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Effect of Vitamin E Supplementation on the Growth Performance of *Clarias Sp*.

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Abstract

Catfish is a fishery commodity with increasing demand throughout the year. This causes cultivators to increase production at high densities. As a result, a decrease in air quality and the rate of growth and survival of fish is one of the challenges. The purpose of this study was to determine the effect of vitamin E supplementation on growth, feed efficiency, and survival of catfish. This study used completely randomized design (CRD) method with five treatments and four replications. Whereas, control treatment (P1); feed without vitamin E, (P2); addition (*calcium lignosulfonate* + vitamin E 50 mg/kg feed), (P3); addition (*calcium lignosulfonate* + vitamin E as much as 100 mg/kg feed), (P4); the addition of (*calcium lignosulfonate* + vitamin E as much as 150 mg/kg of feed), and (P5); the addition of (*calcium lignosulfonate* + vitamin E as much as 200 mg/kg of feed. Vitamin E administration had a significant effect ($p < 0.05$) on growth in each treatment. Where, the highest growth rate was obtained in the administration of vitamin E at a dose of 100 mg/kg of feed of 1.66 ± 0.05 % per day Feed conversion ratio and feed efficiency also obtained the highest values in this treatment, namely 1.2 ± 0.07 and 83.46 ± 3.24% respectively. 100 mg/kg of feed did not have a significant effect ($p > 0.05$) on survival compared to other treatments.

Keywords: Vitamin E, feed supplementation, growth, *Clarias sp.*

INTRODUCTION

As of 2018, Indonesia produced a total of 85,496.85 tons of catfish, making it the most extensively cultivated species there (Sitio et al., 2017; KKP, 2018). Although water quality directly affects the growth and survival of other fish, catfish can still be cultivated with high stocking densities (Conte, 2004). Stress, which is shown by an excess of the hormone cortisol, disrupts growth (Bastien, S., and G. Benjamin, 2019). Cortisol, which can inhibit growth hormone (GH/IGF-I) responses, is a key stress response signal (Liu et al., 2013; Link et al., 2010; Pujante et al., 2015). A minimum of 25–30% protein, 5–10% fat, 10–20% carbs, and a small amount of vitamin A are needed for catfish to thrive (Amalia et al., 2013). For growth, metabolism, movement, and the replacement of damaged cells, healthy feed can be received by the body (Aprilia, 2008). Adding vitamin E-based supplements to feed is one method of enhancing its quality (El-Shebly, 2009). Vitamin E acts as an antioxidant, keeps protein in feed and highly unsaturated fatty acids available in cell membranes, and prevents intracellular free radicals (Lamid, 1995). Other benefits of vitamin E include acting as a protector of lipoprotein membranes stored in the body so that lipid oxidation does not occur, increasing immunity, repairing DNA, and facilitating metabolic processes (Mekkawy et al. 2012). On the other hand, the higher the fatty acids in the feed, the greater the need for vitamin E (Watanabe et al., 1991). However, fish

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cannot synthesize vitamin E and must depend on food intake. Where, a deficiency of vitamin E can cause lipid oxidation, liver degeneration, and damage to cell membranes (Li et al., 2018).

The addition of vitamin E to feed has been shown to increase the growth and survival of *Scylla paramamosain* (Winestri et al., 2014). The need for vitamin E depends on the species and stage of the fish. Fish feed containing vitamin E can increase the specific growth rate, fcr, and feed efficiency of largemouth bass (Li et al., 2018), cobia fish (*Rachycentron canadum*) (Zhou et al., 2012), snakehead fish (*Channa punctatus*) (Hameid et al., 2012), yellow croaker (*Larimichthys crocea*) (Yi et al., 2017), black sea bream (*Acanthopagrus schlegelii*). Based on this, we conducted a study of adding vitamin E with different doses to feed on catfish fry to find out the best results on growth, feed efficiency, and survival.

MATERIAL AND METHOD

Location and time

The study was conducted at the Wet Laboratory of the Aquaculture Study Program, School of Health and Life Sciences, Airlangga University in Banyuwangi from February to May 2021.

Tools and materials

A total of eight hundred catfish fry with a size of 5.6 ± 0.124 cm and an average weight of 1.32 ± 0.097 grams (Figure 1) were harvested. Catfish fry were reared in 20 aquariums measuring 40×30×30 cm with a volume of 20 liters and aerated (Wardani et al., 2017). Tools used in this research are digital scales for measuring the growth of fish samples, millimeter bars for measuring the growth of fish length, thermometers for measuring the temperature of the water. Meanwhile, for measurement of the nitrification parameters using nitrate test kits, nitrite test kits, ammonia test kits. Lastly, DO meters (Lutron™) and pH meters (Hanna™) for measurement of dissolved oxygen and water pH. In addition, the diet pellet used is Pro - Vite 781 with 30% protein, Vitamin E, 100 gram packaging of Vitamin E (Ovagrow™), *calcium lignosulfonate* (Progol), and a sterilizer.

Experimental design

This study used a completely randomized design (CRD) with five treatments and four replications. Where: (P1): Pellets + progol (as an adhesive and vitamin E feed) + without vitamin E; (P2): Pellets + progol + vitamin E 50 mg/kg feed; (P3): Pellets + progol + vitamin E 100 mg/kg feed; (P4): Pellets + progol + vitamin E 150 mg/kg feed; and (P5): Pellets + progol + vitamin E 200 mg/kg feed.

Research preparation

All aquariums used are thoroughly washed and dried to ensure that they are pathogen-free. Next, fill with 20 liters of water and aerate for 24 hours to increase dissolved oxygen. The catfish seeds used came from the Fish Seed Center in Genteng Banyuwangi and were kept in an aquarium with a density of 2 fish per liter, or 40 fish previously acclimatized (Putra et al., 2018). Fish were fasted for one day to eliminate the

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effect of the feed given before starting rearing and reduce stress conditions in fish. Fish feed is given at 5% of fish biomass (Anis and Dyah, 2019). Fish culture was carried out for 40 days with a sampling period every week to determine growth in length, weight, and survival. On the other hand, each sampling period was also carried out with a water change of 20% due to siphoning (Muarif and Rosmawati, 2011).

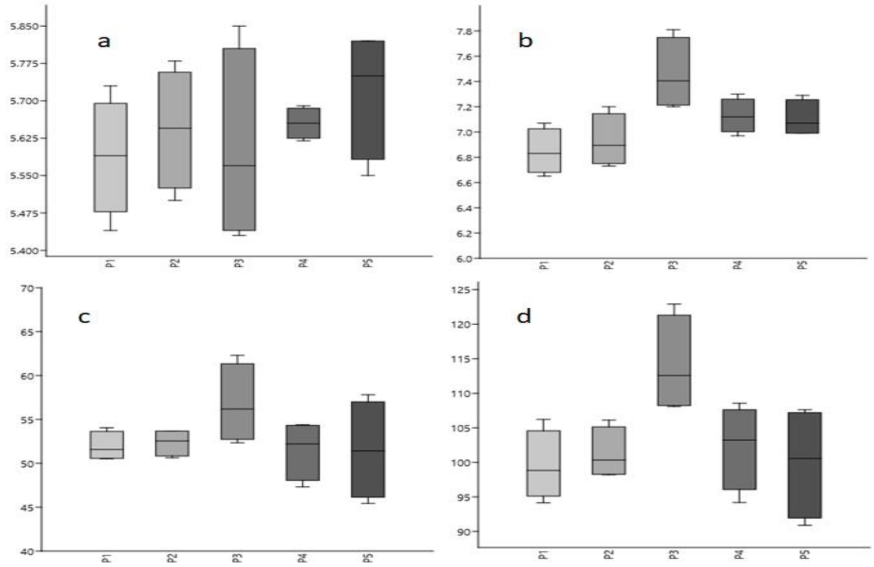

Figure 1. Box plot a: initial length (cm), b: final length (cm), c: initial weight of biomass (g), d: final weight of biomass (g)

Parameters measurement

According to Effendie (1991), the main variables in this study were absolute length growth and absolute weight. Hidayat et al. (2019), Effendi (1997), Ramona et al. (2017), and Iskandar and Elrifadah (2015) defined specific growth rate and feed efficiency, respectively.

Absolute Growth in Length

L = Lt – Lo

Where:

L : total growth length (cm)
Lt : final length (cm)
Lo : initial length (cm)

Absolute Growth in Weight

W = Wt – Wo

Where:

W : absolute growth (g)
W_t : final weight (g)
W_o : initial weight (g)

Spesifik growth rate

$$SGR = \frac{\ln Wt - \ln Wo}{t1 - t0} \times 100\ \%$$

SGR : Spesifik growth rate
Lt : mean final length (cm)
Lo : mean initial length (cm)
t : rearing period (day)

Survival Rate

$$Survival\ (\%) = \frac{\sum final\ number\ of\ fry}{\sum initial\ number\ of\ fry} \times 100\%$$

Feed Convertion Ratio

$$FCR = \frac{F}{(Wt + D) - W0}$$

Where:

F : total feed consumption (g)
W_t: Final Biomassa (g)
W_0: Initial Biomassa (g)
D : Death biomass(g)

Feed efficiency (FE)

$$FE = \frac{Wt + D - Wo}{F} \times 100\%$$

Where:

F : total feed consumption (g)
W_t: Final Biomass (g)
W_0: Initial Biomass (g)
D : Death Biomass (g)

Water quality

Temperature, dissolved oxygen, ammonia, and pH were the water quality parameters were measured each day. During weekly evaluation of growth, ammonia, nitrite, and nitrate levels were measured once every seven days.

Data analysis

Data analysis was used to determine the effect of different doses of vitamin E using (ANOVA), followed by Duncan's test to determine the different significance of each treatment (Kusriningrum, 2008).

RESULT AND DISCUSSION

Growth

The addition of various doses of vitamin E to the feed had a large impact on the total weight (P<0.05) of catfish. The addition of 100 mg/kg of vitamin E (P3) obtained the highest yield, namely 57.28 grams. While the treatment without the addition of vitamin E (P1) gave the worst results, namely as much as 47.58 grams. Furthermore, the best absolute length growth was found in (P3), which was 1.85 ± 0.39 cm, followed by (P4) with a length of 1.47 ± 0.23 cm. However, it was not significantly different from other treatments. Vitamin E is a fat-soluble compound a containing - tocopherol, the most active vitamin (National Research Council, 1993). Consequently, it is able to increase fish growth by regulating the metabolism and preventing tissue damage during stress (Tocher et al., 2002; Li et al., 2008). However, vitamin E needs in fish vary by species and experimental conditions (Zhou et al., 2013).

Lack of Vitamin E in the diet of fish can lead to deterioration of the liver and muscles and death (Hamre et al. 1994). Conversely, excess vitamin E has a pro-oxidant effect and allows for reduced growth (Li et al. 2008). An excess of vitamin E, which is an antioxidant, converts anti-oxidants into pro-oxidants, which accelerates the rate of oxidation (Margaretta et al., 2011). In this study, P3 with the addition of 100 mg/kg of vitamin E-containing feed showed the greatest growth in length and weight.

Table 1: Feed efficiency of catfish seeds reared with different vitamin E doses and feeds for 6 weeks.

Parameters	Unit	P1 (without *Vit* E)	P2 (*Vit E* 50 mg/kg)	P3 (*Vit E* 100 mg/kg)	P4 (*Vit E* 150 mg/kg)	P5 (*Vit E* 200 mg/kg)
				Growth performance		
Final length	cm	$1,26^{b} \pm 0,07$	$1,29^{b} \pm 0,32$	$1,85^{a} \pm 0,39$	$1,47^{ab} \pm 0,23$	$1,39^{b} \pm 0,28$
Final growth	g	$47,58^{b} \pm 3,5$	$48,89^{b} \pm 2,47$	$57,28^{a} \pm 2,61$	$50,77^{b} \pm 3,01$	$48,39^{b} \pm 2,69$
Sgr	g.day^{1-}	$1,55^{b} \pm 0,05$	$1,57^{b} \pm 0,04$	$1,66^{a} \pm 0,05$	$1,63^{ab} \pm 0,04$	$1,58^{ab} \pm 0,07$
Fcr		$1,39^{a} \pm 0,08$	$1,308^{ab} \pm 0,08$	$1,2^{c} \pm 0,07$	$1,25^{bc} \pm 0,07$	$1,31^{ab} \pm 0,05$
Feed efficiency	(%)	$71,72^{c} \pm 2,28$	$76,52^{bc} \pm 3,31$	$83,46^{a} \pm 3,24$	$80,28^{ab} \pm 2,96$	$76,40^{bc} \pm 1,83$

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Parameters	Unit	P1 (without *Vit* E)	P2 (*Vit E* 50 mg/kg)	P3 (*Vit E* 100 mg/kg)	P4 (*Vit E* 150 mg/kg)	P5 (*Vit E* 200 mg/kg)
				Water quality		
Temperature	ºC	27,00	28,00	27,00	27,50	28,00
pH		6,2 - 7,8	6,2 - 7,9	6,2 - 7,10	6,2 - 7,11	6,2 - 7,11
Dissolve oxygen	$Mg.L^{-1}$	5,00 - 8,20	5,00 - 7,21	5,00 - 6,42	5,00 - 6,83	5,00 - 6,13
Nitrite	$Mg.L^{-1}$	0,3-0,8	0,3-0,9	0,3-0,10	0,3-0,11	0,3-0,11
Nitrate	$Mg.L^{-1}$	0-25	0-25	0-25	0-27	0-27
Ammonia	$Mg.L^{-1}$	0-0,25	0-0,26	0-0,24	0-0,38	0-0,28

Note: Different superscript letters show significant differences (P < 0.05) based on Duncan's Multiple Range Test (DMRT). P1 = 0 mg (control); P2 = 50 mg ; P3 = 100 mg ; P4 = 150 mg ; P5 = 200 mg.

Specific Growth Rate

The specific growth rate of catfish fry was significantly affected ($p < 0.05$) by the addition of vitamin E to the meal at varied concentrations. The treatment P3 yielded the greatest value, followed by P1, P2, and P4. In contrast, the lowest specific growth rate (P5) did not change substantially ($p > 0.05$) from the best treatment (P3). Growth performance rose at doses 50–100 mg/kg feed and declined at doses 150 - 200 mg/kg feed. At a vitamin E intake of 100 mg/kg of diet, optimum development occurs. This is contingent upon the capacity of fish to absorb and utilize it. Vitamin E is essential for growth and maintenance of body condition (Salsabila et al., 2010).

At a vitamin E intake of 212.9 mg/kg, eel development was shown to be optimal (Shahkar et al., 2018). However, cobia and *Chana punctatus* had the best development when vitamin E was added at levels of 78 - 101 mg/kg and 140 -169 mg/kg, respectively (Zhou et al., 2013; Abdel-Hameid et al., 2012). In this investigation, the optimal dose of vitamin E was lower than in other carnivorous fish (snakefish). The SGR of grass carp fish seed supplemented with 100 mg/kg of vitamin E was 1.88%. (Li et al. 2008).

In this study, the SGR value for catfish seeds fed at a dose of 100 mg/kg was 1.66 percent. In addition, Vitamin E overdose has a pro-oxidant effect on lipid tissue (Ito et al., 1999), liver damage that leads in mortality (Halver, 2002), necrosis, and apoptosis in the liver, resulting in an inability to release growth hormone (Sudatri et al., 2016; Li et al., 2014).

Fcr and feed efficiency

The FCR of catfish seeds was significantly affected ($p < 0.05$) by the addition of vitamin E to the meal. The FCR for P3 is the greatest, followed by P4 and P5. In contrast, the lowest FCR was observed in control treatment (P1). The feed conversion ratio is inversely proportional to growth; the lower the FCR, the greater the feed efficiency (Ardita et al., 2015). Not often does a high growth rate correspond to a high traditional feed rate. This is because the energy in a fish's body is not used for growth but rather for life support (Zulkhasyni et al., 2015).

In addition, stocking density influences water quality, survivability, fish growth, and immunity (Yarahmadi et al., 2016). An increase in adrenocorticotropic hormone (ACTH) and cortisol levels (Galhardo and

Oliveira, 2009). Increased cortisol levels inhibit growth hormone/insulin-like growth factor-I (GH/IGF-I) response (Pujante et al., 2015). The liver secretes insulin-like growth factor-I, which is activated by growth hormone (Hafez et al. 2000). IGF-I plays a crucial role in the regulation of physiological processes including growth, metabolism, development, reproduction, and osmoregulation (Kling et al. 2011). In contrast, the feed efficiency value for catfish (Clarias spp.) seed during raising ranged from 71.72 to 83.46 percent (Table 1). Different vitamin E doses had a significant ($p < 0.05$) impact on the feed efficiency of catfish fry.

The feed efficiency of P1, P2, and P5 was substantially different ($p < 0.05$) from that of P3 (83.46%). The P3 treatment did not differ substantially ($p > 0.05$) from the P4 feed efficiency of 80.28 percent. The highest feed efficiency was 66.43 in treatment 3. The dosage of fish food is deemed appropriate if the feed efficiency is more than or close to 100 percent (Craig and Helfrog, 2002; Ahmadi, 2012).

Water quality

In the study, temperature and pH were measured every morning between 25 and 27.5º C, pH between 6.2 and 7.8, DO every week between 5 and 8 ppm, nitrite between 0.3 and 0.8 ppm, nitrate between 0 and 25 ppm, and ammonia at 0.25 ppm (Table 1). In this investigation, the water temperature is still ideal for catfish growth. Catfish can survive between 23 and 34 degrees Celsius (Surnama, 2004). In addition, the results of pH and dissolved oxygen assays are still ideal for catfish growth. Whereas the optimal pH and dissolved oxygen levels for catfish growth are 6.5 - 8.5 and 6 - 8 ppm, respectively (Iqbal, 2011), the dissolved oxygen (DO) in the water throughout the maintenance process is approximately 6 - 8 ppm. The measurement values of ammonia during the raising phase ranged from 0-0.25 ppm. In addition, the ammonia concentration is optimal for catfish cultivation. According to Trisnawati and Sudaryono (2014), the optimal ammonia level for catfish maintenance is 0.1 parts per million.

CONCLUSION

The addition of vitamin E to artificial feed for catfish seeds (*Clarias sp*.) affects catfish growth, feed conversion ratio (FCR), feed efficiency, and survival. The recommended amount of vitamin E in catfish seed (*Clarias spp*.) artificial feed is 100 mg /kg feed.

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