Available online at www.worldscientificnews.com

World Scientific News

An International Scientific Journal

WSN 132 (2019) 244-255 EISSN 2392-2192

Effectiveness of potassium diformate in artificial feed against the growth rate of *Nilem* fish *Osteochilus hasselti* (Valenciennes, 1842) seed

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ABSTRACT

Nilem fish is an endemic fish in West Java that has the potential to be developed into superior aquaculture products. The effect of feed additives on growth can help in increasing the protein synthesis process so that the fish growth process can be optimal. This research was carried out at the Ciparanje Experimental Pond Hatchery at the Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran, from October 1 2018 to November 20 2018. The research method was carried out experimentally with Completely Randomized Design (CRD). This study used four treatments which were repeated three times. The treatment in this study consisted of adding potassium diformate to artificial feed at doses of 0%, 0.1%, 0.3%, and 0.5% per 100 grams of feed. The parameters observed in this study were survival, growth rate, feed efficiency, and water quality. The analysis used was the f test and descriptive analysis. The survival rate, growth rate and feed efficiency range from 87.08% -93.75%, 2.22% -2.26% and 41.21%-47.69% respectively. The addition of potassium diformate to artificial feed up to 0.5% per 100 grams of feed can be used as a feed additive in *nilem* fish cultivation.

***Keywords*:** Potassium diformate, *Nilem* Fish, *Osteochilus hasselti,* Growth Rate

(Received 07 July 2019; Accepted 24 July 2019; Date of Publication 25 July 2019)

1. INTRODUCTION

Indonesia has considerable local fish potential. To increase aquaculture production, local fish commodities play an important role in supporting the achievement of these targets. Local fish is a potential that can be developed in addition to fish that have been commonly cultivated. One of the potential local fish is *nilem* fish. This fish is a local fish commodity from West Java.

Nilem fish (*Osteochilus hasselti*) is one of the many freshwater fish that is cultivated in Indonesia. This fish is herbivorous fish, which has been known that his life spread in parts of Southeast Asia waters such as Siam-Thailand, Peninsula-Malaysia, Sumatra, Kalimantan, and Java.

Nilem fish is widely cultivated because it is a consumption fish, especially on the island of Java, especially in West Java. People love it because the taste of the meat is delicious. The potential of *nilem* fish as aquaculture can be seen from the economic side, environmental sustainability, and production. *Nilem* fish are Indonesian endemic fish targeted as potential fish for *minapadi* in the Tasikmalaya and Bandung regencies.

Nilem fish is very potential to be used as aquaculture products. The economic value of *nilem* fish increases after being processed products such as baby fish fried, jerky, *pindang*, smoked and canned. *Nilem* fish eggs are also dried by the community because they taste delicious and have an opportunity as an export commodity. Seeing the conditions and opportunities *nilem* fish have good prospects for the development of aquaculture in the future. The most supporting factors in aquaculture are feed.

Feed as the largest component in financing aquaculture activities, therefore the provision of efficient feed is crucial to the success of cultivation activities. The feed has a fairly high operational cost of around 60% -70%, whereas most of the fulfillment of feed protein needs are supplied from fish meal use whereas, Indonesia is still dependent on imported fish feed raw materials, namely fish flour so that fish feed prices have increased along with the weakening of the rupiah.

The main ingredient in the feed as an energy source that contains protein, fat, and carbohydrates. Besides, the feed must also contain vitamins, minerals, fiber, and water. In the process of making fish feed, protein is an important component. Fish nutrition needs in aquaculture activities can be fulfilled by calculating protein content in the preparation of feed ingredients. Fats, carbohydrates, vitamins, and minerals are other nutritional components that are also important and must be available in fish feed. This makes the role of feed-in aquaculture activities to be quite dominant.

The feed may be one way to raise the performance of growth hormones in fish by adding the feed additive. Feed additives are a combination or arrangement of ingredients that are added in small amounts into a feed mixture to meet special needs. Feed additives that are often used to meet special needs include antibiotics, hormones, arsenic, surfactants, and tranquilizers. However, the use of antibiotics in animals in several countries has been banned because of the residue in the meat produced and can endanger consumers. Then one alternative that can be used to add the substances necessary in the fish growth process by adding potassium diformate as additives in feed. A good quality feed can be added with some mixed ingredients, one example being potassium diformate. This material is salt made with *double-salt technology* so that it has an active ingredient above 90%. Potassium diformate has several advantages compared to formic acid including odorless, non-corrosive, evaporation and neutral pH.

Potassium diformate has been tested on certain fish such as tilapia, catfish, carp, milkfish,

and shrimp that are proven to work optimally. The optimal addition of potassium diformate in artificial feed requires a variety of research to determine the level of use of potassium diformate which can provide the best growth of *nilem* fish seeds, so research on the level of use of potassium diformate in *nilem* fish seed feed needs to be done. The effect of potassium diformate on growth can optimize pH in the digestive tract and stop the growth of pathogenic bacteria but still retain good bacteria so that it can help the absorption process in the digestive tract so the process of fish growth can be optimal. To find out the effect of potassium diformate on fish growth, it is necessary to research test fish, one of which is *nilem* fish.

2. MATERIAL AND METHODS

This research was carried out at the Hatchery of the *Ciparanje* Experimental Pond Faculty of Fisheries and Marine Sciences, Padjadjaran University, on October 1, 2018, to November 20, 2018. Fish used in this study were *Nilem* fish having a length of 3-5 cm and weights ranging from 1-4 grams per tail, and 2 months old. The feed used in this study was commercial feed with the addition of different potassium diformate, namely 0%, 0.1%, 0.3%, and 0.5% per 100 grams of feed. The test feed used is a commercial feed of Brand FF-999 with a protein content of feed that is by the needs of the test fish protein, which is 35%. The research method was carried out experimentally using a Completely Randomized Design (CRD). This study used four treatments, each treatment was repeated three times. The treatments given are as follows:

Treatment A: Provision of commercial feed without the addition of potassium diformate as much as 0% (control).

Treatment B: Provision of commercial feed with the addition of potassium diformate as much as 0.1% per 100 grams of feed.

Treatment C: Provision of commercial feed with the addition of potassium diformate as much as 0.3% per 100 grams of feed.

Treatment D: Provision of commercial feed with the addition of potassium diformate as much as 0.5% per 100 grams of feed.

2. 1. Research Procedure

2. 1. 1. Mixing of Potassium diformate in Feed

The test is potassium diformate weighed first according to the desired dose. Then mixed into the feed evenly, after that sprayed with distilled water which serves as feed adhesive and potassium diformate. Then the feed mixed with potassium diformate is dried air.

2. 1. 2. The Preparation of Aquariums

The aquarium is washed using a sponge then rinsed with water and then dried. Then dissolved chlorine in an aquarium for 24 hours, the point is to sterilize the aquarium from the remnants of bacteria. After that, the aquarium is rinsed and washed so that the aquarium is clean. The aquarium used was 12 pieces measuring 40 × 30 × 30 cm^3, which were equipped with recirculation. Each aquarium is given a sign according to its layout. The aquarium is filled with 30 L of water and aerated for 24 hours.

2. 1. 3. Fish Test Preparation

The test fish used in this study were *Nilem* fish that had been used chosen based on uniform size. The stocking density in this study was 1 tail / 1.5 L of water or as many as 20 *Nilem* fish were stocked in each aquarium containing as much as 30 liters of water. The test fish is acclimated first so that the fish can adapt to the environment around the research and the feed to be given. Acclimation is carried out for 7 days until the fish feel comfortable with their environment.

2. 1. 4. Implementation of the

Research this study was conducted for 40 days, every 10 days observation and measurement of fish weight and test feed were used during the study. Aquariums that have been cleaned and filled with water are then inserted in the acclimated test fish. Before the test fish is inserted into the aquarium, initial weight measurements are carried out. The feed is given as much as 3% of the bodyweight of the fish. The amount of feed given will change according to the weight gain of the fish. The frequency of feeding is 2 times a day, namely 08.00 AM and 04.00 PM. Then sampling is done every 10 days.

2. 2. Parameters of Research

2. 2. 1. Survival (Survival Rate)

Survival observations are carried out every day. To find out the survival data of the test fish the following formula is used:

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

Description:

SR = Survival (%)
Nt = Number of test fish at the end of the study (tail)
No = Number of test fish at the beginning of the study (tail)

2. 2. 2. Specific Growth Rate

The observation of growth was carried out by measuring fish body weight every 10 days for 40 days of maintenance. Fish were observed by sampling method which was taken as many as 10 fish per aquarium. Calculation of growth is done using the Effendie formula (1997) as follows:

$$\text{SGR} = \frac{\ln Wt - \ln Wo}{\text{t}} \times 100\%$$

Description:

SGR = *Specific Growth RateSpecific Growth Rate* -(%)
Wt = average weight at time t (g)
Wo = initial average weight (g)

t = time (days)

2. 2. 3. The efficiency of Feed Utilization

Efficiency is calculated from the percentage of fish biomass produced compared to the amount of feed given, the efficiency of feed is calculated using the formula:

$$EFU = \frac{Wt - Wo}{F} \times 100\%$$

Description:

EFU = Efficiency of Feed Utilization
Wt = Final fish weight research (gr)
Wo = initial research fish weight (gr)
F = Total feed given (gr)

2. 2. 4. Water Quality

The water quality parameters observed included levels *of Dissolved Oxygen*, temperature, and pH. Observations were made once in each observation of fish by taking water samples from each treatment. Water quality observations are carried out during the morning.

2. 3. Data Analysis

Analysis of survival, daily and daily growth rates Efficiency of feed utilization was tested using the F-test and continued with the test Duncan at level 5%. The analysis in the water quality data was tested descriptively.

3. RESULTS

3. 1. Survival Rate

Survival is the level comparison of the number of fish that live from the beginning to the end of the research. Survival is used as a benchmark to see the tolerance of fish to the environment. The greater the percentage value obtained, the higher the ability of the fish to survive.

Based on the results of observations for 40 days, the percentage of survival rates of *Nilem* fish varies. The highest survival was found in treatment D of 93.75% and the lowest in treatment A was 87.08%. The survival rate of all treatments having a value above 80% is considered to be quite high and SNI No. 01-6137 - 1999 showed that fish gave a positive response to the feed potassium diformate added (Figure 1).

Figure 1 shows that the survival of *Nilem* fish increased at each treatment. The greater the potassium diformate dose in feed, the higher the survival rate of fish. *Nilem* fish given the addition of potassium diformate to feed has a higher survival rate than those not given the addition of potassium diformate.

Based on the results of the analysis of variance, the addition of potassium diformate to feed influences the survival of *Nilem* fish. test results Duncan's follow-up showed that treatment A was significantly different from other treatments (Treatment B, C, and D), but between

treatments B, C and D did not provide a significant difference. That organic acid (potassium diformate) can be used to improve fish survival, stimulate growth, inhibit pathogenic bacteria in the intestine, energy for aquatic organisms, and increase nutrient digestibility.

The survival of fish is very dependent on the adaptability of fish to food, the environment, health conditions of fish, stocking density and water quality that is quite supportive growth. The high survival rate in this study is also thought to be related to the adequacy of feed given and supported by good water quality during the study.

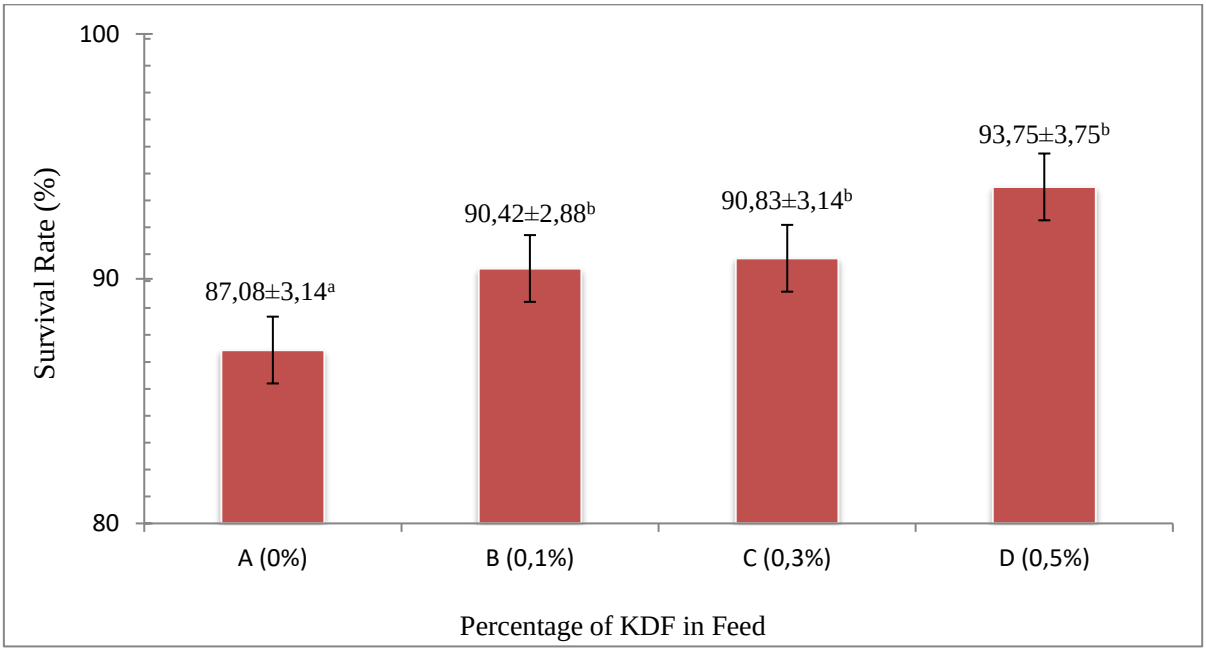

Figure 1. Survival Rate

3. 2. Specific Growth Rate

Growth is the increase in weight and length of the fish body in a given period. Physically, there is a change in form due to the increase in length, weight, and volume in a certain period individually. Growth in individuals is a net increase due to cell division that occurs due to excess energy inputs and amino acids (proteins) derived from food.

Based on observations, the percentage of the daily growth rate of *Nilem* fish has varying values. The highest daily growth rate was found in treatment C at 2.71% and the lowest in treatment A at 2.22% (Figure 2).

In Figure 2 it can be seen that the daily growth rate tends to increase to a dose of 0.3%, but at a dose of 0.5% the value of SGR decreases. The addition of potassium diformate 0.3% to the feed became the potassium diformate dose which tended to be optimal for the growth of *Nilem* fish, because at larger doses, the addition of potassium diformate 0.5% descriptively even gave a smaller SGR value compared to the dose of potassium diformate 0.3% which produce higher SGR values.

The results of variance analysis showed that *Nilem* fish fed with the addition of potassium diformate A (0%), B 0.1%, C 0.3%, and D 0.5% did not give effect to the daily growth rate of

Nilem fish. The influence that is not significantly different in all treatments adding potassium diformate up to 0.5% on feed indicates no negative impact on the growth of *Nilem* fish and does not inhibit or disrupt the growth rate of *Nilem* fish. The absence of a real effect can be expected because the feed provided has sufficient nutrients needed by fish. If the need for maintenance which exceeds the amount of feed given, there will be a process of dismantling the energy in the body of the fish itself (catabolism). A sufficient amount of feed for fish means enough for the maintenance of the body, daily activities, and growth of fish, if there is excess or lack of feed, it can result in a declining growth rate.

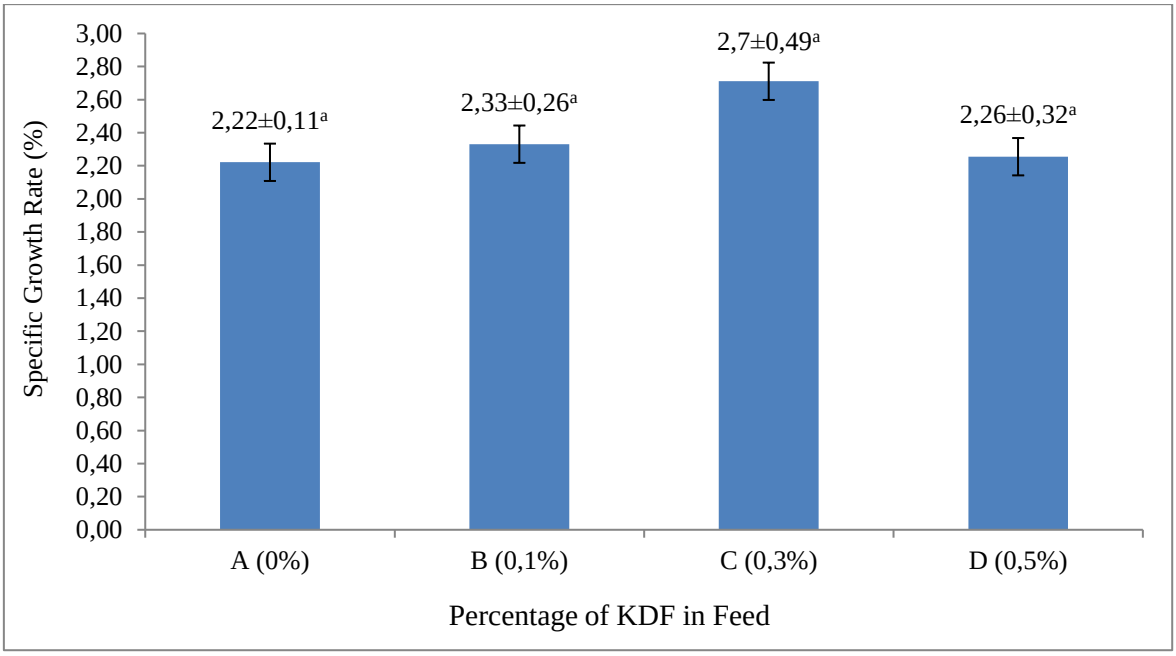

Figure 2. Specific Growth Rate

In this research the use of organic acid in the form of potassium formatted as a growth promoter to increase feed digestibility by lowering intestinal pH, so that the activity of digestive enzymes as catalysts in the process of nutrient hydrolysis of feed into simple products takes place optimally. One digestive enzyme whose activity is affected by a decrease in pH, namely the enzyme pepsin. Pepsin enzyme activity can be optimum at pH 2 or acidic conditions, thus the use of potassium diformate is thought to optimize pepsin activity in protein breakdown into a peptide by reducing intestinal pH. Potassium diformate function in the gut can also break down the cells of pathogenic bacteria in the digestive tract so that the absorption of nutrients in the channel digestion can be optimal and improve the health and growth of fish.

The increase in the average body weight of *nilem* fish shows that the feed provided can meet nutrient intake and can be digested and absorbed by the body of the fish. Growth can occur if there is excess energy from the food consumed because the intake of nutrients from the feed is first used for the metabolism of fish.

The increase in the weight of *nilem* fish is thought to be due to an excess of nutrients from the food that is digested and absorbed by fish. The more feed consumed the higher the bodyweight that is produced to accelerate growth. The growth occurs when feed nutrients are

digested and absorbed by the body of the fish is greater than the amount needed to maintain the body.

3. 3. The efficiency of Feed Utilization

Efficiency shows how much feed the fish can use. Low feed efficiency values indicate that fish need more quantities of feed to be used for growth. Based on the results of observations, the percentage of the efficiency of the utilization of feed for *nilem* fish has varied values. The highest level of efficiency of feed utilization was found in treatment C of 47.69% and the lowest in treatment A was 41.21% (Figure 3).

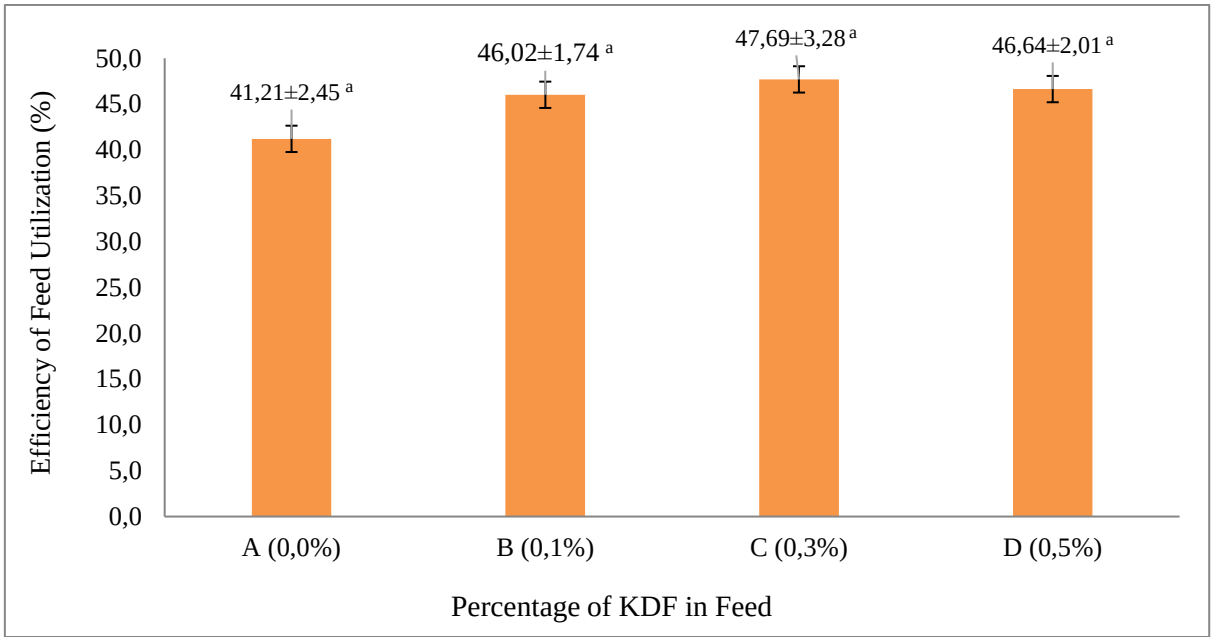

Figure 3. The efficiency of Feed Utilization

In Figure 3 it can be seen that feed utilization efficiency tends to increase to a dose of 0.3% but at a dose of 0.5% value downhill. potassium diformate addition of 0.3% on the feed into the potassium diformate tends to be optimal for fish feed utilization *nilem*, because of the doses greater than the addition of potassium diformate 0.5% descriptively even gives lower values compared to the 0.3% potassium diformate dose produce higher efficiency of feed utilization values.

The results of variance analysis showed that *nilem* fish were given a feed with the addition of potassium diformate A (0%), B 0.1%, C 0.3%, and D 0.5% no influence the daily growth rate. Added potassium diformate 0.3% (Treatment C) on feed gives the highest efficiency of feed utilization value compared to other treatment. This value is much higher than the results of research by Nanda et al (2017) where the results show that the efficiency of feed utilization value of *nilem* fish ranges from 11.17% to 17.33%.

The value of feeding efficiency is directly proportional to growth produced, meaning growth will change in line with changes in the efficiency of feeding. The greater the efficiency of feeding, the better the fish use the feed given so that the greater the bodyweight of the fish

produced. The efficiency of feed utilization can be influenced by several factors, including fish size, fish physiology function, feed quality, and feed consumption level. Not all food eaten by fish is used for growth. Most of the energy is used for maintenance, the rest is for activity, growth, and reproduction. The greater the feed is given to fish does not guarantee the process of digestion and absorption of food substances to be effective. This is because the feed that enters the stomach is not absorbed properly. Feeds that are given at once in large quantities at long intervals cause the food consumed may not be properly metabolized by fish.

The addition of potassium diformate to *nilem* fish feed generally increases the value of feed utilization efficiency compared to the control treatment. It is assumed that the addition of potassium diformate to artificial feed used in this research can improve the quality of fish feed. The feed efficiency is tested to assess feed quality, the higher the feed efficiency value proves that feed is getting better. Based on the results of the research, it was shown that the addition of potassium diformate to the feed given could improve the efficiency of *nilem* fish seed feed compared to without the addition of potassium diformate or control.

The research results obtained is higher than the results of research was conducted by Hermawan et al. (2015) obtained the highest value in *nilem* fish, which is 0.53%, very low feed at *feeding rate*, 1%presumably because fish lack energy intake from food, where only a small portion of energy obtained from feed can be used for basic needs. The feed that has an efficiency of feed utilization of more than 50% or close to 100% can be categorized as a good feed.

The level of efficiency of fish feed utilization can be seen from the feed digestibility given. The feed digestibility is one indicator that can be used to assess the level of feed efficiency given to fish. The greater the digestibility value of a feed, then the more feed nutrients that these fish use. The nutrient value which can be absorbed by the body is influenced by several factors such as composition feed and amount of feed.

The feed efficiency is closely related to preference fish with feed given, besides that, it is influenced by the ability of fish in digesting feed ingredients. Different amounts and composition of feed ingredients in the feed also affect feed efficiency. The organism's preference for feed given is influenced by several factors, namely the stocking density of organisms, the availability of feed, the choice of fish factors and physical factors that affect the waters. The value of feed efficiency, in general, can be interpreted as good feed utilization of the total feed given. The feed efficiency was obtained from the comparison of the result between body weight gain and the amount of feed spent during the maintenance period. The value of feed efficiency is related to the growth rate because the higher the growth rate, the greater the weight gain of the fish body and the greater the value of feed efficiency.

3. 4. Water Quality

The success of aquaculture is largely determined by environmental factors influence it. Water quality is a physical and chemical factor that can affect the maintenance media environment and indirectly will affect the metabolic processes of test fish. Water quality parameters observed in this research include dissolved oxygen (DO), pH, and temperature. The results of observing water quality during maintenance are presented in Table 1 and compared with SNI No. 01-6137-1999 below. The results of the pH range measurement on maintenance media are 6.78 - 7.91. This value is still in the same range as SNI No. carp. 01-6137-1999 and can still be tolerated by *nilem* fish seeds. The pH value of 6.7 - 8.6 is included in the high category to support existing cultivation activities. State that the acidity (pH) that is good for the growth of fish and aquatic organisms is between 6.5 - 8.5.

Table 1. Water Quality Media Research.

Parameter	Unit	Value range	Standard (SNI)
pH	-	6.78 – 7.91	6.5 – 8.5
DO	mg/L	5.8 – 7.9	≥ 5
Suhu	ºC	23.4 – 24.4	≤ 28

The content of Dissolved Oxygen (DO) in maintenance media is above the minimum quality standard according to SNI No. 01-6137-1999 which states that the minimum DO content in waters to support the growth of *nilem* fish is above 5 mg / L. DO of 7.9 mg / L is included in the good category for *nilem* fish growth. The optimal dissolved oxygen content is DO ≥ 4 mg / L for waters.

The water temperature in the aquarium is 23.4 to 24.4 ºC. This value is following the water quality standard according to SNI No. 01-6137-1999. The good temperatures for waters ranged from 25-30 ºC. Water temperature affects the appetite and metabolic processes of fish. At low temperatures, the process of digestion of food in fish takes place slowly, while in warm temperatures the digestion process takes place faster. Based on the results of measurements of the water quality, it can be concluded that potassium diformate in the feed does not affect the quality of the aquaculture water.

4. CONCLUSION

Based on the results of the research that has been done, it can be concluded that the addition of potassium diformate in artificial feed at a dose of 0.1% to 0.5% tends to be effective for increasing survival. The 0.3% dose results in the highest daily growth rate and efficiency of feed utilization.

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