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Growth performance and survival rate of giant gourami fingerlings (*Osphronemus goramy* Lacepede, 1801) with potassium diformate addition

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ABSTRACT

This research aims to determine the method of adding potassium diformate to commercial feed to increase survival and growth in gourami juvenile. The method used in this research is an experimental method using a Completely Randomized Design (CRD), consists of four treatments and four replications. The treatments used are (A) Without giving Potassium diformate (control), (B) giving potassium diformate by 0.3%, (C) giving potassium diformate by 0.5% and (D) giving potassium diformate by 0.8%. The test fish used was 300 giant gourami with a length of 4-6 cm. The containers used in this research were aquariums with a size of 40 × 30 × 40 cm^3 that reared in 16 aquariums. The density of giant gourami fingerlings during the research was 10 fish per aquarium. The rearing period was 40 days. The feed given was 3% of body mass. Water quality parameters (temperature, pH and dissolved oxygen) were observed every 10 days. Other parameters are the daily growth rate, feed efficiency, the survival rate and the acidity of intestinal and stomach which were observed every 10 days. The results showed that the addition of potassium diformate by 0.3% gives the best results of daily growth rate of 1.31%, feeding efficiency of 37.18%, survival rate of 100% and decreased acidity in the intestine and stomach which helps in the process of protein absorption.

***Keywords*:** potassium diformate, giant gourami, growth, survival, *Osphronemus goramy*

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1. INTRODUCTION

Gourami fish (*Osphronemus goramy*, Lacepede, 1801) is a type of freshwater fish consumption that is very popular among people. However, unfortunately, that the growth of gourami fish is very slow compared to other freshwater fish. Gourami fish has good prospects for rearing because it has high economic value, it can also be breed naturally and live in stagnant waters. According to the Directorate General of Aquaculture of Indonesia, gourami fish is one of the potential aquaculture commodities to be developed. There is an increase in gourami fish production from 2013 to 2017 by 55.98% per year wherein 2013 the production of gourami fish was 94,604 tons and increased in 2017 to 405,304 tons.

The 5 cm gourami fish is the slowest growing fingerlings, which is 0.75% for three months of rearing. This is due to the changing phase of eating habits from insect eaters to all eaters (omnivores) and tend to eat leaves at the age of eight months. One way to overcome this is by giving a feed additive because it can maintain a healthy body and protect it against disease and the effects of stress, stimulate the growth rate, increase appetite, and increase meat and egg production in fish. One of the feed additives that are often used is antibiotics because antibiotics have a function to protect livestock from pathogenic organisms, maintain health, spur growth and improve feed efficiency.

But today, the use of antibiotics has been banned by following article 16 of Permentan No 14/2017 on Animal Drug Classification regarding the prohibition of antibiotic use as an additive to feed, because the continuous administration of antibiotics in farm animals can cause bacteria to mutate to become resistant against antibiotics, it is even possible that there is antibiotic residue in the fish meat that is eaten by humans which could endanger human health. One way to overcome this is by adding potassium diformate. Based on the Commission Regulation of the European Communities (EC) 1334/2001, potassium diformate has been registered as a promoter of non-antibiotic growth to replace antibiotics in feed, to ensure the products produced are safer for consumers.

The use of potassium diformate in feed can improve feed efficiency, improve growth performance and kill pathogenic bacteria in the gut so that the growth rate is optimum.

2. MATERIALS AND METHODS

This research was carried out in the Aquaculture Laboratory Building 4, Faculty of Fisheries and Marine Sciences, Padjadjaran University from July to October 2019. The instrument used was an aquarium measuring 40 cm × 30 cm × 40 cm, fiber tank measuring 2 m × 1 m × 1 m, DO meters, pH meters, digital scales, millimeter blocks, aeration equipment, laboratory equipment for mixing potassium diformate into the feed ie measuring cups, sprayers and trays. The material used is 300 gourami fish with a size of 4-6 grams, potassium diformate and granular commercial fish feed.

The experimental design carried out in this research was a Completely Randomized Design (CRD) consisting of four treatments and four replications, namely:

Treatment A: Commercial feed with the addition of potassium diformate as much as 0%.

Treatment B: Commercial feed with the addition of potassium diformate as much as 0.3%.

Treatment C: Commercial feed with the addition of potassium diformate as much as 0.5%.

Treatment D: Commercial feed with the addition of potassium diformate as much as 0.8%.

2. 1. Experimental Units

The gourami fingerlings that will be treated are acclimatized for 5 days in a fiber container which was given aeration and commercial feed. There were 16 fish kept in the aquarium equipped with aeration and heater. Feeding was carried out twice a day, namely in the morning at 08.00 West Indonesia Time and late in the evening at 17.00 West Indonesia Time using a mix of test feed which was 3% of fish biomass, potassium diformate with different amounts in each treatment according to research methods. The siphoning was done every day and the water volume is replaced by 10% to maintain water quality during rearing. Gourami fish was reared for 40 days.

2. 2. Experimental Fish

Three hundred gourami fingerlings used with the initial weight of 4-6 grams were obtained from the Southern Ocean and Fisheries Service Office Branch Tasikmalaya, West Java. The fish used must have a homogeneous and healthy body weight.

2. 3. Experimental Diets

The nutritional content of the commercial feed used must be by following the needs of 4-6 grams gourami fish. The step of adding potassium diformate into commercial feed is, to add potassium diformate into the feed and then stir until it becomes homogeneous, after that the feed is sprayed using 10% water so that the formulated potassium is bound to the feed, then dried by aerating it and then the feed can be given to the gourami fish. Feed that has been given potassium diformate must be completely dry because if it's wet, it will be covered with mold. Feed mixing is carried out once every 10 days.

2. 4. Experimental Methodology

Gourami fish fingerlings were kept in an aquarium as a rearing container with a density of 10 fish/aquarium. Fish were weighed once every 10 days to get the value of weight gain, feed efficiency and survival. Measurement of water quality in gourami habitat namely temperature, DO (Dissolved oxygen) and pH was done every 10 days to maintain the environment of the fish according to the standard values required for the fish to live. And the measurement of the stomach acidity is carried out at the beginning of and at the end of treatment.

Observed parameters include:

a. Daily Growth Rate

$$\alpha = \frac{\ln \mathrm{Wt} - \ln \mathrm{Wo}}{t} \times 100\%$$

Explanation:

α = Daily Growth Rate of weights
Wt = Average weight at the end of treatment (t-day)

Wo = Average weight of initial treatment (day 0)
t = Observation Duration (days)

b. Efficiency of Feeding

$$EPP = \frac{(Wt+D)-Wo}{F} \times 100\%$$

Explanation:

EPP = Efficiency of Feeding
F = Amount of feed given during the research (g)
Wt = Biomass at the end (g)
Wo = Biomass at the beginning (g)
D = Gourami biomass that died during the research (g)

c. The Degree of Survival

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

Explanation:

SR = Degree of Survival (%)
Nt = Number of living fish at the end of treatment (individual)
No = The number of fish at the beginning of treatment (individual)

d. The Degree of Acidity (pH) of the Intestine and Stomach

The measurement of intestinal and gastric pH of gourami fish was carried out at the beginning and at the end of the research to compare the degree of acidity of the intestine and stomach of the gourami fish before and after the treatment. Dissected fish amounted to two fish per test. Intestinal pH measurements were carried out using a pH meter according to the Elala and Naela method (2015). After the fish were dissected, the digestive tract, which was the intestine and stomach, was then removed and the intestine was divided into three equal parts (upper, middle, and lower intestine). The intestine which had been divided into three parts and the stomach was then smoothed and taken as much as 0.5 grams from each part then mixed with 4.5 ml of distilled water for pH measurement.

e. Water Quality

Water quality measurements in this research included temperature, DO (Dissolved Oxygen) and pH (temperature, DO and pH, respectively, measured with a thermometer, pH meter and DO meter).

Data on daily growth rates, feeding efficiency and survival rates were analyzed using the F-test with a 95% confidence level. If there were significant differences, then the test would be continued with Duncan's multiple range test. While data on the intestine and stomach acidity were analyzed descriptively and water quality data were analyzed descriptively according to the quality standards of SNI (Indonesian National Standard).

3. RESULT

Based on the research activities, the following results are obtained:

3. 1. Daily Growth Rate

The results show that the daily growth rate of gourami is in the range of 0.64 - 1.31%. The daily growth rate of gourami fish can be seen in Figure 1.

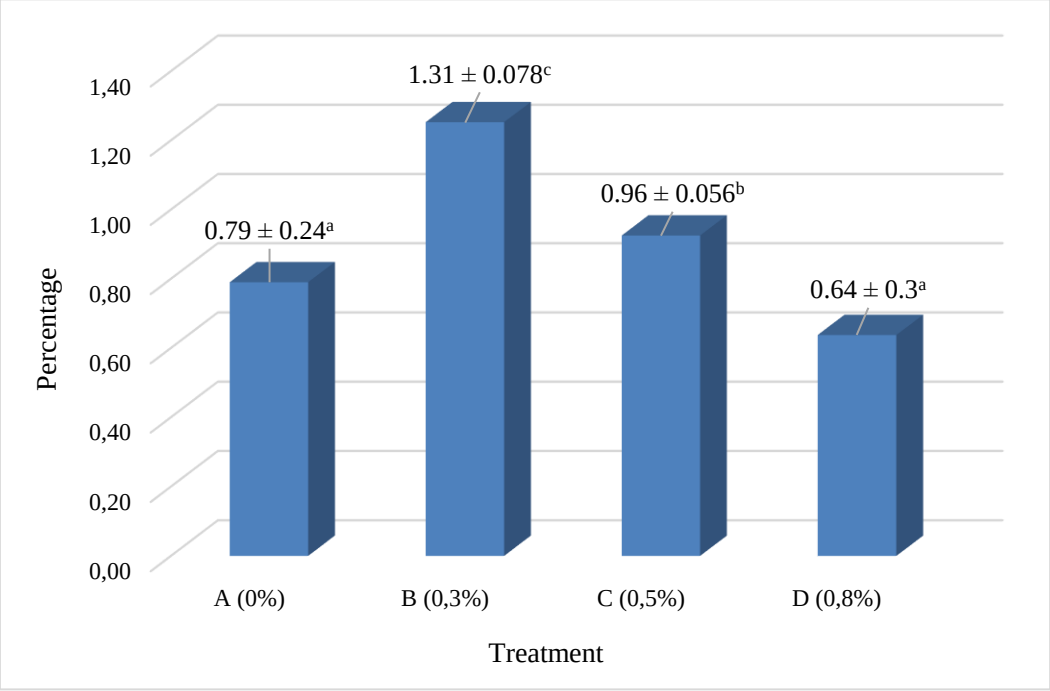

Figure 1. Daily Growth Rate Graphic

The highest daily growth rate of gourami is treatment B with an average daily growth rate of 1.31%, then followed by treatment C of 0.96%, then treatment A of 0.79% and the lowest daily growth rate is the treatment D with a daily growth rate of 0.64%.

The range of daily growth rate of treatment B can be said to be good because it is above a good growth rate of at least 1%. However, treatments A, C and D can also be said to be good because the 5 cm gourami fish are the slowest growing fingerlings, which is 0.75% during the three-month rearing period. This can be expected because in this research the fish that the digestive tract was used had begun to complete but then began to experience a transition of eating habits after all they were already 4 months old. The intestinal length is relatively increased when fish size increases.

So the fish that are fed with organic acids will grow faster, fish intestines will absorb protein and nutrients more optimally. Therefore, administering organic acids is thought to be able to reduce the pH of the digestive tract where under acidic environmental conditions, the digestive tract will absorb more nutrients because it is in optimal conditions. Because the pepsin will break down proteins by releasing peptide bonds and forming peptones in the acidic

digestive tract. Besides, the addition of organic acids will reduce pathogenic bacteria in the digestive tract by damaging cytoplasmic cells, so that the number of pathogenic bacteria decreases and the number of commensal bacteria increases.

(a) Initial Biomass Fish **(b)** Final Biomass Fish

Figure 2(a,b). Comparison of Biomass Gouramy During Research

3. 2. Feed Efficiency

The results showed the feed efficiency of gourami is in the range of 23.01 – 37.18%. The daily growth rate of common gourami fish can be seen in Figure 3.

The addition of potassium diformate can increase the value of feeding efficiency as evidenced by the value of feeding efficiency of treatment B (potassium diformate by 0.3%) significantly different from other treatments (Figure 3). This is because the higher the dosage of potassium diformate given to the feed will affect the osmoregulation system of fish. After all, the potassium diformate is an organic acid salt so that the energy used for growth is only in a small amount and the rest is to balance the osmoregulation system of fish.

Also, potassium diformate can kill pathogenic bacterial cells in the digestive tract and increase the number of commensal bacteria so that the nutrients contained in the feed can be easily absorbed and the feed given to the fish can be utilized efficiently and thus increase the value of feeding efficiency. Potassium diformate can make the digestive tract of animals become acidic.

This can help increase the assimilating enzymatic activity and can then increase feed intake and feed efficiency. Potassium diformate can also reduce *Escherichia coli* and *Salmonella*, increasing beneficial bacteria and reducing diarrhea by lowering the intestinal pH. High feeding efficiency shows that the use of feed is efficient so that only a few nutrients are overhauled to meet energy needs and the rest is for growth. This is because the higher the dosage of potassium diformate given to the feed will affect the osmoregulation system of fish. After all, the potassium diformate is an organic acid salt so that the energy used for growth is only in a small amount and the rest is to balance the osmoregulation system of fish.

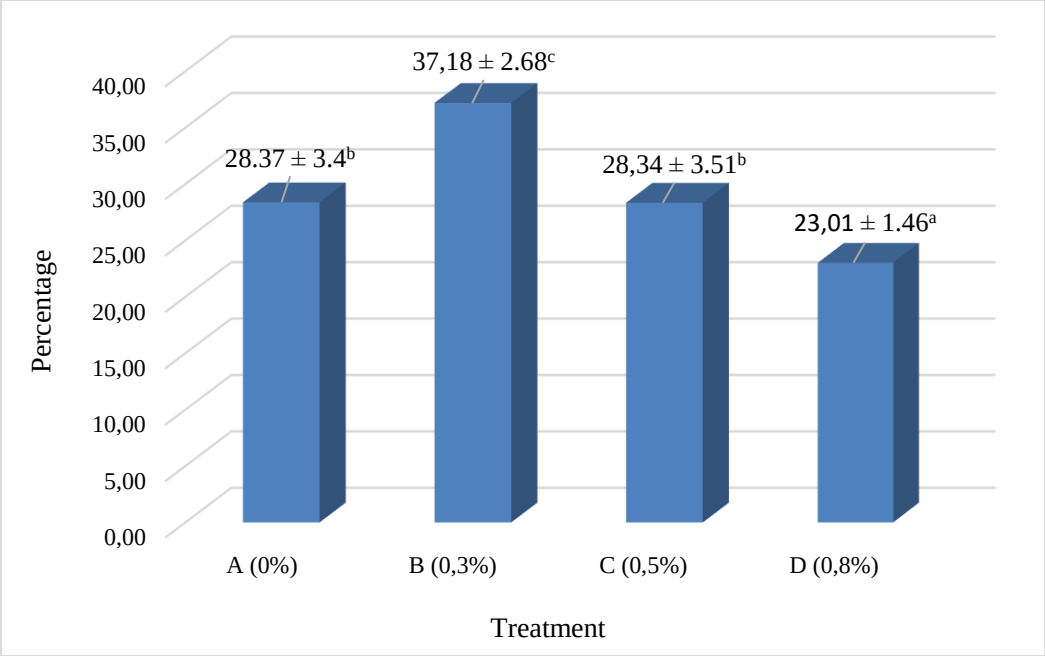

Figure 3. Feed Efficiency Graphic

3. 3. Survival Rate

The results show that the survival rate of gourami is in the range of 90 – 100%. The daily growth rate of common gourami fish can be seen in Figure 4.

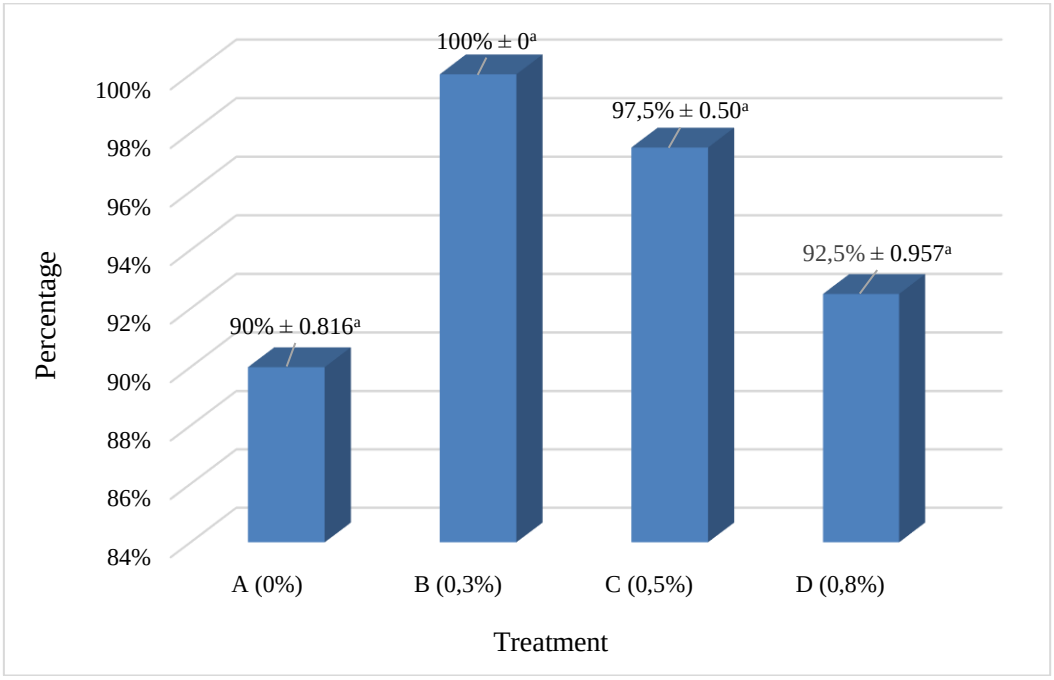

Figure 4. Survival Rate Graphic

Based on observations made for 40 days, the highest survival rate is treatment B with 0.3% addition of potassium diformate that is equal to 100% (Figure 4). Giving potassium diformate in fish feed has an effect but not significant (only has a tendency) to the survival rate of gourami fish because in the control treatment and the treatment which the potassium diformate is added does not show significantly different values, other than that the survival rate in this research is above 90% which is considered quite high. The survival rate of gourami fish that is not significantly different for each treatment and is within a very good range can be caused by the positive reaction of fish to feed that is added with potassium diformate. This is marked by the consumption of feed that has been added in potassium diformate. Besides, the feed factors and environmental conditions also affect the survival rate of gourami fish, because environmental conditions at the time of treatment are by following the standards of gourami fish culture according to Indonesian Nasional Standard.

The existence of fish deaths that occur during the treatment is allegedly due to stress because the rearing media used for the research was an aquarium in a laboratory, where this media is a different one used from the previous treatment which were kept in outdoor ponds, so it caused fish to experience stress. This happened because gourami fish has a sensitivity to stress shown by the movement of fish that were very active when removed from the water. After all, it is known that stress can reduce feed absorption, weaken fish and affect spawning success. The survival rate of gourami fish is not significantly different for each treatment due to the positive response of fish to feed. This is marked by the amount of test feed eaten during research. This indicates that the addition of potassium diformate in commercial feed by 0.3%, 0.5% and 0.8% has no negative effect on the survival of gourami fish fingerlings.

3. 4. Intestine and Stomach Acidity

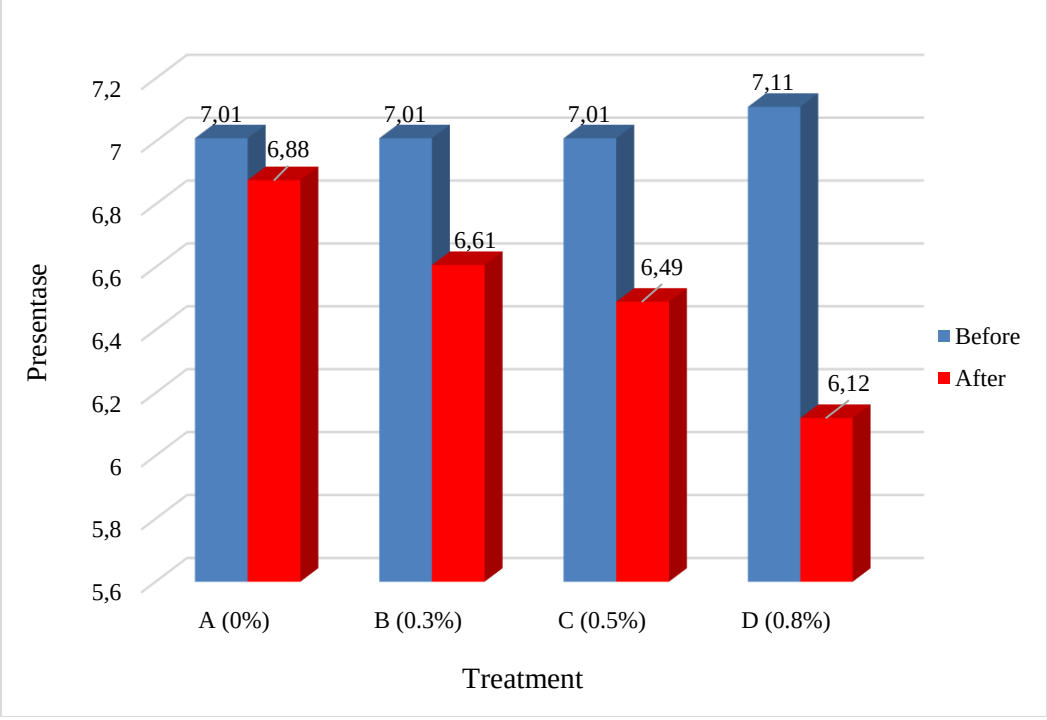

Figure 5. The Degree of Intestine and Stomach Acidity Graphic

The results show the intestine and stomach acidity of gourami is in the range of 6.12 – 7.11. The daily growth rate of gourami fish can be seen in Figure 5.

Based on Figure 5, it can be seen that the pH of the gourami's stomach measured decreases after the addition of potassium diformate to the feed. Treatment A (without the addition of KDF) has an initial pH of 7.01 and at the end of the research, it increases to 6.97. Treatment B has an initial pH value of 7.01 and a final pH of 6.61, treatment C has an initial pH value of 7.01 and a final pH of 6.49, and treatment D has an initial pH value of 7.11 and a final pH of 6.12. Gurame fish that were fed with the addition of potassium diformate have a lower pH value than those without the addition of diformate potassium. This makes the condition of the stomach in an optimal state to digest feed so that fish growth becomes faster. pH below 6 pepsinogen is broken and then active pepsin is formed which has a very stable amino acid residue at pH 6-6.3. Pepsin's activity depends on pH, temperature, and type of substrate. A low pH value will be easier to destroy materials originating from the feed consumed.

The pH value of the digestive tract obtained in research proves the function of potassium diformate addition to the feed that it can reduce the pH of the digestive tract to provide optimal conditions for the activation of the enzyme pepsin in protein breakdown, and can stop the growth of pathogenic bacteria and increase the growth of commensal bacteria, so the feed with the addition of diformate potassium consumed by fish can increase growth.

3. 5. Water Quality

Water as the medium of fish life must qualify the parameters that show that it is suitable for fish life because water quality can influence the growth of aquatic organisms. The results of average water quality measurements can be seen in Table 1.

Table 1. Water Quality Measurement Result

Parameter	Unit	Range Value	*Quality Standards
Temperature	ºC	26 – 30	25 – 30
pH	Mg/L	6,38 – 7,30	6,5 – 8,5
DO	-	6,5 – 7,10	> 4

*****According to Indonesian National Standard (SNI) 2000.

Based on the measurement results, the temperature range in aquarium treatment was between 26 – 30 ºC, this range is still within the range of the standard quality temperature according to SNI for gourami fish, which is 25 – 30 ºC. The temperature affects the response of fish to feed. The optimum water temperature in the rearing media can make the fish's response to feed optimum. However, if the temperature is less or more than the optimum temperature range, the fish's response to feed will decrease.

Temperature values are related to dissolved oxygen (DO) values in the aquarium water. The higher the temperature of the water, the lower the solubility of oxygen in water, and vice versa. When the temperature is optimum, the dissolved oxygen will be optimum. Dissolved

oxygen becomes one of the determining factors of fish live in water. Dissolved oxygen is used for metabolic processes in the body of the fish, therefore the lack of dissolved oxygen will threaten the life of the fish. The content of dissolved oxygen which is good for fish farming ranges from 4-9 mg / L. The value of dissolved oxygen during the research was still in the normal range, which is 6.5 - 7.10 mg / L. This shows that the fish's need for dissolved oxygen was fulfilled during the research.

The degree of acidity (pH) of water in the rearing aquarium ranges from 6.38 - 7.30. The pH of water in the aquariums is suitable for gourami culture, the standard quality limit for gourami pH is 6.5 - 8.5. Also, the degree of acidity that is good for the growth of fish and aquatic organisms is between 6.5 to 8.5. The pH value will affect the growth of fish because the appetite of fish is reduced at low pH. A low pH value can cause clumping of mucus in the gills and the fish will suffocate so that the food consumed is used more as energy to maintain the body than for growth. The effect of pH varies, depending on the species and size of the fish and the temperature.

4. CONCLUSIONS

The conclusion that can be drawn from this research is that the optimum dosage of the addition of potassium diformate is 0.3% to produce the highest daily growth rate of 1.31%, the highest feeding efficiency of 37.18%, the highest survival rate of 100% and decreased acidity in the intestine and stomach which helps in the process of protein absorption.

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