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EFFECT OF USING POTASSIUM DIFORMATE AS A FEED ADDITIVE TO GROWTH RATE AND FEED EFFICIENCY OF NIRWANA TILAPIA *(OREOCHROMIS NILOTICUS)*

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ABSTRACT

The aim of the research it to determine dose of potassium diformate to be added to feed of Tilapia Nirwana (*Orechromis niloticus*) that can improve the highest growth and feed efficiency. The research was conducted from 25 April to 20 July 2018 in Aquaculture Laboratorium of The Faculty of Fisheries and Marine Science Universitas Padjadjaran. This research used experimental method with a Completely Randomized Design (CRD), which concists of four treatments and four replications. The treatment consist of A (dietary 0% potassium diformate), B (0,3%), C (0,5%) and D (0,7%). Parameters observed in this research are Spesific Growth Rate (SGR), Feed Effeciency (FE), Survival Rate (SR), pH of Intestines and water quality. Data if this research analyzed with F-Test and Duncan's Multiple Range Test (DMRT). The result show significantly that feed added by potassium diformate 0,3% improves the specific growth rate and feed efficiency of Nirwana Tilapia by 3,20% per day and 67,39%, respectively the survival rate of the treatment is 100%.

Keywords: Nirwana Tilapia (*Oreochromis niloticus*), potassium diformate, specific growth rate, feed efficiency

INTRODUCTION

Indonesian aquaculture commodities have prospects to be developed, one of which is tilapia (*Oreochromis niloticus*) which has long been known, is relatively fast growing and has a good response to the environment so that it is easy to aquaculture (Arie 1999). The advantages of tilapia have a specific taste, solid meat, easy to serve, do not contain a lot of thorns, are easily obtained at relatively cheap prices (Yans 2005). Tilapia meat contains 17.5% protein, 4.7% fat

and 74.8% air (Suyanto 1994). The total export of Indonesian tilapia in 2005 was 151,363 tons and continued to increase to 206,904 tons in 2007 (FAO 2009).

At present, the development of tilapia aquaculture is widespread throughout Indonesia, one of the tilapia known and accepted by fish farmers is the fish value of the ras wanayasa tilapia strain (Nirwana). Nirwana Tilapia is create from the selective breeding process of Tilapia GIFTS (Genetic Improvement of Farmed Tilapia) from the Philippines. Nirwana Tilapia has several advantages possessed by Nirvana tilapia which increased by 45% in the 3rd generation (F3) compared to the initial income. Maintenance of larvae weighing more than 650 grams per head can be achieved in just 6 months (faster than other strain of tilapia). The body of the nirvana tilapia is relatively larger with a shorter head size. This makes these fish have a meat structure that is thicker than other strain of tilapia (Khairuman and Amri 2013).

Zhou et al (2009) founded that formic acid, acetic acid, propionate and citric acid are organic acids that are used in the environment and as additives in feed ingredients in aquaculture especially salts and formatic acids (potassium diformate). Potassium diformate is the first substance approved and accepted as a non-antibiotic growth promoter by The European Union [Commission Reg (EC) number 1334/2001]. Potassium diformate is an organic acid containing 35% forminic acid, 35% formate, and 30% potassium (ADDCON, NordicAS, Pongrunn, Norway). Potassium diformate has the potential to replace antibiotics (Antibiotic Growth Promoter) which can improve growth performance and livestock health (Lim et. al. 2010).

Organic acid creates intestine condition that inhibition of pathogenic, increases proteins and minerals uptake and can improve growth in fish and shrimp. Addition of organic acids to fish or shrimp feed is used to reduce the pH of the gastrointestinal tract (Luckstadt 2008). Addition of potassium diformate to feed can significantly increase specific growth rates, increase fish weight, feed conversion ratio and protein efficiency ratio in tilapia species (Elala and Ragaa 2015). Based on this, it is necessary to know the effect of the addition of potassium formatted as a feed additive to the growth rate and feed efficiency of the tilapia strain specifically from Indonesia, namely fish seed strain Nirvana (Nila Ras Wanayasa).

METHOD

This research was conducted from April until June 2018 in Faculty of Fisheries, Marine Sciences, Universitas Padjadjaran. The method used in the research is experimental method with experimental design Complete Randomized Design (CRD) 4 treatments 4 replications.

- Treatment A: Without the addition of potassium diformate (control).
- Treatment B: Add formatted potassium 0.3%.
- Treatment C Addition of formatted potassium.
- Treatment D: Add 0.7% formatted potassium.

The effect of the real difference in addition of potassium diformate feed (KDF) on the growth rate and efficiency of tilapia nirwana seed feed using analysis of variance (ANOVA) with significantly of 5%, and if there are significant differences then continued with Duncan's multiple distance test on the level of confidence 95% (Gaspersz 1991). Furthermore, the data from the observations of water quality and pH value of the digestive tract of fish were analyzed descriptively. The variables measured included Spesific Growth Rate (SGR), Feeding Efficiency, Survival Rate (SR), Fish Digestion pH, and Water Quality.

1. Spesific Growth Rate (SGR)

According to Ricker (1975) to calculate specific growth rate used by the formula:

$$SGR = \frac{\ln Wt - \ln Wo}{t} \; x \; 100\%$$

Keterangan :

SGR = Spesific growth rate (%)
t = Length of fish maintenance at the beginning of the experiment (g)
W_0 = Weight at the beginning of the experiment (g)
W_t = Weight at the end of the experiment (g)

2. Feeding Efficiency

Feeding efficiency utilization can be calculated using formulas Zonneveld *et al.* (1991)

$$FE = \frac{(Wt + D) - Wo}{F} \; x \; 100\%$$

Keterangan :

FE = Feeding efficiency (%)
W_0 = Weight at the beginning of the study (g)
W_t = Weight at the end of the study (g)
D = The weight of the test fish that died during maintenance (g)
F = The amount of fish feed given during maintenance (g)

3. Survival Rate (SR)

The percentage of fish survival is obtained using the following Effendie formula (1979).

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

Keterangan :

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

RESULTS AND DISCUSSION

The results of the observation of the effect of potassium diformate addition as feed additives on tilapia nirwana feed during the study of spesific growth rate, feed efficiency, intestine pH levels, and survival rate of tilapia nirwana presented in Table 1.

Table 1. Observation Results The effect of the addition of potassium diformate on the feed of nirwana tilapia seeds

Result	Control	KDF 0,3%	KDF 0,5%	KDF 0,7%
Initial weight (g)	8,75	7,87	7,84	7,94
Final weight (g)	26,13	28,32	25,12	27,41
Spesific growth rate (%)	2,73[a]	3,20[c]	2,91[ab]	3,09[bc]
Feeding efficiency (%)	58,92[a]	67,39[c]	62,09[ab]	66,87[bc]
Gastric pH	3,40	2,75	2,80	2,70
Intestinal pH				
Anterior	7,10	6,75	6,80	6,80
Middle	7,60	7,35	7,60	7,45
Posterior	7,55	7,55	7,45	7,35
Survival rate (%)	100	100	100	100

Description: data on daily growth and feed efficiency were analyzed by F test and Duncan's advanced test 95% confidence level to determine the effect of real differences between treatments, while digestive pH data of fish were analyzed descriptively

Spesific Growth Rate

Growth in fish is defined as a change in weight or length in a certain time and is a complex biological process that is influenced by many factors both internal and external (Effendie 1997). Based on the results, the highest daily growth rate of nirvana tilapia seeds is 3.20% with the addition of potassium diformate dosage of 0.3% of the total weight of commercial feed given and the lowest value obtained in treatment A with a daily growth rate of 2.73 % of control (Figure 1).

According to Retnosari (2007) cited Yudhistira et al. (2015) a good fish growth rate at a value of at least 1%. Thus the growth rate of tilapia nirvana seeds in this study has a good growth rate of fish.

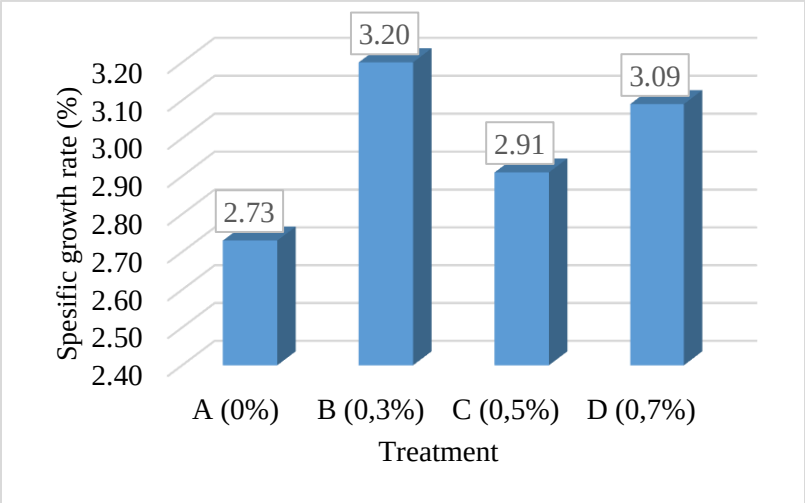

Figure 1. Graph of Nirwana Tilapia Seed Growth Rate

Feed quality is directly proportional to fish growth, the higher the quality of feed given, the higher the growth of fish that is maintained. In this study the use of feed additives containing potassium diformate as growth promoter is expected to increase feed digestibility by reducing digestive pH requiring the activity of digestive enzymes as a catalyst in the process of hydrolysis of feed nutrients so that the product becomes easily optimal.

One digestive enzyme whose activity is lowered by a decrease in pH, namely the enzyme pepsin. The activity of pepsin enzyme is optimal at pH 2, thus the use of potassium diformate can be used in pepsin activity in processing proteins into peptides by reducing the pH of the gastric pH levels. Changing the pH in the stomach is by removing stomach acid (HCl). The relationship of HCl secretion which is influenced by organic acid, namely acidic format (HCO2-) which is present in potassium diformate will break down into H^+ and CO2. Cl^- lon moves from plasma to the gastric cavity through surface cells. In the gastric cavity H^+ growth will focus on Cl^- forming HCI.

In the digestive tract of formic acid (HCO2-) in potassium diformate which is an anion it will easily bind to mineral cations, containing calcium (Ca_2^+), iron ($Fe2^+$), copper ($Cu2^+$), zinc ($Zn2^+$) and magnesium ($Mg2^+$) Will attract minerals in the contamination channel to occur optimally and improve the health and growth of fish.

Based on the Duncan test results showed that the use of potassium diformate did not have a significant difference in increasing the spesific growth rate of Nirwana tilapia seeds by control treatment (Table 1). However, the spesific growth rate of Nirwana tilapia seeds with the addition of potassium diformate has a higher spesific growth rate compared to the control treatment, thus the addition of potassium diformate is thought to better increase the fish growth rate compared to without the addition of potassium diformate. The use of potassium diformate as much as 0.3% on commercial feed given to tilapia nirwana seeds showed the highest spesific growth rate of fish compared to other treatments with a growth rate of 3.20%. It is assumed that by adding 0.3% potassium diformate to the optimum dose to increase the growth rate of organic Nirwana tilapia seeds compared to the addition of potassium diformate 0.5% and 0.7%. This is in accordance with the results of the Elala (2015) study that significantly the use of 0.2% and 0.3% potassium diformate can increase the growth of specific tilapia by 0.86% and 0.87% per day compared to the treatment without potassium diformate 0.77% per day. Furthermore, according to the Luckstadt (2008) the use of 1.35% potassium diformate significantly increased the specific growth rate (SGR) by 0.87% on the control treatment ie 0.78%. In addition, in the study of Cuvin-Aralar et. al (2012) showed the results that feed supplemented with potassium diformate could increase the addition of final fish weight and the specific growth rate in tilapia. The weight gain of tilapia in the control treatment reached an average body weight of 45.5 g while fish fed with potassium diformate reached an average weight of 51.4 g. In this research an increase in the growth rate of nirwana tilapia by adding 0.3% potassium diformate was shown by increasing the average weight of fish from 7.87 g to 28.32 g for 40 days of maintenance.

Feed Efficiency

Feed efficiency is defined as the ratio between the weight gain of fish and the weight of feed consumed during the maintenance period expressed in percent (Shafrudin 2003). The average value of feed efficiency in this research ranged from 58.92% -67.39% (Figure 2). Craig and Helfrich (2002) state that feed can be said to provide good growth if the efficiency of feed utilization is more than 50% or even close to 100%. Based on this, the feed used in this research

has good feed utilization efficiency to increase fish growth with a feed efficiency value of the control treatment of 58.92%.The high efficiency of feed utilization every treatment in this research is suspectedbecause the quality of feed used has a good quality of feed and in accordance with the nutritional needs of fish seeds the value of Nirwana. The high efficiency of feed utilization shows that feed use is efficient so that only a few food substances are overhauled to meet energy needs and the rest for growth (Huet 1970).

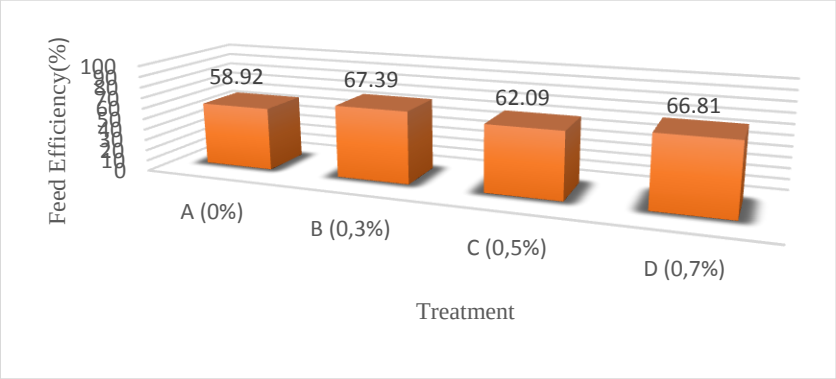

Figure 2. Efficiency of Nirvana Tilapia Seed Feed Chart

The addition of potassium diformate in tilapia nirwana seed feed generally increased the value of feed efficiency compared to the control. It is suspected that the addition of potassium diformate on commercial feed used in this research can improve the quality of fish feed. This is consistent with the statement of Kordi (2009) that 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 feed efficiency of nirwana tilapia seeds compared to without the addition of potassium diformate or controls.

The high value of feed efficiency can indicate the greater the growth rate produced. According to Andriani (2009) the feed efficiency is directly proportional to the growth produced, meaning that growth will change in line with the changing feed efficiency. The greater the feed efficiency, the better the fish use the feed given so that the body weight of the fish is produced. This is in accordance with the results of research that found that the feed added potassium diformate as much as 0.3% has the highest feed efficiency and the highest growth rate,there are 67.39% and 3.20%. Then it can be stated that the energy obtained from fish is thought to be that the feed provided has sufficiently fulfilled the energy needs for growth.

The use of potassium diformate as much as 0.3% on commercial feed given to tilapia nirwana seeds showed the highest feed efficiency compared to other treatments which amounted to 67.39%. It is assumed that by adding 0.3% potassium diformate to the optimum dose to improve feed efficiency of nirwana tilapia seeds compared to 0.5% and 0.7%. This is consistent with the results of the Elala and Ragaa (2015) study that significantly the use of 0.3% potassium diformate can increase the efficiency of tilapia seed feed by 48.31% compared to the feed efficiency control amounting to 43.86 %. Furthermore, according to Ramli et al (2005) research, it was significantly indicated that the addition of potassium diformate in tilapia feed increased feed efficiency compared to control treatment. Addition of potassium diformate 0.3% can increase the value of feed efficiency in 80% while the treatment of control is 74.63%.

pH of digestive tract

The use of potassium diformate as a growth promoter that can optimize the digestive tract of fish by decrease the pH of the digestive tract. In accordance with what was stated by Haetami et al. (2008) the ability of fish to digest the food consumed depends on the presence or absence of the appropriate enim and the conditions needed for the enzyme to react with the substrate in the digestive tract of the fish. Helver and Hardy (2002) cited Rahmatia (2016) state that digestive enzymes secreted in the digestive cavity originate from gastric mucosa cells, their pillars, pancreas and intestinal mucosa. The activity of enzymes in the digestive tract is influenced by environmental factors, namely temperature and pH. Therefore pH value is a determining factor both when the enzyme is active or not (Andriani et al. 2016).

Based on the results of gastric pH measurements of nirwana tilapia seeds at the beginning of the research, the average gastric pH value ranged from 3.45 - 3, 65. While the results of measurements of gastric pH of fish seeds at the end of the study with the treatment of adding potassium diformate on the given feed on nirwana tilapia seeds, the average pH value ranged from 70 - 3.40 (Figure 3).

This low pH value affects the activity of the enzyme pepsin in the gastric mucosa. In the gastric tract to pepsinogen enzyme which is an inactive enzyme, pepsinogen will become enzm pepsin which is an active enzyme in an environment of low pH or acid which is optimum at pH 2. Pepsin enzyme has an important role in protein digestion into simple fertilizers such as polupeptifa , proteases, peptones and peptides. According to Handajani and Widodo (2010) in the stomach protein in the feed will experience denaturation by HCI work and hydrolyzed by catalyst pepsin into peptide. Digestion in the stomach is an expression for digestion in the intestine.

The use of organic acids as additives in feed is intended to reduce digestive pH which is in accordance with the digestive enzymes of nutrients in the feed to be optimal. The Scipioni et al (1978) study found that a decrease in gastric pH from 4.6 to 3.5 by adding 1% citric acid and from 4.6 to 4.2 with the addition of 0.7% fumarite acid to the pork stomach. The results of the study of the addition of potassium diformate in fish feed showed a decrease in gastric pH. In the treatment of the addition of 0.3% potassium diformate experienced the highest difference in pH decrease, from 3.65 to 2.75 with a decrease in difference of 0.90; in the treatment of the addition of 0.5% potassium diformate decreased pH from 3.45 to 2.80 and the gastric treatment decreased from 3.50 to 2.70.

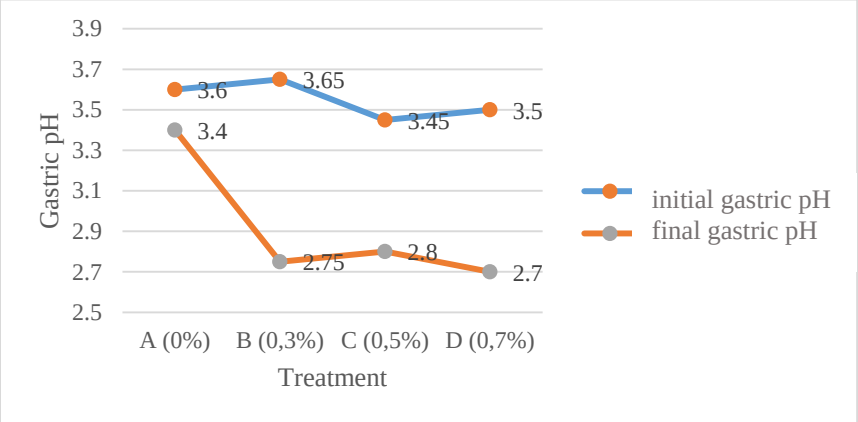

Figure 3. Tilapia Nirwana Seed Gastric pH Chart at the Beginning and End of Research

According to the study of Elala and Ragaa (2015) the effect of giving potassium diformate (KDF) on tilapia showed that a decrease in gastric pH with the addition of 0.3% potassium diformate had a lower gastric pH which was pH 2.96 compared to pH control 3, 43.

The results of observations of intestinal pH at the beginning of the study showed that the pH value of the front (anterior) intestine ranged from 7.15 to 7.40. The pH of the middle intestine ranged from 7.30 to 7.55 and the posterior intestinal pH ranged from 7.50 to 7.65. While the intestinal pH at the end of the study with the addition of potassium diformate showed that the pH value in the anterior part of the intestine ranged from 6.75 to 7.10; Lower part intestinal pH ranges from 7.35 to 7.60 and posterior intestinal pH ranges from 7.35 to 7.55 (Figure 4). According to Hickling (1971) pH of the intestine is neutral or almost alkaline, which is between 6 and 8. In grass carp pH ranges between 7.4 and 8.5 in the anterior appendix, in the middle part ranges from 7.2 and 7.6; and in the posterior area around 6.8.

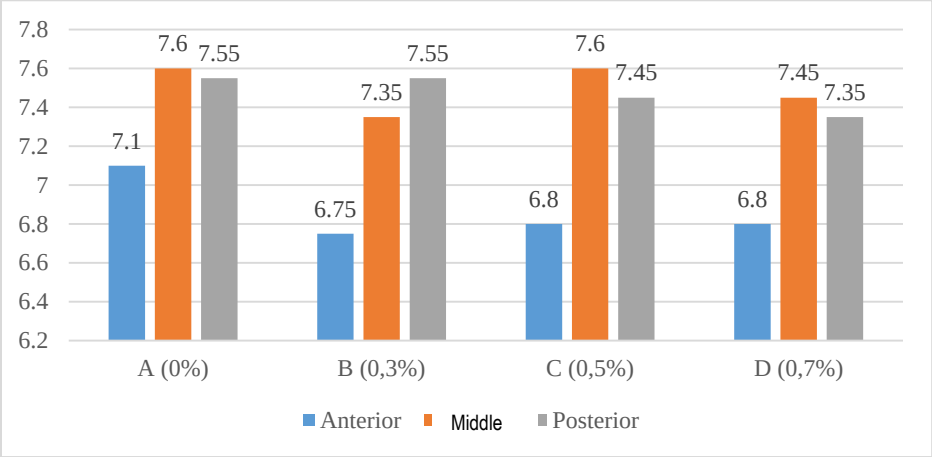

Figure 4. PH Chart of Nirwana Tilapia Seed Intestine at the End of Research

At the end of the study with the treatment of the addition of potassium diformate on commercial feed given the intestinal pH value of Nirwana tilapia slightly decreased, the pH value ranged from 6.75 to 7.10. The decrease in anterior part intestinal pH of fish is thought to be influenced by the addition of potassium diformate to the given fish feed. According to the study of Elala and Ragaa (2015) showed that the addition of 0.3% potassium diformate significantly lowered the intestinal pH in the anterior to 6.43 while the intestinal pH in the middle and posterior did not give a significant decrease in intestinal pH.

According to Hepher (1988) states that all enzymatic enzymes in the active intestine at pH range between 6 and 11. Thus the pH of the fish intestine in this research has supported the activity of proteolytic enzymes as a catalyst in protein absorption.

Survival rate

Tingkat kelangsungan hidup merupakan nilai persentase jumlah ikan yang hidup selama periode pemeliharaan (Effendie 1977). Nilai kelangsungan hidup berdasarkan hasil penelitian memiliki tingkat kelangsungan hidup yang tinggi yaitu 100% pada setiap perlakuan (Gambar 5). Hal ini diduga berhubungan dengan tercukupinya pakan yang diberikan dan ditunjang oleh kualitas air yang baik selama penelitian.

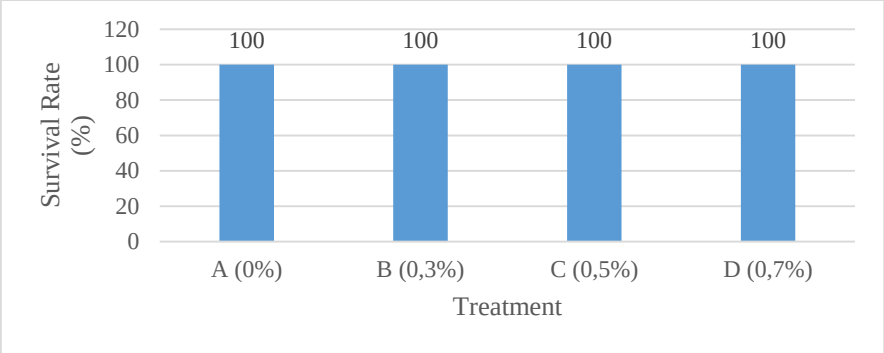

Figure 5. Graph of the Survival Rate of Tilapia Nirwana Seeds

Setiawan (2009) states that increasing density will result in disruption of physiological processes and fish behavior towards space which ultimately can reduce the health and physiological conditions of fish as a result of decreased dietary requirements, growth, and survival. Stress will quickly increase when the endurance limit of the fish has been reached or exceeded. The impact of this stress has resulted in decreased body data on fish and death. In addition, the density of fish has an effect on the geak space and competition for nile nirwana fish seeds that are maintained. The stocking density of fish seeds in this study was 1 tail per liter (10 fish per aquarium measuring 40 x 25 x 25 cm). Based on this, fish seeds have ample room for movement.

Based on the Indonesian National Standard (SNI) for SNI tilapia cultivation (2009) a good survival rate in cultivation is 70%. Thus the survival rate of tilapia nirvana seeds in this study has a very good survival rate. In addition potassium diformate on fish feed does not have lethal or fish effects and is not toxic to the survival of fish.

Water Quality

Water quality is one of the external factors that affect the survival and growth of fish. Water quality parameters observed in this study include temperature, dissolved oxygen (DO) and pH. Water quality data obtained during the study are as follows (Table 2).

Treatment	Temperature (°C)	DO (mg/l)	pH
A(0%)	25 - 26	4,7-5,9	7,04-7,65
B (0,3%)	25-26	4,5-5,8	6,97-7,70
C (0,5%)	25-26	4,5-5,9	7,02-7,76
D (0,7%)	25-26	4,6-5,8	7,17-7,67
SNI (2009)	25-30	>5	6,5-8,5

Table 2. Kisaran Kualitas Air Pemeliharaan Benih Ikan Nila Nirwana

Water quality during tilapia seed maintenance is in the maximum range to support the survival and growth of fish according to SNI (2009). The air quality in this study is controlled to avoid sudden or drastic different air quality.

One of the maintenance of air quality is that maintenance of maintenance containers is carried out every day to avoid the quality of dirty water due to the rest of the feces or feces of fish and leftover feed that is not consumed on the bottom of the maintenance container. It is expected that the rest of the regular fish feed and feces twice a day must be approved and

maintain the air quality value in a reasonable and ideal range for the life of Nirvana tilapia seeds. Next, a water treatment is carried out to stabilize the air nutrient content again.

CONCLUSION

Based on the results of the research that has been done, it can be concluded that the addition of 0.3% potassium diformate in nirwana tilapia feed can increase the highest spesific growth rate of 3.20% per day and feed efficiency of and 67.39% and the survival of the tilapia nirvana is 100% in each treatment.

ADVICE

The use of potassium diformate 0.3% is a dose that can increase the growth rate and feed efficiency of nirwana tilapia seeds in the stage of seed maintenance, so that there is a need for further testing of potassium diformate addition in the enlargement stage.

REFERENCES

[1] Andriani, Y. 2009. *Reduction of Cyanide Acid (HCN) in Cassava Skin Physically and Chemically as a Pre-Treatment in its Use as Fish Feed Material*. Scientific Article Faculty of Fisheries and Marine Sciences Universitas Padjadjaran.

[2] Andriani, Y, Rostika, R., Subhan, U., dan Haetami, K., 2016. *Fish Nutrition*. Unpad Press. Bandung.

[3] Arie, U. 1999. *Indigo Gift Hatchery and Enlargement*. Penebar Swadaya. Jakarta, 56 hlm

[4] Craig, S dan Helfrich, L.A. 2002. *Understanding Fish Nutrition, Feeds, And Feeding*. Virginia Cooperative Extension, Virinia Polytechnic Institute and State University, Publication 420 – 256. Accessed on February 20 2018.

[5] Cuvin-Aralar M, Kuhlmann KJ, Schroeder K, Luckdtadt C.2010. Effect Of Potassium Diformate (Kdf) On Growth Performance Of Male Nilae Tilapia (*Orecochromis niloticus*). In: xiv *Internasional Symposium On Fish Nutrition And Feeding*, Qingdao, China, Book of Abstracts; p. 187.

[6] Effendie, M.I. 1979. *Fisheries Biology Method*. Yayasan Dewi Sri. Bogor.

[7] Effendie, M.I. 1979. *Fisheries Biology Method*. Yayasan Pustaka Nusantara. Yogyakarta. 163 page.

[8] Elala,N.M. and Ragaa,N.M., 2015. Eubiotic effect of a dietary acidifier (potasium diformate) on the health status of *cultured Oreochromis niloticus. Journal od advanced research*, 6(4), pp.621-629. Dalam https://www.ncbi.nlm.nih.gov Accessed on February 18 2018

[9] Food and Agricultural Organization (FAO). 2009. Tilapia Market Report – January 2008. Dalam http: //www.fao.org accessed on February 25, 2018.

[10] Haetami, K. Abun dan Mulyani, Y. 2008. *Study of Making BAS Probiotics (Bacillus lichenformis, Aspergilus niger, and Sacharomices cereviseae) As a Feed for Seta Supplement Implications for Red Tilapia Growth.* Research report of the Faculty of Fisheries and Marine Sciences Universitas Padjadjaran.

[11] Handjani, H, dan Widodo, W. 2020. *Fish Nutrition*. UMM Press. Malang

[13] Hapher, B, 1988. *Nutrition of Pond Fishes*. New York Cambridge University Press.

[14] Hickling, C,F. 1971. Fish Culture. Faber adn Faber ltd. London.

[15] Khairuman dan Amri, K. 2013. Tilapia Cultivation. South Jakarta: PT AgroMedia Pustaka.

[16] Kordi K. M.G.H. 2009. *Aquaculture*. Citra Ditya Bakti. Bandung.

[17] Lim, C., Lickstadt, C., Kleusius, P.H. 2010. *Review: Use Of Organic Acids Salts in Fish Dieats*. Global Aquaculture Advocat, 5:45-6.

[18] Lickstradt, C. 2008. The Use Of Acidifiers In Fish Nutrition. CAB Reviews : Perpectives in Agriculture, Veterinary Science, Nutrition and Natural Resource. 3, No. 044. Dalam wfish.de/fulltext/CAB_rerview-paper_acidifiers-in-fish-nutrition, Accessed on February 18, 2018.

[19] Luckstadt, C., 2008. Effect of dietary potassium diformate on the growth and digestibility of Atlantic salmon Salmo salar. In Proceedings of the 13th International Syamposium on Fish Nutrition & Feeding, Florianopolis, Brazil (p.279). Accessed on August 30, 2018.

[20] Pullin, R.S.V. 1997. World Tilapia Culture ant its Future Prospects. In : Pullin R.S.V. Lazard, J., Legendre M., Amon Kothias, J.B & Pauly, D. (Eds) The Second International Symposium on *Tilapia in Aquaculture*, ICLARM *Conference Proceeding 41. International Center for Living Aquatic Resource Management*, Manila, Philippines

[21] Rahmania, F. 2016. Evaluation of Feed Digestion of Tilapia (Oreochromis niloticus) at Three Different Stadia. Satya Mina Bahari Scientific Journal, Vol 01. https://Perikanan.usni.ac.id/ accessed on August 25, 2018,

[22] Ramli N, Heindl U, Sunanto S. 2005. Effect of Potassium-Diformate On Growth Performance Of Tilapia Challenged with Vibrio anguillarum. Abstracct CD-Rom World Aquaculture Society, 0-13 Board.Can., 191:382.

[23] Ricker, W.E, 1975. Computation and Interpretation of Biological statistic of fish population. Bull. Fish Res. Board. Can., 191:382.

[24] Sciopioni, R., Zaghini, G. Dan Biavati, B. 1978. *Researches on The Use of Acidified Diets for Early Weaning of Piglets*. Zootecnol Nutr. Anim. Hlm 4:201- 218

[25] Setaiwan,B. 2009 Effect of Solid Spread of 1.2 and 3 Tails / L on Life Survival and Growth of Maanvis Seed Pterophyllum scalare. Essay. Aquaculture Technology and Management Study Program. Department of Aquaculture. Faculty of Fisheries and Marine Science. Institut Pertanian Bogor. Bogor.

[26] Shafrudin, D. 2003. Enlargement of Carp in the Net of the Pool Module: Management of Feed. Directorate of Vocational Secondary Education. Directorate General of Primary and Secondary Education. Ministry of Education. In http://bos.fkip.uns.ac.id Accessed on February 26, 2018.

[27] SNI:01-614. 2009. *Production of Black Tilapia Seed (Orecochromis niloticccus Bleeker) Spread Seed class. National Standardization Agency (BSN).* Jakarta.

[28] Yans, P. 2005. Production of Black Tilapia Seed (Orecochromis niloticccus Bleeker) Spread Seed class. National Standardization Agency (BSN).

[29] Yudhistira, S., Iskandar. Andriani, Y. 2015. Effect of Use of Apu - Apu Leaves (Pistila stratiotes) in Fermented Feed on Daily Growth and Nilem Fish Seed Feed Conversion Ratio. Akuatika Journal, 6(2): 118-127.

[30] Yustiati, A., D. F. Kundari, A. A. H. Suryana And I. B. B. Suryadi. 2019. Effectiveness of potassium diformate addition to feed to improve immune system of pangasius (*Pangasianodon hypophthalmus)* that challenged by *Aeromonas hydrophila. Scientific News of Pasific Region 3 : 76-90.*

[31] Yustiati, A., N. A. Nadiyah, I. B. B. Suryadi And Rosidah. 2019. Immune performances of sangkuriang catfish (*Clarias gariepinus)* with addition of potassium diformate on feed. *World News Of Natural Sciences* 25 : 113-129.

[32] Zhou Z, Liu Y, He S, Shi P Gao X, Yao B, Ringo E. 2009. Effects og Dieatary Potassium diformate (KDF) on Growth Diformate (KDF) on Growth Performance, Feed Conversion And Intestinal Bacterial Community Of Hybrid Tilapia (Oreochromis niloticcus x O. Aureus). Aquaculture ;291:89-94

[33] Zonneveld, N.E.A., Huiman, dan J.H. Boon. 1991. Principles - Principles of Fish Cultivation. Gramedia Pustaka. Jakarta, 318 hlm.