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Addition of Eco Enzyme to Feed for Growth of Siamese Catfish (*Pangasianodon hypophthalmus*)

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ABSTRACT

The addition of eco enzyme at an optimal dose is expected to enhance growth efficiency and feed conversion in Siamese catfish (Pangasius hypophthalmus), as demonstrated in previous studies. This study aimed to analyze the effects of eco enzyme supplementation on the growth performance of Siamese catfish juveniles reared in aquariums. The research was conducted at the indoor hatchery of the Municipal Freshwater Aquaculture Production Unit, using juveniles measuring 6–8 cm. The treatments consisted of four levels of eco enzyme supplementation to commercial feed: A (0 mL/kg feed), B (20 mL/kg feed), C (40 mL/kg feed), and D (60 mL/kg feed). The results showed that adding eco enzyme positively influenced the relative weight growth of the juveniles, while no significant effect was observed on relative length. The feed conversion ratio (FCR) indicated the best growth when feeding was optimized according to the nutritional needs of the Siamese catfish. This study concludes that eco enzyme supplementation improves growth performance, particularly weight gain, in Siamese catfish juveniles.

Keywords: *Eco Enzyme, Growth, Siamese Catfish,*

INTRODUCTION

Feed is a critical factor that determines the success and sustainability of aquaculture practices. The main component of production costs, feed covers more than 65% of total operational costs, and the increase in feed prices that occurs every year has a direct impact on decreasing profits for fish farmers. This price increase is mainly due to the high protein content in the feed, which increases feed costs significantly (Hartiyaningsih, 2022). Therefore, simple and applicable technology is needed which can increase the efficiency of protein absorption in fish feed, so that feed requirements can be minimized without reducing overall fish growth.

A potential technological approach in dealing with this problem is the use of eco enzymes as feed additives. Eco enzyme is a natural compound produced by fermenting kitchen waste, such as fruit and vegetable peels, with sugar, producing a vinegar-like compound that is environmentally friendly (Kartika et al., 2018). The increase in fruit and vegetable production is accompanied by a fairly large accumulation of organic waste,

where around 30–40% of fruits and vegetables are wasted each year. This waste is rich in beneficial compounds such as phytochemicals and nutraceuticals, which have the potential to become value-added products such as eco enzymes.

Eco enzymes contain various secondary metabolite compounds, including flavonoids, quinones, saponins, alkaloids and cardioglycosides, as well as functional enzymes such as amylase, lipase and protease (Widyasari et al., 2023). This compound, when utilized in fish feed, can increase metabolic activity which plays a role in accelerating appetite and feed consumption, which has the potential to significantly encourage fish growth. Eco enzyme has also been proven to improve the intestinal structure of fish larvae, thereby increasing the efficiency of optimal nutrient absorption. Previous research indicates that adding enzymes to feed can accelerate the growth rate of several fish species, including siamese catfish.

Previous research has shown that eco enzymes have broad benefits in agriculture and small industry as additional ingredients in products such as soap, cleaners, fertilizers and hand sanitizers. In aquaculture, eco enzyme has the potential to increase fish feed efficiency (Fitriana et al., 2023). Providing eco enzyme at an optimal dose is expected to increase and support growth efficiency and feed conversion, as has been proven in siamese catfish in similar studies. This research aims to analyze the effect of adding eco enzyme on the growth of Siamese catfish seeds kept in an aquarium.

MATERIALS & METHODS

Siamese catfish are reared at the Banjarbaru City Freshwater Aquaculture Production UPT, in an indoor hatchery using an aquarium. Each aquarium measures 60 cm x 40 cm x 40 cm with a total of 12 aquariums used. Each treatment uses 1 aquarium containing 48 liters of water (2/3 of the container volume) and a stocking density of 10 fry per aquarium. The Siamese catfish seeds used were 6-8 cm in size and were obtained from local farmers. The addition of different doses of Eco enzyme to commercial feed is as follows:

- A = Feeding without adding eco enzyme
- B = Feeding with adding eco enzyme (20 mL/kg feed)
- C = Feeding with adding eco enzyme (40 mL/kg feed)
- D = Feeding with adding eco enzyme (60 mL/kg feed)

RESULT

Growth in Relative Length

The results of the research on relative length growth were obtained by calculating the final fish weight and initial fish weight. The results of the relative weight growth can be seen in table 1 as follows.

Table 1. Relative length growth

Treatment	Test	(Lo)	(Lt)	Relative length growth (%)
A	1	4.84	8.87	83.2
	2	5.02	8.55	70.32
	3	5.2	9.14	75.85
Average		**5.02**	**8.85**	**76.46**
B	1	5.49	10.16	85.06
	2	5.46	10.33	89.26
	3	5	10.09	93.30
Average		**5.39**	**10.19**	**89.21**
C	1	5	9.22	84.4
	2	4.9	9.07	85.03
	3	5	9.60	89.72
Average		**5**	**9.30**	**86.38**
D	1	6	9.57	73.94
	2	4.95	9.03	82.32

	3	4	9.46	81.57
Average		**5**	**9.35**	**79.28**

The results of the Lilifors normality test for the relative length of fish show the value Wcount (0.895) > Wtable (0.859), which means the data is normally distributed. The results of the homogeneity of variance test showed that the Lcount value (1.528) < Ftable 5% (4.066) means that the data is homogeneous. Based on the results of the ANOVA test calculations, the calculated F value was (0.498) < F table 5% (4.066) & 1% (7.591), therefore the decisions that could be taken for all treatments did not show any significant differences. Table 1 shows that the average percentage of the relative length of siamese catfish seeds in treatment A has an average of 76.46%, treatment B has an average of 89.21%, treatment C has an average of 86.38%, and treatment D has an average of 79.28%. Good growth can be achieved by providing feed with siamese catfish feed requirements that are adjusted to the weight of the fish by providing 5% of the weight of the fish.

Feed with the addition of eco enzyme results in an increase in protein content, although the increase in the dose of eco enzyme is not directly proportional to the addition of protein content in the feed. This can be seen in treatment B, the addition of 20 mL/kg of eco enzyme produces 42.44% protein in the feed, then in treatment C, the addition of 40 mL/kg of eco enzyme produces 41.13% protein in the feed, and in treatment D 60 mL/kg produces 37.64% protein, while feed without eco enzyme in treatment A (control) has a protein value of 76.46%. Feed with the addition of eco enzyme produced energy for the growth of the relative length of the fish's body which was higher than that without eco enzyme treatment. This indicates that the digestibility of feed with the addition of eco enzyme can break down complex molecules into simpler molecules so that the nutrients in the feed are more easily utilized by fish for the growth process. This is supported by the opinion of Widyasari et al. (2023), that eco enzyme contains various types of enzymes, such as amylase, protease, lipase, and cellulase, which assist in the digestion and breakdown of various types of organic materials.

Maulidin et al., (2016), reported that the administration of the papain enzyme in feed had an influence on the absolute growth rate of snakehead fish. Syahputra et al., (2015) also reported that the administration of papain at a dose of 2.5% has a better effect on the growth of fish seeds. Salam et al., (2020) administration of papain enzyme at a dose of 2.5% is the optimal dose for the survival rate and growth of siamese catfish. Hartiyaningsih (2022), The effect of administering eco enzyme in the aquaponic system on the survival and growth of siamese catfish with the highest average growth was in treatment 2 (administration of eco enzyme 1.5 ml/L of water) obtained results with an average length of 19.49 cm and an average weight reaching 61.85 grams during the 90-day maintenance period. The administration of eco enzyme has an effect on the survival and growth of siamese catfish.

Growth Relative Weight

The results of the research on relative weight growth were obtained by calculating the final fish weight and initial fish weight. The results of the relative weight growth can be seen in Table 2 below.

Table 2. Relative weight growth of siamese catfish seeds

Treatment	Test	(Wo)	(Wt)	Relative weight growth (%)
A	1	1.75	4.25	142.86
	2	1.75	6.12	249.71
	3	2.44	3.34	36.89
Average		**1.98**	**5.57**	**143.15**
B	1	2.38	7.57	218.07

	2	1.75	6.68	281.71
	3	2.37	7.13	200.68
Average		**2.17**	**7.13**	**233.49**
C	1	2.38	8.31	249.16
	2	2.38	5.31	123.11
	3	2.38	6.01	152.52
Average		**2.38**	**6.54**	**174.93**
D	1	2.38	7.81	228.15
	2	1.75	7.81	346.29
	3	1.75	6.69	282.29
Average		**1.96**	**7.44**	**285.57**

The results of the homogeneity test of variance show the L count value (0.586) < F table 5% (4.066) meaning that the data is homogeneous. Based on the results of the ANOVA test, the F count value (2.279) < F table 5% (4.066) & 10% (7.591) was obtained, therefore the decisions that can be taken all show significant differences. Table 2 shows the average relative weight percentage of siamese catfish seeds in treatment A which has an average of 143.15%, treatment B has an average of 233.49%, treatment C has an average of 174.93%, and treatment D has an average of 285.57%. So from the table above it can be seen that the feed given eco enzyme has a higher weight gain compared to feed that is not given eco enzyme. This is thought to be due to the contribution of eco enzyme with digestive enzymes by bacteria that can improve the digestion process.

Amarwati (2015) where eco enzyme which is a liquid from fermented fruit skin can break down compounds or materials that are difficult to digest with the help of microorganisms or bacteria such as fiber or complex proteins. However, after statistical testing, it showed that the normality of Lilifors relative weight of siamese catfish showed L (0.972)> Wtable (0.859) so that it was concluded that the data was normally distributed. Feed given probiotics at different doses did not show a significant difference without being given probiotics on the growth, weight, length and survival of Siamese catfish fry. This statement contradicts the opinion of Kartika et al. (2018) in their research, emphasizing that the provision of aquaenzyme as a probiotic in feed has an effect on the digestive tract. Based on research results, feed with aquaenzyme added to the feed is able to convert chemical compounds in commercial feed into simple compounds. Suhartono and Artika (2017) The digestion process occurs by changing complex, macro-sized feed into simple, micro-sized compounds so that it will really help the food absorption process in fish digestion.

Jusadi et al. (2004) conducted research with the addition of eco enzyme in the form of probiotic Bacillus sp. Commercial feed given to siamese catfish larvae measuring 1.859 g at a dose of 15 ml/1 kg of feed can provide a final daily weight gain of 2.00 g. Protein is a substance that builds muscle tissue and meat, as well as hormones and enzymes that play a role in the growth process. Protein requirements will decrease with increasing fish weight and age (Arnason et al., 2010).

Feed Conversion Rate (FCR)

Feed conversion is the division between the body weight achieved in the current month with the feed consumption in that month. Feed conversion is obtained by dividing the total feed consumed by the total production results. Iskandar and Elrifadah, (2015), the higher the feed conversion value means the lower the feed utility, the high feed conversion is caused by the low digestibility of the feed due to the high crude fiber content. The calculation results regarding the feed conversion value of siamese catfish seeds can be seen in Table 3 below.

Table 3. Siamese catfish Feed Conversion Ratoi (FCR)

Treatment	Test	Feed	(Wo)	(Wt)	Dead fish	FCR (%)
A	1	147.25	43.75	106.25		2.36
	2	136	43.75	153		1.24
	3	133.5	61	144.5	10	1.43
Average		**138.92**	**49.50**	**134.58**	**3.33**	**1.68**
B	1	159.50	59.50	189.25		1.23
	2	129.50	43.75	167.00	7.50	0.99
	3	154.25	59.25	178.25	2.50	1.27
Average		**147.75**	**54.17**	**178.17**	**3.33**	**1.16**
C	1	162.50	59.50	207.75		1.10.
	2	125.50	59.50	132.75		1.71
	3	136.25	59.50	150.25		1.50
Average		**141.42**	**59.50**	**163.58**		**1.44**
D	1	160.50	59.50	195.25	7.50	1.12
	2	122.50	43.75	195.25		0.81
	3	119.00	43.75	167.25		0.96
Average		**134.00**	**49.00**	**185.92**	**2.50**	**0.96**

Based on the table above, it shows that the average percentage of Feed Conversion Ratio is 0.96-1.68. The highest Feed Conversion Ratio was in treatment A (1.68) and the lowest conversion value was in treatment D (0.96). Treatment A has an average of 1.68%, treatment B has an average of 1.16%, treatment C has an average of 1.44%, and treatment D has an average of 0.96%. The Feed Conversion Ratio decreased along with the addition of the ecoenzyme dose sprayed on the feed. However, after the normality test was carried out, the Feed Conversion Ratio of siamese catfish seeds showed W count (0.893) > W table (0.859) which means the data is normally distributed. The homogeneity test results produce a value of Lcount (3,834) < Ftable 5% (4,066), meaning the data is homogeneous. Based on the results of the ANOVA test calculations, the calculated F value was (0.322) < F table 5% (4.066) & 10% (7.591), so it can be concluded that all treatments given did not show any real differences.

Widyasari et al. (2023), eco enzyme involves microorganisms that exist naturally in a fermentation environment that are rich in probiotics, the enzymes in eco enzyme have the ability to break down various types of organic material, and the probiotics help maintain the microbiota in digestion. The addition of ecoenzymes to commercial feed has an influence on growth and feed conversion. Ihsanudin et al., (2014), stated that a low Feed Conversion Ratio means the quality of the feed given is good. A high Feed Conversion Ratio means the quality of the feed provided is not good. The smaller the feed conversion ratio, the feed provided is good enough or suitable to support fish growth and vice versa, the lower the FCR value indicates that the more efficient the feed is and the feed eaten is used well by the fish for its growth (Ardita et al., 2015).

The use of eco enzymes in aquaculture provides significant environmental benefits by promoting sustainable practices. Eco enzymes, derived from organic waste such as fruit peels, contribute to reducing environmental pollution by repurposing biodegradable materials that would otherwise contribute to waste accumulation (Li et al., 2021; Rahman et al., 2020). Their inclusion in fish feed enhances nutrient utilization and digestion, resulting in less organic waste in aquatic environments (Priani et al., 2020). This improvement in water quality creates healthier ecosystems, minimizes harmful algal blooms, and supports the overall sustainability of aquaculture practices (Amyliana et al., 2021; Zubaydah et al., 2023).

The scalability of eco enzyme use in aquaculture demonstrates promising potential. Their low-cost production from

easily available raw materials makes them an attractive alternative for enhancing feed efficiency across various aquaculture systems (Dilla et al., 2023; Ma et al., 2020). Incorporating eco enzymes into feeds for widely farmed species like Siamese catfish could be scaled to benefit smallholder farmers and large-scale operations alike (Zhou et al., 2022; Harahap et al., 2022). The observed improvements in feed conversion ratios (FCR) and growth performance highlight eco enzymes as a viable option to reduce dependency on expensive commercial additives while maintaining profitability and sustainability (Wang et al., 2023; Kumar et al., 2021).

Eco enzyme application aligns with global trends toward environmentally friendly aquaculture. By reducing waste outputs and enhancing productivity, the adoption of eco enzymes addresses key challenges in aquaculture sustainability (Hidayat & Saputra, 2023). Their potential to reduce feed costs and improve growth metrics can catalyze broader implementation, particularly in developing regions. Future research into long-term impacts, optimal dosages, and compatibility with various species and feed formulations will further solidify eco enzymes as a cornerstone of green aquaculture innovation (Suprapto et al., 2021).

Recent studies and advancements in eco enzyme-based aquatic feed have highlighted their transformative potential in aquaculture. Research has demonstrated that eco enzyme supplementation can enhance the bioavailability of nutrients in feed, particularly proteins and fats, leading to improved growth and feed efficiency in various fish species, including Siamese catfish (Ma et al., 2020; Zhou et al., 2022). Eco enzymes, rich in proteolytic and lipolytic activity, have been shown to break down complex nutrients into simpler forms, facilitating better absorption and utilization by fish (Harahap et al., 2022; Kumar et al., 2021). Additionally, innovative formulations combining eco enzymes with probiotics or other bioactive compounds have emerged, amplifying their effects on fish health, immunity, and stress resistance (Wang et al., 2023). These advancements underscore the potential of eco enzyme-based feeds to revolutionize aquaculture by fostering sustainability and economic efficiency.

CONCLUSION

The effect of adding eco enzyme on the growth of Siamese catfish seeds kept in aquariums was concluded that the addition of eco enzyme to commercial feed in cultivating Siamese catfish seeds had a positive effect on increasing the relative weight growth of seeds, but increasing the dose of eco enzyme did not significantly affect relative length. Feed conversion rate (FCR), the best growth is achieved when feeding is adjusted to the needs of siamese catfish.

Declaration by Authors

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