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The Analysis of Growth and Survival Rate of Carp (*Cyprinus Carpio*) Rearing With Addition of Water Hyacinth Flour (*Eichornia Crassipes*) As an Artificial Feed

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ABSTRACT

This research was an experimental study aiming to determine the effect of difference in commercial feed and artificial feed with the addition of water hyacinth (*Eichornia crassipes*) flour. There were 6 experimental units which included 2 treatments and 3 replications, the measured parameters were growth which includes absolute weight growth, absolute length growth and specific growth rate, survival rate and feed efficiency which includes feed conversion ratio, feed utilization efficiency and protein conversion ratio. Water quality parameters, including ammonia, pH and temperature were also measured in this study. The research data were analyzed using the t test data analysis method. The results showed that the feeding of commercial feed and the artificial feed with the addition of water hyacinth flour did not have a significantly different effect on growth parameters, survival rate, feed efficiency and water quality ($p>0.05$). The best treatment was produced by the artificial feeding treatment with addition of water hyacinth flour on growth and feed efficiency parameters but produced a lower result on survival rate compared to the commercial feeding treatment. In conclution, the artificial feed with addition of water hyacinth flour could be used as an alternative feed to reduce the cost of fish feed cost during aquaculture.

INTRODUCTION

Aquaculture is one of the subsectors that is expected to realize the welfare mission of the marine and fisheries community. Aquaculture includes freshwater, brackish water, and seawater aquaculture. According to Faradina et al, (2018) there are approximately 4000 species of fish in Indonesian waters and as many as 800 species of fish live in brackish water and fresh water. Carp is a freshwater fish that lives in shallow waters that flow calmly.

Feed supports the growth and development of fish. Fish feed includes natural feed, artificial feed, commercial feed and others. Artificial feed is fish food that is made from natural ingredients or processed residual substances that still have nutritional content and can be formed according to the needs and mouth openings of fish. To overcome the high price of feed, an alternative is needed to replace feed ingredients that have an economically important price and are available all the time. One alternative that can be used as a feed ingredient

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is water hyacinth (*Eichornia crassipes*) (Pane, et al. 2018).

Water Hyacinth (*Eichornia crassipes*) is a plant that is considered a weed by some Indonesians because it disturbs the aesthetics of a body of water and can also clog waterways. The high fiber and protein content in water hyacinth plants, its abundance in the waters makes this aquatic plant very good as an alternative raw material for artificial feed for carp enlargement. Water hyacinth contains quite high crude fiber so it needs to be processed first before being made into pellets, one way of processing is through the fermentation process.

In aquaculture, the constraints commonly faced are low survival rates and relatively slow fish growth (Ridwantara, et al. 2019). Fish growth is one of the factors that determine the success of aquaculture (Putrianti et al. 2015).

Water hyacinth has been widely used as a research subject but the use of fermented water hyacinth flour as a carp artificial feed is less studied so it is necessary to conduct further research on the effect of using water hyacinth in carp artificial feed. This study was conducted with the aim of analyzing the effect of artificial feeding with the addition of water hyacinth flour on the growth and survival of goldfish *(Cyprinus carpio).*

MATERIALS AND METHODS

Type of Research

This study is an experimental study and analyzed using the *independent* t *test* method used to compare the impact of artificial feeding supplemented with fermented water hyacinth flour and commercial feed. There were 6 experimental units with 2 treatments and 3 replicates.

Time and Place of Research

This research took place in two locations, namely, in the Laboratory of Agricultural Technology Education (PTP) which includes fermentation and drying of water hyacinth and in the Parang Tambung Fish Seed Center (BBI) Ward which includes maintenance activities and measurement of survival and growth of carp. Water samples and feed samples from the study were then tested in the laboratory of the Takalar Brackish Water Center. The research was conducted from February to April 2021.

Tools and Materials

Some of the tools used in this study are aerators, sieves, stationery, stirring rods, boiling stones, sample bottles, bulbs, burettes, petri dishes, porcelain cups, funnels, buchner funnels, desiccators, distillators, destructors, erlenmeyer, fishnet, soaking furnaces, beakers, measuring cups, hot plates, plastic bags, kjedhal flasks, measuring flask, pellet press, drying tray, oven, fat oven, tongs, electric pipette, pH meter, pipette, dropper, volume pipette, test tube rack, aeration hose, spatula, spectrophometer (V-630 UV-VIS), sterofoam (55x40x25 cm), distillation tube, fat tube, test tube, thermometer, analytical balance and digital balance.

Some of the materials used in this study include water, alcohol, aquadest, H3BO4, HCL, H2SO4 I.BCG, filter paper, em-4 solution, NaOH, brown sugar, commercial feed, artificial feed with the addition of water hyacinth flour, petroleum benzene, selenium, tissue and ammonia reagent.

Research Procedure

Feed Manufacturing

Table 1 Formulation of artificial feed with water hyacinth addition.

Material Type	Percentage of Feed Formulation (%)
Soybeans	20,57
Fish meal	20,57
Bran	20,92
Water Hyacinth Flour	20,92
Tapioca flour	10
Vitamins	1
Minerals	1
Fish Oil	5

Water hyacinth raw materials were sorted and chopped to a size of approximately 3 cm, then dried in the sun until half dry. Fermentation procedures were carried out based on research conducted by Nainggolan, et al. (2018) which included the addition of 2% brown sugar, 10% water and the provision of EM-4 with a concentration of 25% of the total weight of fermented water hyacinth and a fermentation time of 10 days. Fermented raw materials were dried and pulverized using a blender. All raw materials were weighed according to the specified formulation and then mixed by stirring and adding a little water to facilitate stirring the ingredients into dough. Pellet formation is done using a pellet molding machine (hammer mill). The mixing of raw

materials follows the feed formulation shown in Table 1.

Pellets are formed with a size of 2 mm with the type of pellet that is sinking. The pellets are dried in the sun or based on Sutikno, et al. (2017), namely up to 10% moisture content and then packaged using a pellet sack which is covered with plastic to keep it dry and stored in a room that is protected from direct sun contact and the bottom is given a mat so that it is not damp and not moldy.

Media Preparation and Seed Preparation

The media used as rearing tanks are sterofoam with a size of 55 x 40 x 25 cm that has been sterilized with each tub containing 30 liters of water. Weighing and measuring seeds before stocking was also done as a weight comparison to determine the effect of artificial feed after stocking on fish weight. The seeds used were seeds with a size of 7-9 cm. Acclimatization is carried out on the stocked fish so that the fish can slowly adjust to the new environment, namely the maintenance container. Stocking density is determined based on the treatment with the best results in the research of Sihite, et al. (2020) which is 15 fish / 30 liters of water.

Enlargement

Feeding was done every morning at 08.00 and in the afternoon at 16.00. The feed stocked in a day is based on the research of Ningsih (2020) which amounts to 3% of the body weight of the fish. Goldfish enlargement is carried out with a time frame of 30 days and with measurements of temperature and pH parameters carried out every day, measurements of length and weight of fish and ammonia are carried out every 7 days. The piping of the tanks is done every day at 17:30.

Data Collection Technique

The data collection technique used in this research is the sampling method. Data or samples for each parameter studied include.

Proximate Test

Proximate test on artificial feed with the addition of water hyacinth which includes moisture content test using gravimetric method, crude protein content test using kjeldhal method, and fat content tested using soxhlet method, each of which refers to SNI 01-2891-1992. Crude fiber content was tested using the gravimetric method which refers to AOAC (2005), ash content using the gravimetric method was tested using the gravimetric method with reference to SNI 2354-1-2010 and carbohydrates (BETN) which refers to Faradibha's research (2018) conducted at the Takalar Brackish Water Center.

Growth

Growth parameters measured include absolute weight growth, absolute length growth, specific growth rate.

Absolute weight growth was calculated using the formula of Mulqan, et al. (2017):

$$W_m = W_t - W_0$$

Description:

Wm = Absolute weight growth (grams)
Wt = Weight of biomass at the end of the study (grams)
Wo = Weight of biomass at the beginning of the study (gram)

Absolute length gain was calculated using the formula of Mulqan, et al. (2017):

$$Pm = Lt - Lo$$

Description

Pm = Absolute length gain (cm)
Lt = Final average length (cm)
Lo = Initial average length (cm)

According to Mulqan, et al. (2017), the specific growth rate calculation formula is:

$$SGR = \frac{lnWt - lnWo}{T} \times 100\ \%$$

Description:

SGR= Specific growth rate (%/day)
Wo = Average weight of seeds at the beginning of the study (g)
Wt = Average weight of seeds on day t (g)
T = Length of rearing (days).

Survival Rate

Survival is the *survival* rate of a commodity within a certain period of time.

According to Mustofa, et al. (2018) that the feed ratio (FCR) is calculated based on the following formula:

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

Description:

FCR= Feed conversion ratio
F = Amount of test feed consumed during the study (g)
Wt = Total weight of test fish at the end of rearing (g)

D = Total weight of dead test fish (g)
Wo = Total weight of test fish at the beginning of rearing (g)

Feed Utilization

The measured feed utilization parameters include feed conversion ratio, feed utilization efficiency and feed efficiency ratio.

According to Mustofa, et al. (2018) that the feed ratio (FCR) is calculated based on the following formula:

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

Description:
FCR= Feed conversion ratio
F = Amount of test feed consumed during the study (g)
Wt = Total weight of test fish at the end of rearing (g)
D = Total weight of dead test fish (g)
Wo = Total weight of test fish at the beginning of rearing (g)

Feed utilization efficiency (EPP) was calculated using the formula of Mustofa, et al. (2018):

$$EPP = \frac{Wt-Wo}{F}\ x\ 100\%$$

Description
EPP= Feed utilization efficiency (%)
Wt = Biomass of test fish at the end of the study (g)
Wo = Biomass of test fish at the beginning of the study (g)
F = Amount of fish feed consumed during the study (g)

According to Shofura (2017), the protein efficiency ratio value can be calculated using the following formula:

$$PER = \frac{Wt-Wo}{Pi}\ x\ 100$$

Description
PER= Protein utilization efficiency ratio
Wt = Biomass of test fish at the end of the study (g)
Wo = Biomass of test fish at the beginning of the study (g)
Pi = Protein content x amount of feed consumed by fish

Water Quality

Water quality parameters measured in this study include ammonia content, temperature and pH (acidity).

Data Analysis Technique

The analysis technique used in this study is the Assumption Test (normality) which is then continued using the *Independent Sample T Test* analysis with a level of 95% and processed using the SPSS version 23 program.

RESULTS AND DISCUSSION

Proximate Test

The proximate test results produced by commercial feed have a superior content compared to artificial feed with the addition of water hyacinth. The protein content in commercial feed is 39%, while artificial feed with the addition of water hyacinth is 35.02%. Crude fiber content in commercial feed is 5% while artificial feed with the addition of water hyacinth is 6.71%. Fat content in commercial feed is 6% while artificial feed with the addition of water hyacinth is 4.15%. The content of ash content in commercial feed is 12% while artificial feed with the addition of water hyacinth is 10.35%. The content of carbohydrates (BETN) in commercial feed is 38% while artificial feed with the addition of water hyacinth is 43.77%.

The fermentation process improves the nutritional content of water hyacinth flour, especially reducing crude fiber content which can interfere with the digestibility of artificial feed. In accordance with the research of Mahmilia (2005), fermentation using mold can improve the nutritional nutrition of water

Table 2 Proximate Test Results of Commercial Feed (A) and Artificial Feed with Water Hyacinth Flour Addition (B)

Type	Content (%)				
	Crude protein	Crude fiber	Fat	Ash content	BETN
Commercial	39	5	6	12	38
Artificial	35.02	6.71	4.15	10.35	43.77

hyacinth flour by increasing crude protein by 61.81% and reducing crude fiber by 18%. The value of the proximate test results of artificial feed with the addition of water hyacinth flour is shown in Table 2.

Growth

The treatment of commercial feed and artificial feed with the addition of water hyacinth gives almost similar results with a slight difference in growth parameters which include absolute weight growth, absolute length growth and specific growth rate. This is because both feeds meet the nutritional needs for carp growth. The nutritional content of the feed can greatly affect the yield, which is the ultimate goal of the fish farming process. Nutrients that are well-sufficient will certainly spur good growth in fish (Cahyani, 2018). The observed growth parameters are shown in Table 3.

Table 3 Mean values of absolute weight growth (Wm), absolute length growth (Pm) and specific growth rate (SGR).

Parameters observed	Feed Treatment	
	Commercial	Artificial
Wm (g)	5.63+0.15[a]	6.07+0.15[a]
Pm (cm)	1.68+0.08[a]	1.83+0.10[a]
SGR (%)	1.41+0.04[a]	1.46+0.03[a]

Table 3 shows that the commercial feeding treatment gives the results of absolute weight growth of 5.63 + 0.15g and artificial feeding with the addition of water hyacinth flour is 6.07 + 0.15g. The results of the t test analysis showed no significant difference in absolute weight growth ($p>0.05$). This study is in accordance with the results of research by Mukti and Octaviani (2020) which examined the treatment of commercial feed (P0), water hyacinth feed (P1) and kambang feed (P2) and showed that the treatment of commercial feed and water hyacinth feed did not give significantly different results, namely P0 = 2.46 ± 0.37g and P1 = 2.78 ± 0.09g.

Table 3 shows that the value of absolute length growth of goldfish in the artificial feed treatment is 1.68 + 0.08cm and in artificial feed with the addition of water hyacinth flour is 1.83 + 0.10cm. The t test results showed no significant difference ($p>0.05$). This is different from research conducted by Sonata, et al. (2015) which compared the treatment of A = 25% water hyacinth, B = 50% water hyacinth, C = 75% water hyacinth and D = 0% water hyacinth on the length gain of carp showed that treatments A and B were significantly different from treatment D with each result namely A = 4.04 ± 0.33cm, B = 3.92 ± 0.23a, C = 3.74 ± 0.32b and D = 3.78 ± 0.28cm.

Table 3 shows that the treatment of commercial feed with the results of 1.41 + 0.04% and artificial feed with the addition of water hyacinth flour, namely 1.46 + 0.03%, does not give a significant difference to the specific growth rate of carp ($p>0.05$). In accordance with the results of research conducted by Putra, et al. (2020) where the feed treatments used were commercial feed (A), hydrolyzed water hyacinth feed (B) and water hyacinth feed without hydrolysis (C) gave results that were not significantly different from the specific growth rate of tilapia with each result, namely A = 3.52 + 0.13%, B = 3.57 + 0.18% and C = 3.66 + 0.23%.

Commercial feed containing higher protein levels did not give better growth results than the artificial feed with the addition of water hyacinth. This is due to the use of EM4 solution in the fermentation process which improves nutrition and increases feed digestibility. The use of EM4 in the fermentation process of feed raw materials also functions as a probiotic that increases the level of digestibility of artificial feed with the addition of water hyacinth (Tobing, 2018). Lisi (2020) also argues that fermentation is a process that increases feed digestibility because fermented ingredients can change the content of materials that are difficult to digest into single cell proteins.

Good quality and intensity of feeding support and accelerate fish growth. Arief, et al. (2011) argue that the amount and intensity of feeding that is right for the needs of fish can not only ensure its life but also accelerate its growth. Razikin, et al. (2019) added that feed with amino acid content similar to fish amino acids provides a good growth rate. Water hyacinth contains quite complete essential amino acids, one of which is tryptophan.

The small size of the tanks limits the space for fish to move, so the fish in each tank tend to move less. Fish that continue to move will affect their behavior and physical shape and can also affect the growth of fish length (Sihite, et al. 2020). Fish kept in small containers use less energy than fish kept in larger containers so that energy is used more for growth than for physiological activities.

Trajectory

The treatment of commercial feed and artificial feed with the addition of water hyacinth flour in carp rearing tanks studied for 30 days experienced death. This is thought to be due to the impact of stress on the fish and the presence of infection in the fish. Goldfish survival is shown in Table 4.

Table 4. Goldfish Survival Rate on Artificial Feed with Water Hyacinth Addition and Commercial Feed.

Week to	Trajectory (%)	
	Commercial	Artificial
0	100+0[a]	100+0[a]
1	96+0.04[a]	100+0[a]
2	96+0.04[a]	100+0[a]
3	96+0.04[a]	100+0[a]
4	96+0.04[a]	93+0.07[a]

Table 4 shows that the commercial feeding treatment gave a survival rate of 96+0.04% and artificial feed with the addition of water hyacinth flour was 93+0.07%. The results of the t test showed that the commercial feeding treatment and artificial feed with the addition of water hyacinth did not show a significant difference in the survival rate of goldfish. In accordance with research conducted by Mukti and Octaviani (2018) which compared the effect of commercial feeding (P0), water hyacinth (P1) and kiambang (P3) on catfish, resulting in a survival rate of P0 = 100 + 0.00% and P1 = 96.67 + 5.77%.

The death of fish at the beginning of maintenance was caused by stress due to transportation and at the end of the study was caused by bacterial infection with *Aeromonas sp.* Midihatama, et al. (2018) argue that the death that occurs in fish can be caused by the weak condition of the fish after the transportation process and must adjust to the new environment after being moved. The mortality rate of goldfish is still considered normal because it is still below 30% in accordance with the opinion of Razikin, et al (2019) that mortality rates that reach 30-50% are still considered normal.

Bacterial infection and stress in some fish are thought to occur due to poor handling during the measurement of fish weight and length and the pipetting process. High mortality was caused by several unsuitable environmental factors such as water pH, temperature and feed unavailability, as well as physical damage caused by lack of care in handling (Sonata, et al. 2015).

Feed Efficiency

Feed Conversion Ratio (FCR)

The commercial feed treatment resulted in an FCR value of 1.77+0.10 and artificial feed with the addition of water hyacinth flour of 1.65+0.11. The t-test results showed that the two treatments did not give a significantly different effect on the feed conversion ratio of carp ($p>0.05$) The feed efficiency parameters observed during the study are shown in Table 5.

Table 5. Measurement Results of Feed Conversion Ratio (FCR), Feed Utilization Efficiency (EPP) and Protein Efficiency Ratio (PER)

Parameters observed	Feed Treatment	
	Commercial	Artificial
FCR	1.77+0.10[a]	1.65+0.11[a]
EPP (%)	56.64+0.03[a]	60.94+0.04[a]
PER	1.45+0.08[a]	1.74+0.11[a]

Based on Table 5, the FCR value produced by commercial feed and artificial feed with the addition of water hyacinth flour gives relatively good results, in accordance with the opinion of Ningsih (2020) the smaller the FCR value, indicating that the feed used is of high quality. Jasansong, et al. (2020) also argue that goldfish fed with a dose of 3% of their total weight produce FCR values between 1.2-1.6. In contrast to the results of research conducted by Lisi (2020) where dumbo catfish treated with water hyacinth feed fermented with cow rumen fluid (A) and feed without water hyacinth fermented with cow rumen fluid (B) for 43 days gave higher FCR results, namely A = 2.87 and B = 2.38.

Feed with the addition of water hyacinth flour gives better results besides because it meets the nutritional needs of fish is also influenced by better feed digestibility due to the fermentation process using EM4. According to Tobing (2018), using EM4 solution during the feed fermentation process can increase the level of feed digestibility because this solution will function as a probiotic.

Feed Utilization Efficiency (EPP)

Table 5 shows that the commercial feeding treatment gives an EPP value of 56.64 + 0.03% and artificial feed with the addition of

water hyacinth flour is 60.94 + 0.04% The t test results show that the two treatments do not give a significantly different effect on the efficiency of carp feed utilization ($p>0.05$). These results are considered good when compared to the results of research by Lisi (2020) with the treatment of artificial feed without water hyacinth (A) and artificial feed with the addition of water hyacinth (B) with the results of feed efficiency, namely A = 23.44% and B = 31.83%.

Excessive protein levels can reduce fish consumption of feed and inhibit growth. High levels of protein in feed result in excessive work done by the body to form glucose from amino acids (gluconeogenesis).

Protein Efficiency Ratio (PER)

Table 5 shows that commercial feed with a PER value of 1.45 + 0.08 and artificial feed with the addition of water hyacinth flour is 1.74 + 0.11, the test results show that the two treatments do not give significantly different differences in protein efficiency ratio. Hariati, et al (2015) argue that the more protein is broken down into amino acids, the more amino acids can be absorbed and utilized by the body.

The treatment of commercial feeding has a higher protein content of 39% while artificial feed with the addition of water hyacinth flour has a protein content of 35.02%. In accordance with research conducted by Haetami (2012) who conducted research with 6 feed treatments with different protein and energy content, the best feed efficiency results were produced by the treatment of feeding with 40% protein and 3200kcal/kg energy while the treatment with the lowest results was feed with 45% protein and 4050kcal/kg energy.

Commercial feed has a higher protein content but exceeds the optimal growth needs of fish. Generally, fish need protein around 20 ± 60% and optimum 30 ± 36% (Putrianti, et al. 2015). The protein content exceeds the optimal needs of fish, causing fish to be unable to absorb protein properly. According to Saiful (2016) that excess protein in feed can reduce growth, if too much protein supply in feed, only part of the protein is utilized for growth and the rest will be broken down into energy.

Water Quality

Temperature

The temperature in the commercial feeding treatment tanks ranged from 25.8 - 27.1 ℃ while, the temperature in the artificial feeding treatment tanks ranged from 25.9 - 27 ℃. The temperature in each basin fluctuates and is in optimal conditions for carp growth. According to Safri et al. (2020) the optimal temperature for goldfish is 25-30 ℃. Manunggal, et al. (2018) argue that the optimal water temperature with fish appetite is in the range of 22-29 ℃, at this temperature range fish can eat greedily, this happens in the morning and evening. The results of temperature measurements in carp rearing tanks are shown in Figure 1.

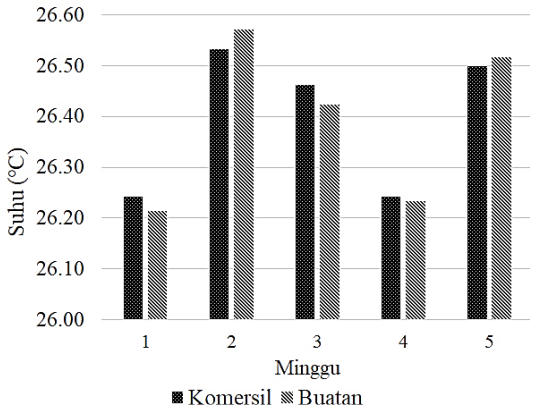

Figure 1. Temperature Measurement Results on Goldfish Raising Tubs

The t-test results showed that the treatment of commercial feed and artificial feed with the addition of water hyacinth did not show a significant difference in temperature in goldfish enlargement tanks ($p>0.05$). According to Faradiba (2018) fish are *poikilothermal* type animals, namely animals whose body temperature is the same as the temperature of the surrounding environment.

pH

The pH value in carp rearing tanks with commercial feeding treatment ranged from 7.09 - 7.89 while, in the artificial feeding treatment with the addition of water hyacinth flour ranged from 7.03 - 7.94. The pH value in each treatment is the optimal value for carp rearing. The optimal pH value for carp farming is between 6.5-8.5 (Safri et al., 2020). The results of pH measurements in carp rearing tanks are shown in Figure 2.

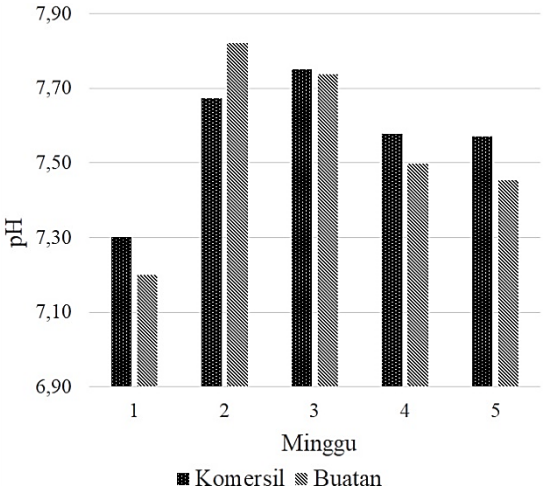

Figure 2. Results of pH Measurement in Goldfish Raising Tubs.

The t-test results showed that the treatment of commercial feed and artificial feed with the addition of water hyacinth did not show a significant difference in the pH value of the carp rearing tanks ($p>0.05$). The pH value that fluctuates and tends to vary in each enlargement basin is influenced by water quality control activities, namely penyiponan which is carried out every day. The pH value affects the pipetting process because the pipetting process removes some water from the bottom of the tub and then adds new water. The high and low pH is also influenced by fluctuations in the water content. O_2 or CO_2 (Rukminasari, et al. 2014).

Ammonia

The ammonia content in the commercial feed and artificial feed treatments with the addition of water hyacinth flour were each below 0.006 mg/L. This value is the reading limit on the spectrophometer used. The results of ammonia measurements in carp rearing tanks are shown in Table 6.

Table 6. Measurement results of ammonia levels in carp rearing tanks.

Week to	Ammonia Level (mg/L)	
	Commercial	Artificial
1	<0.006[a]	<0.006[a]
2	<0.006[a]	<0.006[a]
3	<0.006[a]	<0.006[a]
4	<0.006[a]	<0.006[a]

Table 6 shows that each treatment produces ammonia levels that are <0.006 mg/L, where 0.006 mg/L, this is because the ammonia levels produced by the commercial feed and artificial feed treatments have values below 0.006 mg/L.

The ammonia content in each treatment is in a good condition for carp growth. This is in accordance with the opinion of Alam, et al. (2020), the limit of ammonia levels that are safe for fish farming is 0.5 mg/L, while goldfish can be disrupted if their living media contain ammonia at levels of 1.2 mg/L.

Low ammonia levels in each treatment were due to routine daily flushing and good aeration. Siphoning needs to be done for aquaculture because this process can reduce the concentration of ammonia and nitrite which comes from piles of fish feces and uneaten feed residues at the bottom of the pond (Hardelah, et al. 2019).

CONCLUSION

The treatment of artificial feeding with the addition of water hyacinth flour gave better results on growth parameters (absolute length growth, absolute weight growth and specific growth rate) and feed efficiency (protein efficiency ratio, feed utilization efficiency and feed conversion ratio) but had a lower percentage of survival. Based on the results of the study, it can be concluded that artificial feed with the addition of water hyacinth flour can be an alternative feed as a substitute for commercial feed to reduce fish feed costs during aquaculture. Research can test the content of harmful metals in water hyacinth flour, because water hyacinth lives by absorbing harmful metals as nutrients to grow.

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