nutrition and Feed Science Laboratory, University of Mataram.

Equipment and Materials

The equipment used in this research includes a blender, basin, molding machine, tray, spoon, and digital scale. The materials used include carp fry, coconut oil, fish oil, mineral mix, cow rumen, tapioca/sago flour, corn flour, corn cob flour, soybean meal flour, fish meal, and vitamin mix.

Research Method

This research employed an experimental method using a Completely Randomized Design (CRD) with five treatment levels, each with different dosages, and three replications, resulting in a total of 15 treatments. The dosages used in this study can be seen in the following table:

Table 1. Research Plan

Treatment	Information
P1	Control (No corn cob flour added)
P2	25% corn flour substitution with corn cob flour
P3	50% corn flour substitution with corn cob flour
P4	75% corn flour substitution with corn cob flour
P5	100% corn flour substitution with corn cob flour

Table 2. Feed Formulation and Proximate Analysis Results

Raw Material	Treatment (%)				
	0%	25%	50%	75%	100%
Fish Meal	35.96	35.96	35.96	35.96	35.96
Soybean Meal	45.00	45.00	45.00	45.00	45.00
Corn Meal	10.00	7.50	5.00	2.50	0.00
Corn Cob Meal	0.00	2.50	5.00	7.50	10.00
Wheat Flour	2.00	2.00	2.00	2.00	2.00
Sago	2.00	2.00	2.00	2.00	2.00
Squid Oil	1.00	1.00	1.00	1.00	1.00
Fish Oil	2.00	2.00	2.00	2.00	2.00
Vitamin Mix	1.00	1.00	1.00	1.00	1.00
Mineral Mix	1.00	1.00	1.00	1.0	1.00
BHT	0.02	0.02	0.02	0.02	0.02
Choline Chloride	0.02	0.02	0.02	0.02	0.02
TOTAL	**100**	**100**	**100**	**100**	**100**
Protein	28.41%	28.56%	28.40%	28.25%	28.09%
Fat	9.48%	9.38%	9.28%	9.27%	9.07%
Ash	11.80%	11.84%	11.88%	11.92%	11.97%
Carbohydrate	30.03%	29.76%	29.50%	29.23%	28.97%
Energy	2523.81	2503.43	2483.05	2462.67	2442.29

Research Procedure

Preparation of Rearing Containers

The containers used in this study were 15 45 L containers. The containers were first washed with soap and a sponge, then rinsed with fresh water until all traces of soap were removed. The rinsed containers were then dried thoroughly. To prepare the rearing media, fresh water that had been settled for 24 hours was used. The rearing containers were then filled with 30 L of water in each container, equipped with aeration to supply oxygen.

Preparation of Test Animals

The test animals used in this study were common carp (*Cyprinus carpio*). The carp used were 10-gram fingerlings obtained from the Batu Kumbung-Lingsar Fish Seed Center (BBI), West Lombok Regency. Before stocking, the fish were acclimatized for 15 minutes to prevent stress and allow them to adapt to their new environment. The stocking density used in this study was 20 fish per container (Subekti et al., 2017).

Preparation of Test Feed Ingredients

A. Soybean Flour Preparation

According to Safira et al. (2022), the procedure for making soybean flour involves preparing 15 kg of soybeans, then roasting them for approximately 30 minutes over medium heat until the soybeans turn brown. Afterward, the soybeans are ground using a grinder until they are finely ground or become flour.

B. Fish Meal Preparation

According to Praptiwi & Wahida (2021), fish meal can be made by boiling, drying, and grinding. The fish meal preparation process begins with preparing the fish, using trash fish. Washing and cleaning the fish's belly are performed. Then, a container is prepared to boil the fish for approximately 10 minutes. The cooked fish is then strained and dried for three days until completely dry. The fish is then ground using a grinder. If the result is not smooth enough, it is blended again until a finer consistency is achieved.

C. Making Corncob Flour

Corncobs can be processed into flour, which serves as a source of carbohydrates in feed. According to Sosiati et al. (2021), the process of making corncob flour involves preparing dried corncobs, then grinding them using a grinder three times to obtain a fine powder.

D. Corncob Fermentation

According to Ferliansyah (2020), the stages in the fermentation process involve filtering the cow's rumen through a white cloth and squeezing it to extract the rumen fluid. Then, prepare a fermentation container and add the cow rumen fluid and corn cob flour to the container at a ratio of 1 liter (100 ml) of cow rumen to 250 grams of corn cob flour. Cover the container with a white cloth and tape it shut, then store it away from direct light. Leave the fermentation container for 15 days.

E. Feed Manufacturing

According to Asriyanti et al. (2018), feed manufacturing involves three stages: mixing raw materials, molding, and drying. The stages are as follows:

a. Feed Mixing
   To mix the raw materials, prepare a feed molding machine, basin, tray, analytical balance, spoon, plastic gloves, and the ingredients to be used. Then, weigh the feed ingredients according to the specified formulation. Mix the feed ingredients, starting with the smallest quantities: coconut oil and premix (vitamin and mineral mix), followed by fish oil, sago, wheat flour, cornmeal, corn cob flour, soybean flour, and fish meal, and then homogenize. Next, add 35-40% of the total ingredients and stir thoroughly until the mixture is smooth.
b. Feed Molding
   The smooth feed is formed into balls to facilitate the milling process. The feed mixture is then fed into the molding machine and molded into pellets. Each pelleted feed is cut into 1 cm pieces.
c. Feed Drying
   The pelleted feed is then dried in the sun for approximately 3 days. The dried feed is stored in a closed container in a dry place (not humid and not exposed to direct sunlight).

Research Parameters

Absolute Weight Growth

Absolute weight growth is calculated using Effendie (1997) formula as follows:

$$W = Wt - Wo$$

Where:

W : Biomass of test animals (g)
Wt : Weight of test animals at the end of the study (g)
Wo : Weight of test animals at the beginning of the study (g)

Absolute Length Growth

Absolute length growth can be calculated using Effendie (1997) formula as follows:

$$Pm = Pt - Po$$

Where:

Pm : Average length increases in fish (g)
Pt : Average length of fish at the end of the study (g)
Po : Average length of fish at the beginning of the study (g)

Survival Rate (SR)

Survival Rate (SR) can be calculated using Effendi (1997) formula as follows:

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

Where:
SR : Survival rate (%)
Nt : Number of fish surviving at the end of the culture (fish)
No : Number of fish surviving at the beginning of the culture (fish)

Water quality measurements included temperature, DO, pH, and ammonia. A DO meter was used to measure temperature and DO, a pH meter was used to measure pH, and a spectrophotometer was used to measure ammonia. The data collected during the study, including absolute weight gain, absolute length gain, and survival rate (SR), were analyzed using analysis of variance (ANOVA). If the results were significantly different (P<0.05), a Duncan's test was conducted to determine which treatment had a significantly different effect.

RESULTS

Survival Rate (SR)

Based on the results of the Analysis of Variance (ANOVA), feeding substituting corn flour with corn cob flour at different percentages did not significantly affect (P>0.05) the survival rate (SR) of carp. The highest survival rate (SR) was found in P1 at 77.7%, and the lowest in P3, P4, and P5 at 73.3%.

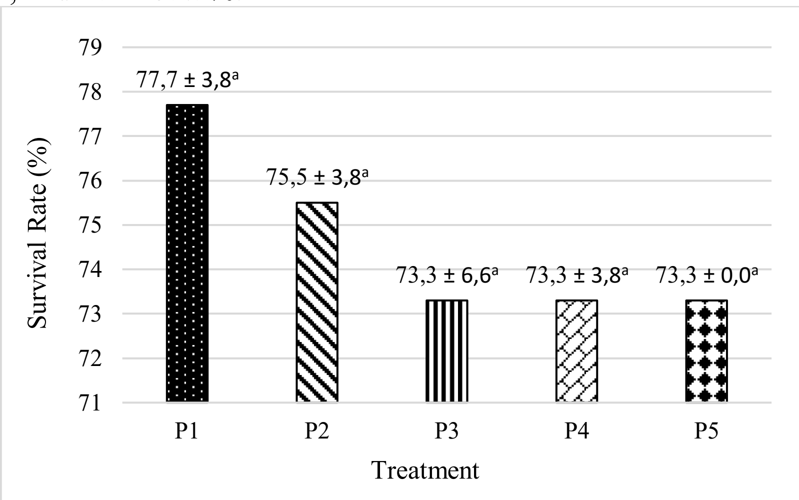

Figure 1. Survival Rate

Absolute Weight Growth

Based on the results of the Analysis of Variance (ANOVA), feeding substituting corn flour with corn cob flour at different percentages significantly affected (P<0.05) the absolute weight gain of carp. The Duncan test results showed that P5 had the highest value, not significantly different from P1, P3, and P4, but significantly different from P2. The highest value was found in P5 at 3.57g, and the lowest was found in P2 at 2.73g.

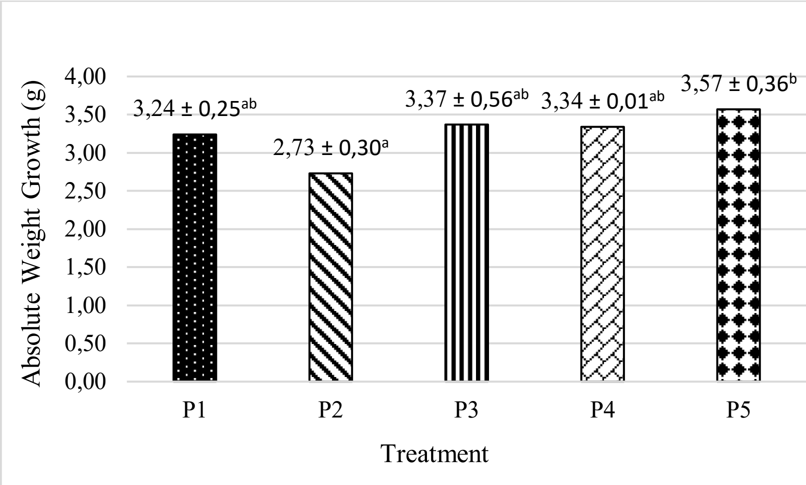

Figure 2. Absolute Weight Growth

Absolute Length Growth

Based on the results of the Analysis of Variance (ANOVA), feeding by substituting cornmeal for corncob meal at different percentages significantly affected ($P<0.05$) the absolute length growth of carp. The Duncan test results showed that P5 exhibited the highest value for absolute length growth, and was not significantly different from P3 and P4. However, it was significantly different from P1 and P2. The highest value was found in P5 at 1.30 cm, and the lowest was found in P2 at 0.80 cm.

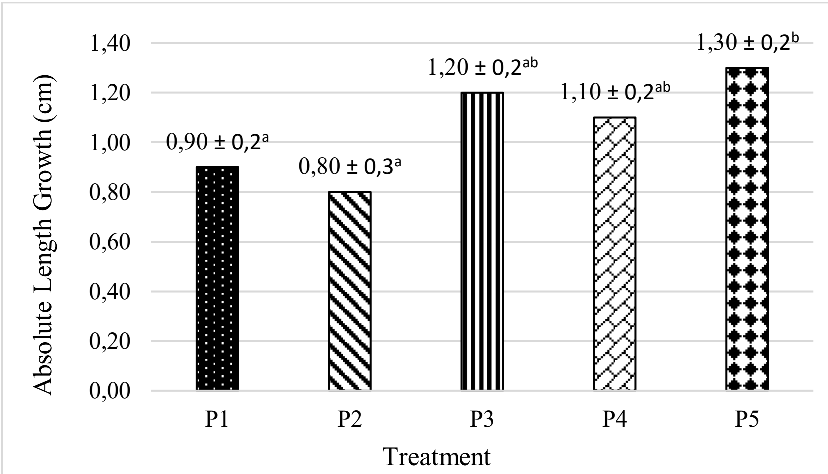

Figure 3. Absolute Length Growth

Water Quality

Several water quality parameters observed in this study, such as temperature, DO, pH, and ammonia, are shown in the following table:

Table 3. Water Quality

Treatment	Temperature (ºC)	pH	DO (mg/L)	Ammonia (mg/L)
P1	26.4-27.6	8.2-8.3	7.3-8.5	0.3
P2	26.3-27.7	8.2-8.3	7.2-8.4	0.2
P3	26.4-27.4	8.1-8.3	7.3-8.3	0.3
P4	26.4-27.8	8.2-8.4	7.1-8.2	0.1
P5	26.3-27.6	8.0-8.4	7.3-8.3	0.2

Treatment	Temperature (ºC)	pH	DO (mg/L)	Ammonia (mg/L)
Optimum Value	(Wahyu & Chadijah, 2017) 25 - 30ºC	(Wahyu & Chadijah, 2017) 7– 8	(Iskandar *et al.,* 2023) >4	(Pratama *et al.,* 2020) 0.04 - 3.01

DISCUSSION

Survival Rate (SR)

Survival Rate (SR) is a value that indicates an organism's ability to survive in a culture system. Figure 1 shows that the highest value was found in P1 (control) with a value of 77.7%, followed by P2 with a value of 75.5%. The lowest values were found in P3, P4, and P5 with a value of 73.3%. Based on the survival rates obtained during maintenance, each treatment showed quite good results, as indicated by survival rates >70%. This suggests that the nutritional content in each treatment met the fish's basic needs. Proximate test results showed that protein values ranged from 24.83% to 27.23%, and carbohydrate values ranged from 35.47% to 41.11%. This aligns with Word & Adipu (2024) who stated that the optimal protein content for goldfish feed is between 20% and 35%, and the optimal carbohydrate content is between 20% and 40%.

Based on the results, the survival rate ranged from 73.3 to 77.7%, which is still considered quite good. This aligns with research by Amalia & Arini (2013), which found that using a 30% protein content resulted in a survival rate of 86.6%.

Absolute Weight Growth

Absolute weight is the total weight gain of fish from the beginning of cultivation to the end of cultivation. Figure 2 shows that the highest PBM value was found in P5 at 3.57g, and the lowest value was found in P2 at 2.73g. The high PBM value in P5 is suspected to be due to the lower fiber content in the feed compared to the other treatments. Based on the results of the proximate test, the fiber content in P5 was 6%, while in P2 it was 7%. The high crude fiber content in the feed can reduce feed digestibility, as crude fiber is not a nutrient that can be digested by fish. This aligns with Afnan et al. (2023) statement that fiber prevents the body from absorbing other nutrients such as fat, carbohydrates, and protein. Too much crude fiber can lead to decreased digestibility, decreased absorption, increased metabolic waste, and worsened culture water quality.

Based on the results obtained during the 45-day maintenance period, the PBM value ranged from 2.73 to 3.57 g, with a crude fiber content of 6-7% in the feed. This is still considered good, referring to research conducted by Handajani (2011), who found an absolute weight gain in tilapia with the addition of 0.55g of fermented azolla flour, resulting in a crude fiber content of 9%. Furthermore, research conducted by Ahmadi & Kurniawati (2012) found an absolute weight gain of 11.2 g, with a crude fiber content of 5%.

Absolute Length Growth

Absolute length growth is a parameter used to determine the length growth experienced by cultivated organisms from the beginning to the end of cultivation. Figure 3 shows that the highest PPM value was found in P5, with a value of 1.30 cm, and the lowest was found in P2, with a value of 0.80 cm. The high value in P5 is suspected to be due to the protein content in the feed, which helps build body tissue by increasing the efficiency of protein utilization. According to the proximate test results, P5 showed a protein content of 24.82%, while P2 had a protein value of 27.23%. However, P2 had a relatively high crude fiber content of around 7.41%, indicating low growth. High crude fiber in feed can decrease feed digestibility. This is in line with the statement by Afnan et al. (2023), who stated that fiber has the potential to reduce nutrient digestibility by accelerating satiety and inhibiting contact between digestive enzymes and substrates, resulting in suboptimal protein and energy absorption.

Meanwhile, P1 yielded a relatively high protein content compared to the other treatments, but the absolute length growth rate was relatively low. This is suspected to be due to an imbalance between nutrients in the feed, such as the relatively high fat content. Fat is a source of energy; high levels of fat also produce high energy, causing fish to quickly become full and reduce feed consumption. This aligns with Munisa (2015) who stated that the right balance between energy and protein, combined with appropriate feeding, will ensure good growth and efficient feed conversion.

Based on research conducted over 45 days of maintenance, absolute length growth was found to be in the range of 0.80–1.30 cm. This value is considered quite good, referring to research by Mumpuni & Mulyana (2021), who found absolute length values ranging from 0.72–0.90 cm.

Water Quality

Temperature is one of the factors that influences fish appetite and metabolic activity. Furthermore, according to Sriyanti et al. (2025), temperature can also affect dissolved oxygen (DO) levels in water and fish growth. Research has shown that temperatures range between 26.3 and 27.8ºC, which is considered optimal for goldfish. This is supported by Wahyu & Chadijah (2017), who stated that the optimal temperature for goldfish cultivation is between 25 and 30ºC. If the temperature falls below this optimum level, it can lead to a decrease in the goldfish's appetite.

The degree of acidity, commonly referred to as pH, is a parameter used to measure the acidity and alkalinity of water. The pH value significantly influences the biochemical processes of water. Research has found that pH values range between 8.0 and 8.4, which, according to Wahyu & Chadijah (2017), is ideal for goldfish. A pH value that is too low or too high can inhibit fish growth and even lead to mortality.

Dissolved Oxygen (DO) is a parameter that determines the oxygen levels in the culture medium. Oxygen levels significantly impact fish survival. If oxygen levels in the culture medium are suboptimal, it will impact their respiration. Research has found DO values to range from 7.1 to 8.5 mg/L. This is still within the optimal range, supported by Iskandar et al. (2023), who stated that a DO value of >4 is considered optimal for carp cultivation.

Ammonia (NH_3) is an indicator of the abundance of organic waste in water. Ammonia originates from fish metabolic waste dissolved in water, such as feces and uneaten fish food that settles at the bottom of the culture pond. High levels of ammonia in the culture medium can reduce fish appetite, leading to stress and even death (Amri, 2021). Research has shown that ammonia levels range from 0.1 to 0.3 mg/L, a level considered optimal for carp cultivation. This is in line with the statement by Pratama et al., (2020) which states that the ammonia value that can be tolerated well for fish survival ranges from 0.04 – 3.01 mg/L.

CONCLUSION

Based on the research conducted, it can be seen that substituting corn flour with corn cob flour in carp feed at different percentages has an effect on carp growth. The best treatment was found in P5 which showed a tendency to show better values in growth parameters with an absolute weight value of 3.57 g, an absolute length of 1.30 cm, and an SR value of 73.3%.

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REFERENCES

Afnan. A. F., Suharti. P. H., Mustain. A., Arianto. A., Arta. B. T., & Tasyakuranti. V. F. (2023). Pengaruh Jenis Tepung Nabati dan Waktu Pengeringan Maggot Terhadap Kandungan Pakan Ikan Lele Berbahan Dasar Maggot (*Hermetia illicens*). *DISTILAT: Jurnal Teknologi Separasi*. *9*(3). 318-329. https://doi.org/10.33795/distilat.v9i3.3750

Akbarurrasyid. M., Nurazizah. S., & Rohman. F. S. (2020). Manajemen Pembenihan Ikan Mas Marwana (*Cyprinus carpio*) di Satuan Pelayanan Konservasi Perairan Daerah Wanayasa. Purwakarta. Jawa Barat. *Journal of Aquaculture and Fish Health*. *9*(1). 30-37. https://doi.org/10.20473/jafh.v9i1. 15667

Al-Qarazi. M. I., Sukardi. S., & Anwar. A. (2021). Analisis Peramalan Produksi. Konsumsi dan Harga Jagung di Provinsi Nusa Tenggara Barat. *Jurnal Agrimansion. 22*(1). 49-60. https://doi.org/10.29303/agrimansion.v22i1.508

Aman. L.. Sio. S.. & Bira. G. F. (2022). Pengaruh Penggunaan Mikroorganisme Lokal (MOL) Cairan Rumen Sapi Pada Level Inokulum yang Berbeda Terhadap Nilai Kandungan Serat Jerami Padi Terfermentasi. *JAS. 7*(2). 19-22. https://doi.org/10.32938/ja.v7i2.1676

Amri, K. (2021). Penggunaan Probiotik Pada Wadah Pemeliharaan Benih Ikan Nila (*Oreochromis niloticus*) sebagai Pengendali Kualitas Air. *Arwana: Jurnal Ilmiah Program Studi Perairan*, *3*(2), 141–149.

Asriyanti. I. N., Hutabarat. J., & Herawati. V. E. (2018). Pengaruh Penggunaan Tepung *Lemna* sp. Terfermentasi pada Pakan Buatan Terhadap Tingkat Pemanfaatan Pakan. Pertumbuhan dan Kelangsungan hidup Benih Ikan Lele Dumbo (*Clarias gariepinus*). *e-Jurnal Rekayasa dan Teknologi Budidaya Perairan*. *7*(1). 783-798. http://dx.doi.org/10.23960/jrtbp.v7i1.p783-79

Astuti. T., Akbar. S. A., & Putri. A. P. Evaluasi Kecernaan Bahan Kering. Bahan Organik dan Protein Kasar Tongkol Jagung Fermentasi dengan Penambahan Sumber Karbohidrat yang Berbeda secara *In vitro. Jurnal Peternakan. 17*(1). 45-48. http://dx.doi.org/10.24014/jupet.v17i1.8707

Devani. V. (2015). Optimasi Kandungan Nutrisi Pakan Ikan Buatan dengan Menggunakan Multi Objective (Goal) Programming Model. *SITEKIN: Jurnal Sains. Teknologi dan Industri. 12*(2). 255-261

Direktorat Jenderal Perikanan Budidaya. (2018). *Volume dan Nilai Produksi Perikanan Budidaya Menurut Komoditas Utama dan Provinsi.* Direktorat Jendral Perikanan Budidaya. Jakarta.

Effendi. (1997). *Biologi Perikanan*. Yogyakarta: Yayasan Pustaka Nusantara

Fauzan. (2021). *Pemanfaatan Tongkol Jagung yang Dihidrolisis Sebagai Sumber Karbohidrat dalam Pakan Ikan Nila* (*Oreochromis niloticus*). [Skripsi]. Jawa Barat (ID) : Institut Pertanian Bogor.

Hariani. D., & Purnomo. T. (2017). Pemberian Probiotik dalam Pakan untuk Budidaya Ikan Lele. *STIGMA: Jurnal Matematika dan Ilmu Pengetahuan Alam Unipa. 10*(1).31-35. https://doi.org/10.36456/stigma.vol10.no1.a582

Hudha. M. I. (2020). Pemanfaatan Limbah Isi Rumen Sapi Sebagai Mikroorganisme Lokal (MOL). *jurnal ATMOSPHERE. 1*(1). 30-36. https://doi.org/10.36040/atmosphere.v1i1.2958

Iskandar, A., Fataya, S. G., Carman, O., Ayuningtias, A., Juanda, T., & Hidayat, R. (2023). Teknis Pengelolaan Pembenihan Ikan Mas Mantap *Cyprinus carpio* untuk Mendapatkan Benih Kualitas Unggul. *Nekton*, *3*(2), 81–97.

Mumpuni, F. S., & Mulyana, M. (2021). Pengaruh Penambahan Tepung Rimpang Temulawak (*Curcuma xanthorrhiza*) pada Pakan dengan Dosis Berbeda Terhadap Laju Pertumbuhan dan Tingkat Kelangsungan Hidup Benih Ikan Mas Koki (*Carassius auratus*). *Jurnal Mina Sains*, *7*(1), 29–36.

Olagunju A. Onyike E. Muhammad A. Aliyu S and. Abdullahi AS. (2013). Effects of fungal (*Lachnocladium* spp.) Pretreatment on Nutrient and Antinutrient Composition of Corn Cobs. *African Journal of Biochemistry Research. 7* (11): 210 – 214. https://doi.org/10.5897/AJBR2013.0715.

Praptiwi. I. I., & Wahida. W. (2021). Kualitas Tepung Ikan di Pesisir Pantai Kabupaten Merauke Sebagai Bahan Pakan: Quality of Fish Meal on the Coast of Merauke Regency as Feed. *Jurnal Ilmu Peternakan Dan Veteriner Tropis (Journal of Tropical Animal and Veterinary Science)*. *11*(2). 157-164. https://doi.org/10.46549/jipvet.v11i2.146

Pratama, F. A., Harris, H., & Anwar, S. (2020). Pengaruh Perbedaan Media Filter dalam Resirkulasi Terhadap Kualitas Air, Pertumbuhan dan Kelangsungan Hidup Benih Ikan Mas (*Cyprinus carpio*). *Jurnal Ilmu-Ilmu Perikanan dan Budidaya Perairan*, *15*(2), 95–104.

Putra. I.. Aulia. A. H.. Dwifani. A. P.. Ramadani. D.. Saputra. F. F.. Diva. F.. ... & Putri. W. K. (2022). Pembuatan Pakan Ikan Tenggelam dengan Bahan Baku Lokal di Desa Simpang Beringin. *Journal of Rural and Urban Community Empowerment. 4*(1). 5-8.

Safir. M., Serdiati. N., Putra. A. E., & Warisyu. Y. (2023). Fermentasi Bahan Baku Nabati Pakan dengan Cairan Rumen Sapi dalam Meningkatkan Pertumbuhan Ikan Mas (*Cyprinus carpio*). *Juvenil: Jurnal Ilmiah Kelautan dan Perikanan*. *4*(1). 57-66. https://doi.org/10.21107/juvenil.v4i1.18792

Safira. S. A., Gumilar. M., Dewi. M., & Mulyo. G. P. (2022). Sifat Organoleptik dan Nilai Gizi Cookies Soygreen Formula Tepung Kacang Hijau dan Tepung Kacang Kedelai. *Jurnal Kesehatan Siliwangi*. *2*(3). 1028-1040. https://doi.org/10.34011/jks.v2i3.868

Sinaga. I., Simamora. F., & Telaumbanua.E. I. (2020). Efektifitas Penggunaan Ovaprim dengan Dosis yang Berbeda pada Pemijahan Ikan Mas (*Cyprinus carpio*). *Tapian Nauli: Jurnal Penelitian Terapan Perikanan dan Kelautan. 2*(1). 28-37 https://doi.org/10.300491/tapian%20nauli.v2i1.50

Sosiati. H., Wahyono. T., Azhar. A. R., & Fatwaeni. Y. N. (2021). Pemanfaatan Limbah Tongkol Jagung untuk Makanan Ternak Bernutrisi. *Community Empowerment*. *6*(4). 656-661. https://doi.org/10.31603/ce.4570

Sriyanti, A., Yani, E., Kusuma, T. D., & Sari, F. P. (2025). Pendayagunaan Barang Bekas dan Limbah Sebagai Filter untuk Memperbaiki Kualitas Air dalam Pemeliharaan Benih Ikan Mas (*Cyprinus carpio*). *Prosiding Seminar Nasional Hasil Penelitian Kelautan dan Perikanan*, *3*, 348–361

Subekti. M., Hutabarat. J., & Hastuti. S. (2017). Pengaruh Periode Pemuasaan Terhadap Efisiensi Pemanfaatan Pakan. Pertumbuhan dan Kelangsungan hidup Ikan Bawal Air Tawar (*Colossoma macropomum*). *Journal of aquaculture management and technology*. *6*(3). 204-213.

Wahyu, F., & Chadijah, A. (2017). Penambahan Cangkang Rajungan Pada Pakan Untuk Intensitas Warna Ikan Mas Koi Kohaku (*Addition of rajungan shell to feed for color intensity of kohaku koi carp*). *The NIKe Journal*, 5(3), 142–147. https://doi.org/10.37905/nike.v5i3.1411

Word, L. E., & Adipu, Y. (2024). Kualitas Pakan Pelet Ikan dari Limbah Ternak. *Gorontalo Fisheries Journal*, *6*(1), 1–9.