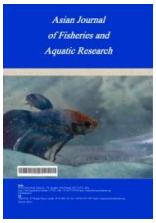

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The Effect of Potassium Diformate Addition to Feed on Growth and Survival Rates of Common Carp (*Cyprinus carpio* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. Author AY designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors MS and Junianto managed the analyses of the study. Author IBBS managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

This research aimed to determine the optimal dosage of potassium diformate addition to commercial feed in order to increase the growth and survival rate of common carp seeds. The method used in this research was experimental in a completely randomized design (CRD) consisting of five treatments and four replications. The treatments used were A (control), B with addition of potassium diformate (0.2%), C (0.3%), D (0.4%), and E (0.5%). For test fish, there were 200 of Common carp seeds with a size of 2-3 cm. The media used was 20 aquariums with a size of 40x30x40 cm^3 and a stocking density of 10 individuals/aquarium. The rearing period was 35 days and the amount of feed given was 3% of the fish body weight. The parameters observed included water quality (temperature, pH, and dissolved oxygen) which were observed every 7 days for 35 days. Other parameters monitored were daily growth rate, survival rate, feed efficiency, and the acidity level of the intestine. The results showed that 0.3% addition of potassium diformate gave the best results with a daily growth rate value of 3.21%, highest survival of 98%, efficiency of feed utilization of 64.83%, and a decrease in intestinal pH which helped the process of protein absorption in the fish body. In conclution, the addition of potassium diformate has good effect on growth and survival rates of common carp.

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Keywords: Common carp; potassium diformate; growth; survival; Cyprinus carpio.

1. INTRODUCTION

Statistically speaking, Indonesia's population is constantly on the increase, which results in a wide range of impacts on human survival. The growing number does not only demands extra food availability but also improved nutrition. In response to those issues, various government efforts have been exerted to increase food production and improve nutrition for the people of Indonesia. One of those efforts has been to fulfill people's needs for animal protein, such as fish. Fish is a high protein commodity greatly demanded by the Indonesian peoples, especially West Javanese .

Various efforts to improve fish farming have also been attempted by the wider community, with the main objective being to obtain higher production values. However, despite these efforts, there are still important things that remained yet unknown. Several factors crucial to the cultivation of fish include the availability of good seeds, both in terms of quality and quantity, the method of rearing, frequency of feeding, regulation or management of water quality [1].

One type of fish that is widely cultivated, especially in West Java, is the *Cyprinus carpio* It is a freshwater fish commodity that has a high economic value and relatively easy to cultivate. Apart from that, this fish taste no less delicious than other freshwater fish [2]. Common carp have a relatively fast growth rate. Five months after the eggs hatched, their body weight would reach 500g/individual [3], while its growth rate in ponds is usually 3 cm per month [3]. However, uncontrolled cultivation systems would result in unstable environmental conditions, making them inevitably susceptible to various survival threats, both to growth rate and health.

An alternative way for farmers to accelerate the growth rate and increase the survival rate of common carp is by using potassium diformate. Potassium diformate is one of the antibiotic animal nutrition products that contains growth-promoting features. The antimicrobial effect of potassium diformate can also reduce the population of bacteria such as those from the genus *Escherichia*, *Micrococcus*, and others. It can result in improving fish growth and survival status, while at the same time ensuring a safer product for consumers [4]. Potassium diformate is registered as an antibiotic growth promoter used for increasing growth rate and fish survival [4].

Therefore, this study aimed to investigate the effect of the addition of potassium diformate, at various inclusion levels, to feed on the growth rate and survival of common carp.

2. MATERIALS AND METHODS

Materials used included common carp seeds, potassium diformate, and commercial pellets. The method used in this research was an experimental method using a completely randomized design (CRD) which consisted of five treatments and four replications. The treatments used were A (control, 0% potassium diformate), B (0.2%), C (0.3%), D (0.4%) and E (0.5%) potassium diformate inclusion.

2.1 Procedure

2.1.1 Preparation of rearing containers

To prepare the rearing container for usage, the research facilities such as aquariums, fiber tubs, hoses, and aeration stones were washed with soap. The facilities were then were put in the sun to dry before labeling them according to the position of the aquarium. Each aquarium was filled with 20 liters of water from the aquaculture laboratory in the Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran (water was filtered with a sieve beforehand to prevent parasites from entering the aquarium) and aerated for 24 hours.

2.1.2 Acclimation of test fish

The available seeds were subjected to an acclimatization process for 3 days in a fiber tub. This was done so that the fish can adapt to their environment and also to protect them from parasites. Throughout the acclimatization process, the test fish were fed twice a day *adlibitum*. The acclimatized fish were then placed in the aquarium randomly with a stocking density of 10 fish/aquarium.

2.1.3 Addition of potassium diformate

Four boxs of 100 grams commercial feeds was mixed with 0.2%, 0.3%, 0.4%, and 0.5% potassium diformate separately for each treatment (the step was done repetitively in every

7 days). Potassium diformate was mixed with 10% water before being sprayed into the feed, stirred and dried by aeration (so it would stick to the feed). The fish were fed at 3% of body weight of the feed mixture..

2.1.4 Growth and water quality parameters

The rearing period lasted for 35 days. Feeding was carried out 2 times a day, at 08.00hrs and 17.00hrs. The parameters observed during the rearing period were daily growth and survival rate, and water quality (once every 7 days). Aquarium siphoning was done using a hose every day before feeding. Thirty percent of water was aspirated from aquarium to eliminate the fish feces [5].

2.1.5 Fish weighing

The initial total weight of fish in each aquarium tank was measured using a digital scale. Thereafter, the total weight of fish in each tank was measured weekly for a period of five weeks, and the quantity of feed administered was adjusted accordingly.

2.2 Growth Parameters

2.2.1 Daily growth rate

Daily growth observations were performed once every 7 days during the potassium diformate administration period. The formula used to calculate the Daily Growth Rate (DGR) is the Effendie formula [6]:

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

Where:
α = Daily weight growth rate
wt = Average weight at the end of treatment (day-t)
wo = The average weight of the initial treatment (day 0)
t = Observation Period (days)

2.2.2 Feed efficiency

Feed efficiency of common carp is calculated based on this formula developed by Djajasewaka [7]:

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

Where:
FE = Feed Efficiency
F = The amount of feed given during the study (g)
Wt = Biomass at the end of the study (g)
Wo = Biomass at the start of the study (g)
D = Biomass of common carp that died during the study (g)

2.2.3 Survival rate

For the 5-week duration of the study, the number of dead fish in each tank was recorded and this was used to calculate the survival rate of fish in each tank. The survival rate (SR) was calculated using the Goddard [8] formula:

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

Explanation:
SR = Survival Rate (%)
N_t = Number of live fish at the end of rearing (individual)
N_0 = Number of fish at the beginning of rearing (individual)

2.2.4 Acidity level of common carp digestive tract

Measurement of pH in the digestive tract of common carp was carried out at the beginning and the end of research. Two fish were dissected per treatment. Intestinal pH measurements were carried out using a pH meter according to the method of Elala and Naela [9]. After the fish was dissected (using a scalpel), the digestive tract (intestine) was removed and divided into three equal parts (upper intestine, middle intestine and lower intestine) Since there is no reference to the pH of the various parts of the intestine in your results/discussion, what is the essence of the separation. The divided intestine was then mashed using a mortar and weighed. 0.5 grams of the marshed intestine was then mixed with 4.5 ml of distilled water into a pH measuring cup and the pH recorded.

2.2.5 Water quality

Water quality parameters monitored included pH, dissolved oxygen (DO) and temperature. These parameters were measured weekly (Describe how these parameters were measured).

2.3 Data Analysis

Data analysis was performed with ANOVA F test, but in case of significant differences between

treatments, Duncan's multiple test [10] at an error level of 5% was used.. Water quality analysis was carried out descriptive statistics.

3. RESULTS AND DISCUSSION

3.1 Daily Growth Rate

From Fig. 1, the highest daily growth rate (DGR) of common carp was recorded with treatment C with an average DGR value of 3.21%, followed by treatment D (2.87%), treatment B (2.77%), treatment E (2.52%) and the lowest was with treatment A (2.40%). This result (DGR of 3.21%) agrees with the result of Sumaraw et al. [11] who reported an average DGR value of 2.98% in common carp which were fed a solution of probiotic bacteria with a density of 108 + 2% egg white for 30 days. Similarly, Masitoh et al [12] also reported a DGR value of 2.94% by giving 30% crude protein feed and an E/P value of 8.5 kkl/g to Common carp for 49 days. Furthermore, Nughara et al. [13] reported DGR value of 1.31% in *Osphronemus goramy* seeds fed with feed containing 0.3% potassium diformate, while, using similar feed, Yustiati et al. [14] and Eid et al. [15] reported DGR values of 3.20% and 2.07% respectively in *Oreochromis niloticus* seeds. Meanwhile, the results of this study revealed a higher DGR value.

In general, according to NRC [16], the digestive ability of fish to a feed is influenced by several factors, namely the chemical properties of water, water temperature, type of feed, size and age of fish, the nutritional content of the feed, frequency of feeding as well as the number and types of digestive enzymes contained in the digestive tract of feed. Effendie [6] report ed that the length of the intestine relatively increases as the size of the fish increases. Therefore, while the fish that are given feed containing organic acids will increase in size faster, the fish intestines would also get better at absorbing protein and nutrients. This is because organic acids can lower the pH of the acidic digestive tract, resulting in more nutrient absorption. Furthermore, the addition of organic acid will reduce pathogenic bacteria in the digestive tract by damaging the cytoplasmic cells, reducing the number of pathogenic bacteria, and increasing the commensal bacteria. This is supported by the statement of Booth and Stratford [17], that a decrease in pH contributes to an increase in mineral growth and utilization. Besides, the increase in growth occurs due to a reduction in bacteria, especially gram-negative bacteria in the digestive tract. This is caused by the diffusion of organic acids into the bacterial cell which results in a decreased pH of cytoplasm resultant and cell death.

The addition of potassium diformate to feed can be a good recommendation because it affect better on DGR. According to the result of research, the value of control feed and potassium diformate feed (0.3%) is 2.40% and 3.21% respectively which show better result of potassium diformate feed than control feed.

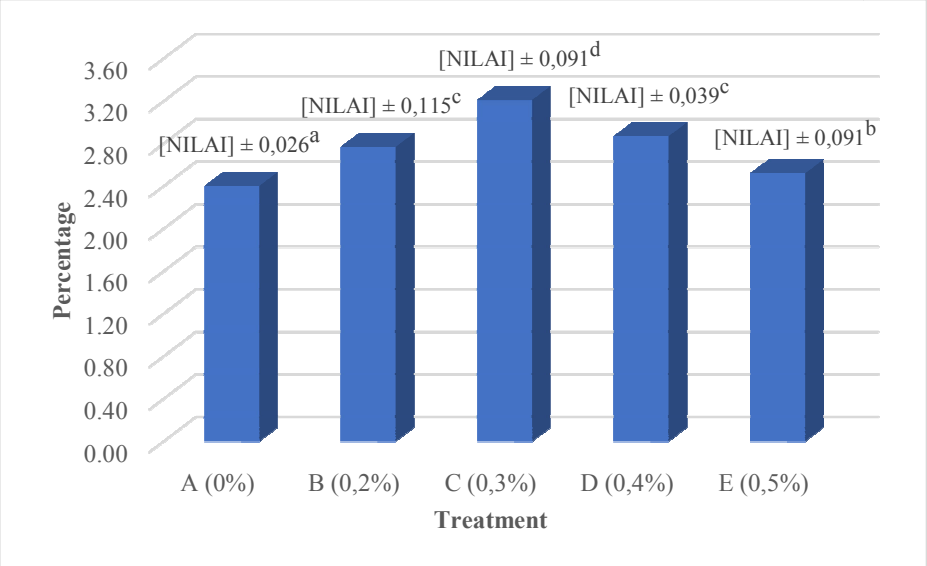

Fig. 1. Daily growth rate of common carp

3.2 Feed Efficiency

The best FE value of 64.83±2.03% in common carp was recorded with treatment C (Fig. 2). Kurniasih et al. [18] reported FE value of 59.09% for common carp fed with feed containing 0.90% fish oil and 0.60% lecithin, while Masitoh et al [12] recorded FE value of 55.58% with a 30% protein feed and an E/P value of 8.5 kkl/g. The FE values for treatments A, B, C, D and E were 37.50±21.65%, 56.06±5.87%, 64.83±2.03%, 59.69±4.40% and 54.80±4.25% respectively. Thus, there was a significant difference between treatment A (control, with no potassium diformate inclusion) and treatments B, C, D, and E (with potassium diformate inclusion). It is believed that the appropriate inclusion of potassium diformate (0.3%) can increase FE for its ability to 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 these fish can be utilized efficiently. However, there was no significant difference between the FE values for treatments A, B, C and D, which implies that the potassium diformate inclusion had significant effect on the feed consumption. It was also observed that the higher the potassium diformate inclusion level, the lower the Feed Efficiency (FE) value.

3.3 Survival Rate

From Fig. 3, treatment C with 0.3% of potassium diformate recorded the highest mean survival rate (98±0.005%), while treatments B, D and E recorded survival rates of 93±0.010%, 93±0.010% and 87±0.010% respectively. The lowest survival rate (85±0.006%) was recorded with treatment A (control).

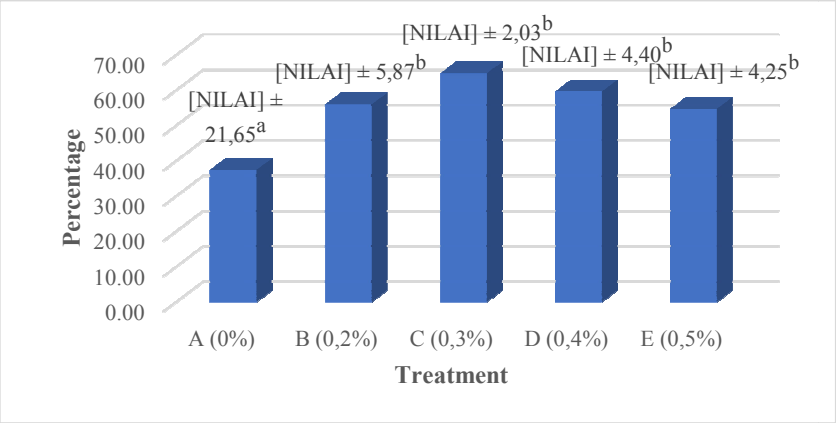

Fig. 2. Feed efficiency graph

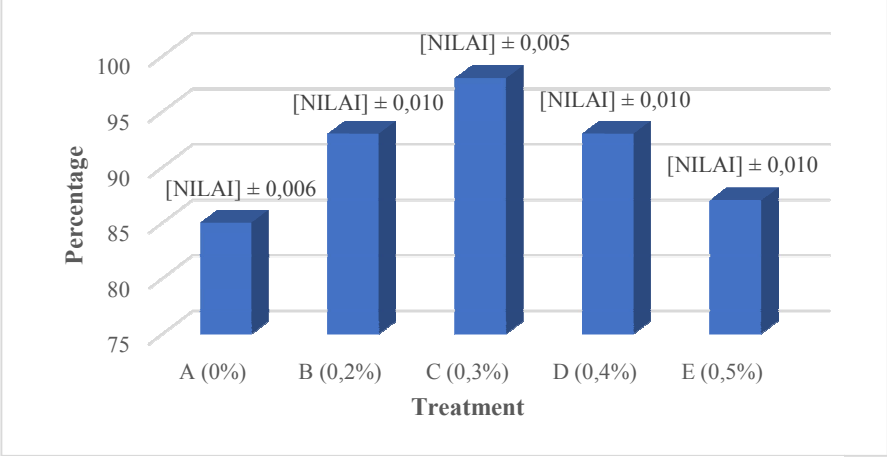

Fig. 3. Survival rate (%) of common carp

Several studies have reported that the usage of potassium diformate is able to provide benefits to the survival of common carp. According to Nugraha et al. [13] potassium diformate addition at 0.3% resulted in 100% survival rate of *Osphronemus goramy* seeds, While Suryadi et al. [19] reported that the addition of potassium diformate to feed at an inclusion rate of 0.3% resulted in 81.67% survival rate for *Osteochilus hasselti*. Yustiati et al. [20] conducted different research on *Carrasius auratus* that were given 0.3% of potassium diformate and obtained effective results with the highest survival rate 46%. Meanwhile, different research with probiotic feed show less effective result that only has highest survival rate 70% that show lower value than when potassium diformate was given instead.

According to Hepher [21], the survival rates are influenced by internal factors which include gender, heredity, age, reproduction, disease resistance, and external factors including water quality, stocking density, the number, and composition of amino acids in the feed. It can be concluded that that the high survival rate during this study shows that the nutritional requirements, the amount of feed, space for movement and water quality of the rearing media sufficiently support the growth of the seeds.

3.4 Acidity Level (pH) in Digestive Tract of Common Carp

The results show that the pH in digestive tract of common carp is in the range of 5.20-7.11. Based on Fig. 4, it can be seen that the pH of the digestive tract decreased with the addition of potassium diformate to the feed. Treatment A (control) had an initial pH of 7.11 which decreased to 6.93 at the end of the study. Treatments B, C, D and E had initial pH values of 6.95, 6.97, 6.98 and 6.91 respectively and the corresponding final pH values were 6.67, 6.26, 5.87 and 5.20. common carp that were fed with the feed that had inclusion of potassium diformate recorded lower pH values than the fish without. This condition makes the intestine in an optimal state to digest food so as to increase the rate of fish growth. Pepsinogen enzymes at pH below 5.5 would be damaged and active pepsin which has very stable amino acid residues would be formed [9]. The activities of pepsin depends on pH, temperature, and the type of substrate. A low pH value will more easily destroy materials of the feed that is consumed.

The pH value of the digestive tract obtained in this study shows that adding potassium diformate can reduce the pH of the digestive tract in order to provide optimal conditions, activation of the pepsin enzyme in protein breakdown, and stop the growth of pathogenic bacteria and increase the growth of commensal bacteria, so that feed with potassium diformate, when consumed by fish can promote its growth.

3.5 Water Quality

Poor and unsuitable water quality can inhibit the growth and development of fish and even cause death. Sulistiawati [22] stated that factors, namely temperature, dissolved oxygen content, and degree of acidity can inhibit metabolic processes and fish survival. Water quality data (Table 1) during the rearing period are presented in the table.

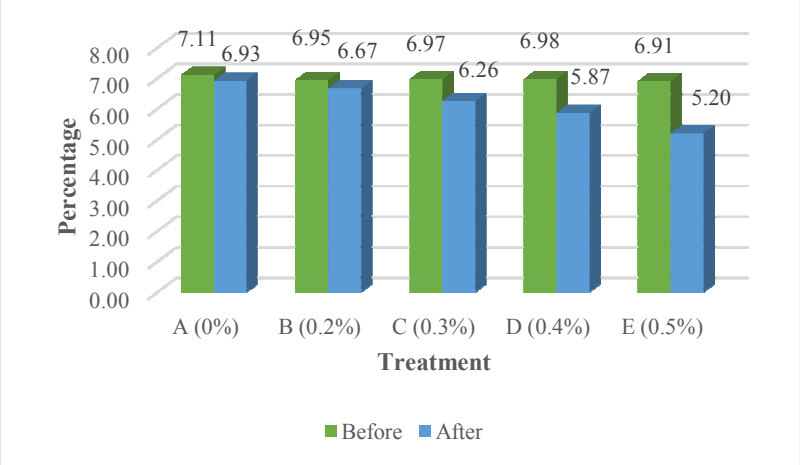

Fig. 4. Graphic of acidity levels of intestine

Table 1. Value range of water quality during rearing

Parameter	Unit	Value range	*Quality standard
Temperature	°C	24 – 27	25 – 30
pH	-	6,54 – 8,20	6,5 – 8,5
DO	Mg/l	5,30 – 7,10	> 5

** Source: Indonesian National Standard 1999*

Table 1 shows the results of temperature, pH and dissolved oxygen measurements of the water used for the rearing of the fish in this study. The temperature ranged between 25°C and 27°C, and this was within the Indonesian National Standard (INS) [23] recommended temperature range. This implies that the temperature during the study period was conducive for the survival of common carp. Laevastu and Hela [24] stated that the effect of temperature on fish is in the metabolic processes, such as growth and food intake, body activity, such as swimming speed. Djajasewaka and Djajadireja [7] also stated that the optimum temperature for fish appetite is 26 – 27°C.

According to Kordi and Ghufran [25] the higher the water temperature, the lower the solubility of oxygen in the water, and vice versa. When the temperature is optimum, dissolved oxygen will also be optimum. Dissolved oxygen (DO) is one of the determinants for fish life in water. Dissolved oxygen is used for metabolic processes in the fish body, therefore, insufficient dissolved oxygen will threaten the life of the fish. Gusrina [26] revealed that dissolved oxygen content that is good for fish culture ranges from 4-9mg/L. In Table 3, the DO values (5.30 mg/l – 7.10mg/l) recorded during the rearing period satisfied the INS [23] recommendation for dissolved oxygen for the rearing of fish. Thus, the DO requirements of the fish were met during the rearing period.

The degree of acidity (pH) of water in the rearing facility ranged from 6.54 - 8.20, which was within the range of pH (6.5 - 8.5) for common carp [23]. Therefore, the acidity level (pH) of water during rearing was well fulfilled. Kordi and Ghufran [25] also said that a good acidity level for the growth of fish and aquatic organisms is between 6.5 to 8.5.

4. CONCLUSION

The conclusion that can be drawn from this research is that the optimum dosage of potassium diformate addition to feed is 0.3% with the highest daily growth rate of 3.21%, the highest feed efficiency of 64.83%, the highest survival of 98%. Potassium diformate decreases the acidity level (pH) of the digestive tract of common carp seeds, which helps in the process of protein absorption.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Widiastuti I. Quality Analysis of tuna during off-catch on differences in preparation and storage time. Thesis. Graduate School. Bogor Agricultural Institute; 2008.
2. Cahyono. Freshwater Fish Cultivation. Kanisius. Jakarta.1; 2000.
3. Susanto H. Backyard Fish Farming *(revision)*. Jakarta: Penebar Swadaya; 2006.
4. Lückstädt C, Christiansen R. Effects of potassium diformate with different doses in fish meal on atlantic salmon performance. World Aquaculture Society Conference. Busan, Korea. CD-Rom Abstract. 2011;467
5. Gusman E, Firdaus M. Utilization of Mangrove Fruit as a Feed Mixture to Increase Growth of Common carp (*Cyprinus common carpio*). Harpodon Borneo Journal. 2014;07(01):27-35.
6. Effendie. Fisheries Biology. Yayasan Pustaka Nusatama: Yogyakarta. 1997;163 hal.
7. Djajasewaka H, Djajadireja R. Effect of artificial foods with different crude fiber content on the growth of common carp. Bogor Fisheries Research Bulletin. 1985;(I):55–57.
8. Goddard S. Feed Management in Intensive Aquaculture. Chapman and Hall. New York; 1996.
9. Abu Elala N, Naela M. Eubiotic effect of a dietary acidifier *(potassium diformate)* on the health status of cultured Oreochromis niloticus. Journal of Advanced Research. Cairo University; 2015.

10. Steel RG, Torrie JH. Principles and Procedures of Statistics. Bambang Sumantri translation. Gramedia. Jakarta; 1993.
11. Sumaraw JT, Manoppo H, Tumbol RA, Rumengan IFM, Dien HA, Sumilat DA. Evaluation of the effect of probiotic bacteria on growth performance and survival rate of common carp, (*Cyprinus carpio*). Journal. 2019;7(1). ISSN: 2302-3589.
12. Masitoh D, Subandiyono, Pinandoyo. The Effect of Different Feed Protein Content with E/P Value 8.5 kkl/g on the Growth of Common carp (Cyprinus common carpio). *Journal* of Aquaculture and Technology Management. 2015;4(3):46-53
13. Nugraha AA, Yustiati A, Bangkit I, Adriani Y. Growth performance and survival rate of giant gourami fingerlings (*Osphronemus goramy* Lacepede, 1801) with potassium diformate addition. Journal; 2020 WSN 143. 103-114. ISSN : 2392-2192
14. Yustiati A, Aminah S, Lili W, Andriani Y, Bioshina IB. Effect Of using potassium diformate as a feed additive to growth rate and feed efficiency of Nirwana Tilapia (*Oreochromis niloticus*). Journal; 2019. GSD : Vol.7, ISSN : 2320-9186
15. Eid AK, Mohamed, Ali B, Sayed N. Effect of various levels of potassium diformate on growth performance and feed utilization of monosex nile tilapia (*Oreochromis Niloticus*) Fingerlings. Journal of Animal, Poultry and Fish Production, Suez Canal University; 2014.
16. National Research Council [NRC]. Nutrient Requirement of Domestic Animals. Washington DC (US): National Academy Press. 1983;215.
17. Booth IR, Stratford M. Acidulants and Low pH. New York (US): Kluwer Academic Plenum Publishers. 2003;25–47.
18. Kurniasih, Subandiyono, and Pinandoyo. Effect of fish oil and lecithin with different doses in feed on feed utilization and growth of common carp (*Cyprinus common carpio*). Journal of Aquaculture and Technology Managemen. 2015; Vol 4, No 3 hal 22-30
19. Suryadi IBB, Ulfa DN, Yustiati A, Rosidah R. The Effect of Potassium Diformate as Feed Additive on Immune Performances of Nilem (*Osteochilus hasselti* Valenciennes, 1842) Under Infection of *Aeromonas hydrophila. Journal.* Omni-Akuatika. 2020;16(1):11-23.
ISSN: 1858-3873
20. Yustiati A, Suryadi IBB, Iskandar I, Aditya K. Growth performance of freshwater pomfret fish (*Colossoma macropomum*) Feeded with Potassium Diformate. 2020;5(1).
21. Hepher B. Nutrion of Pond Fishes. Cambridge University. New York; 1988.
22. Sulistiawati N. Evectivity of Kirinyuh as Antibacterial against Infected of Common carp Seeds Bacteria Aeromonas Hydrophila. Essay. Faculty of Fisheries and Science Maritime Affairs, Padjadjaran University, Jatinangor. 2011;62.
23. Indonesian National Standard. Production of Common carp (*Cyprinus carpio* Linneaus) Majalaya Strain of main seeds class. INS: 01-6131-1999
24. Laevastu T, Hela I. Fisheries Oceanography and Ecology. Fishing, News. Books Ltd. London; 1970.
25. Kordi K, Ghufran M. Fish Pest and Disease Management. First Print. PT Rineka Cipta. Jakarta. 2005;190.
26. Gusrina. Fish cultivation. Ministry of Education: Jakarta. 2008;355.

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