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Turmeric Flour Supplementation Through Feed-in Biofloc System Cultivation on the Growth of Nilem Fish (*Osteochilus hasselti*)

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ABSTRACT

Nilem fish (*Osteochilus hasselti*) is favored by the community because of its chewy meat texture, good taste, and relatively cheap price, so it has the potential to be developed. However, the growth of nilem fish is slow therefore it needs to be given an immunostimulant to increase its growth. Biofloc is known as a cultivation system that can maintain water quality and provide sufficient floc for additional fish feed. This study aims to determine the effect of using turmeric flour in feed to increase the growth of nilem fish reared in the biofloc system. The study used a completely randomized design (CRD), with 3 treatments and 1 control each repeated 4 times. The treatments were supplementation of turmeric flour through feed at a dose of 1.125 g (B), 0.75 g (C), and 0.375 g (D) kg^{-1} feed and control (A) in cultivation with a biofloc system. The study lasted for 90 days with feeding 3%/kg of biomass weight given 2 times a day, in the morning and evening. Parameters observed in this study were weight (WG) and length growth (LG), daily growth rate (SGR), feed conversion ratio (FCR) and feed efficiency (EF). The data collection method was carried out by weighing and measuring the weight and length of the fish and the amount of feed consumed. The data obtained were collected and analyzed using SPSS 2.0.

The results showed that supplementation of turmeric flour through feed reared in the biofloc system could increase weight and length growth, daily growth rate, feed conversion ratio, and feed efficiency. The optimal dose was obtained in the treatment of 1.125 g kg^{-1} feed (B), proving that supplementation of turmeric flour through feed has the potential to be applied to fish culture using the biofloc system.

Keywords: turmeric, nilem fish, biofloc, growth

INTRODUCTION

Fish farming is an important sector to support rural economic development. Currently, many fish cultivations have been developed such as African catfish, gourami, and tilapia, but there is still potential for other cultured fish such as nilem (*Osteochilus hasselti*) to be developed. The chewy texture of nilem fish with not too many spines compared to tawes fish, the delicious and savory taste of the meat makes nilem fish popular with consumers (Mulyasari, Soelistyowati, Kristanto, & Kusmini, 2016). In addition, the cultivation of nilem fish has advantages both economically and environmentally. Nilem fish have a habit of eating moss or algae attached to the walls of the water, so it can be used as a cleaner for the dirt of the aquatic environment. The population of nilem fish in public

waters is allegedly decreasing. The decline in fish populations is a result of overexploitation and changes in the aquatic environment. Nilem fish cultivation techniques are needed to increase the population and ensure the sustainability of nilem fish (Syamsuri *et al*., 2017).

In addition to maintaining the sustainability of the nilem fish population, innovation in cultivation techniques is needed for better growth. Likewise, the price of commercial feed is quite high so the profits are small. This kind of situation requires efforts to reduce production costs in the cultivation of nilem fish so that a decent profit is obtained. Several research results show that cultivation using a biofloc system can reduce production costs. According to (Salamah & Zulpikar, 2020), cultivation using a biofloc system in addition to improving water quality can also provide feed in the form of floc which can be used by fish for an additional feed to reduce production costs. Flock-shaped feed is reported to increase the value of feed efficiency. In the biofloc system, there is also no need to change water as in general cultivation, it can even be said to be zero water exchange. The addition of water is only carried out under certain conditions such as evaporation and other problems, so that cultivation with this system is more environmentally friendly. However, for fish growth, not only good water quality is needed but also growth promoters such as turmeric.

One alternative natural additive that has the potential to increase growth is *Curcuma longa* turmeric. Turmeric is a type of turmeric rhizome-producing plant that thrives in Indonesia (Arifin, Setiawati, Bambang, & Utomo, 2015). Turmeric also contains 9.61% curcumin compounds (Sinurat *et al*., 2009). Curcumin functions in regulating fat metabolism. The cholagogum activity of curcumin can stimulate bile to secrete more bile which will help in the breakdown of fat (Alappat & Awad, 2010). (Maqsood, Singh, Samoon, & Munir, 2011), that with the addition of turmeric it can produce a low MDA value in mice. (Yarru *et a*l., 2009), that the administration of turmeric can increase the SOD enzyme in broiler chickens. Turmeric can increase the activity of the SOD enzyme in the liver so that it can counteract ROS. Furthermore, through the NRf-1 pathway, curcumin instructs the brain to produce SOD which functions to suppress ROS (Kocaadam & Şanlier, 2017) so that it indirectly affects better growth. This study aims to determine the effect of adding turmeric flour supplements through feed on nilem fish reared with a biofloc system.

Curcumin functions in regulating fat metabolism. The cholagogum activity of curcumin can stimulate bile to secrete more bile which will help in the breakdown of fat (Alappat & Awad, 2010). (Singh, 2011), that the addition of turmeric was able to produce low MDA values in rats. Catfish given the addition of turmeric in their feed can reduce MDA because turmeric has antioxidant compounds *(Traifalgar et al*., 2010) (Tung et al. 2019 *in* Rahmadani, Jusadi, Setiawati, & Hastuti, 2020). The decreased MDA value has a relationship with the antioxidant enzyme in counteracting ROS, namely superoxide dismutase (SOD). (Yarru *et al*., 2009) reported that turmeric was able to increase the SOD enzyme in broiler chickens. Furthermore, through the NRf-1 pathway, curcumin instructs the brain to produce SOD which functions to suppress ROS (Kocaadam & Şanlier, 2017) so that it indirectly affects better growth. So far, research about biofloc has been carried out, as well as the use of herbs for cultivation. However, the combined application of herbal use in biofloc cultivation has not been studied. This study aims to determine the effect of adding turmeric flour supplements through feed on gourami reared with a biofloc system.

RESEARCH METHODS

This study used nilem fish seeds measuring 3-5 cm. Nilem seeds were kept in plastic buckets with a volume of 64 L, while the volume of water was 56 L. The treatments were in the form of biofloc media and turmeric flour supplements. Biofloc media used molasses as a carbon source and probiotic EM4.

The study used an experimental method with a completely randomized design. The

treatment given was in the form of turmeric flour supplementation through feed on cultivation media with a biofloc system. Each bucket was filled with 20 nilem seeds, while the control and each treatment were repeated 4 times. During maintenance, water quality parameters were measured consisting of pH, temperature, and dissolved oxygen. The feed is given as much as 3% of the weight of fish biomass, given 2 times a day in morning (± 07.00) and afternoon (± 17.00). The feed used in this study was produced by PT Mataram Sakti, Surabaya with consist of 33% protein, 5% fat, 4% crude fiber, 12% ash content, and 10% water content.

Parameters observed in this study included growth in weight (WG) and length (LG) gain of fishes, daily growth rate (SGR), feed conversion ratio (FCR) and feed efficiency (FE). Data was collected by weighing the weight of the fish, measuring the length of the fish at the beginning and end of the study, as well as the feed consumed during the study. The collected data was processed and analyzed using SPSS 2.1.

The full treatment is:

A: Biofloc

B: Biofloc + turmeric powder 1.125 g/kg feed

C: Biofloc + turmeric powder 0.75 g/kg feed

D: Biofloc + turmeric powder 0.375 g/kg feed

RESULTS AND DISCUSSION

Research on nilem fish that was given turmeric flour supplementation through feed-in biofloc system culture resulted in significant growth. Growth in weight (WG) and length (LG), daily growth rate (SGR) as well as FCR and feed efficiency (FE) showed significantly different results than control (Table 1).

In this study, both control and treatment used biofloc, the difference was the different doses of turmeric flour in the treatment. The dose of turmeric used refers to the results of research conducted by (Arifin *et al*., 2015), the optimum dose (DO) of turmeric flour for the growth of gourami is 0.15% (1.5 g kg-1 feed) which is given through feed. In the first treatment (T1), 75% of the optimum dose (DO) was given, then T2 and T3 were 50% and 25% of DO, respectively. Meanwhile, the dose of biofloc used was based on research results from (Rijal, Susanto, Simanjuntak, Hernayanti, & Sukardi, 2020), that nilem fish reared in the biofloc system had optimum growth when given 10 mL of probiotic EM4 and 40 mL of molasses in a pond containing a volume of 144 L of water. Optimum growth results obtained in treatment B (Bioflok + turmeric flour 1.125 g kg^{-1} feed), showed that biofloc given herbal turmeric powder supplement was better than biofloc alone.

Table 1. Growth of nilem fish fed turmeric flour diet in biofloc culture

Parameters	Experimental group			
	A	B	C	D
Weight gain (WG, g)	4.03 ± 0.12^{a}	7.28 ± 0.55^{c}	6.49 ± 0.13^{b}	6.51 ± 0.35^{b}
Length gain (LG, cm)	3.35 ± 0.05^{a}	5.77 ± 0.24^{b}	5.50 ± 0.07^{b}	5.57 ± 0.27^{b}
SGR (%/d)	1.31 ± 0.03^{a}	1.84 ± 0.05^{c}	1.73 ± 0.02^{b}	1.78 ± 0.03^{b}
Feed intake (g)	426.35	558.06	526.38	516.36
Protein level (%)	31	31	31	31
FCR	7.06 ± 0.21^{b}	5.14 ± 0.34^{a}	5.39 ± 0.12^{a}	5.32 ± 0.24^{a}
Feed efficiency	14.18 ± 0.42^{a}	19.52 ± 1.24^{b}	18.57 ± 0.41^{b}	18.84 ± 0.88^{b}

The results showed that gourami reared in the biofloc system with feed supplemented with turmeric flour had better growth than those reared only on biofloc media without additional turmeric flour supplementation. This is because the cultivation of the biofloc system places more emphasis on improving water quality and additional feed in the form of floc. As reported by (Rijal *et al*., 2020), intensive cultivation with a biofloc system can provide additional feed in the form of floc and control the quality of aquaculture water. Cultivation with a biofloc system can take advantage of excess feed and metabolic waste so that water quality is maintained properly. Biofloc works by adding a carbon source and aerobic bacteria to decompose and maintain the population of floc-forming bacteria. The biofloc system also works by converting inorganic nitrogen, especially ammonia, by heterotrophic bacteria into microbial biomass that can be consumed by cultured fish (Ekasari, 2009). This causes the level of ammonia in the water to decrease so that water quality can be maintained properly. This technology minimizes water changes to increase biosecurity by minimizing external effects on the culture environment (De Schryver, Crab, Defoirdt, Boon, & Verstraete, 2008).

Furthermore, added by (Panca Dias Purnomo, 2012), the addition of a carbon source into the fish rearing media will be able to stimulate the growth of heterotrophic bacteria that can be used by fish as nutritional supplementary feed. In biofloc media there are microorganisms such as protozoa, rotifers, and heterotrophic bacteria that can be a source of food for fish, thereby increasing survival (Azim, Little, & Bron, 2008) to suppress cannibalism (Apriani, Setiawati, & Budiardi, 2016). However, in this study, growth was better in gourami reared with the biofloc system which was fed with turmeric flour supplements than those reared on the biofloc system alone without the addition of turmeric supplements. This shows the role and function of turmeric flour as a supplement in increasing the growth of nilem to be more optimal.

1. Growth of fish

The results of the study (Prabowo, Madusari, & Mardiana, 2017) proved that turmeric mixed with feed at a dose of 12g kg^{-1} could increase the growth of milkfish by 1.97 g while in control it was only 0.74 g. The results of the same study reported by (Mooraki, Batmany, Zoriehzahra, & Kakoolaki, 2019), ornamental fish (*Andinocara rivulatus*) fed a diet containing 0.3% turmeric flour can improve growth performance, feed conversion, condition factors, and better survival percentages, even among treatments that were not significantly different. Improvement of growth in turmeric diet in fish feed can be caused because turmeric can stimulate the release of digestive enzymes in the digestive tract. As reported by (Rojtinnakorn, J., Rittiplang, S., Tongsiri, S., 2012), Sand Goby fish (*Oxyeleotris marmoratus*) fed a diet containing turmeric flour 0.03, 0.05, 0.1 and 0.5% can increase the secretion of the enzyme amylase, lipase, trypsin and chemotrypsin in the digestive tract of fish. These results indicate that the 0.3% turmeric diet in fish feed has a significant effect on increasing enzymes so that digestion and absorption of nutrients increases. In this study, the number of enzymes was not considered, but turmeric flour administration could affect the quality and quantity of digested and absorbed feed based on growth index measurements.

Mukherjee, Mandal, & Banerjee (2009), investigated the effect of turmeric flour diet on growth performance and body color of guppies. In this study, 0.03, 0.06, 0.09, 0.1, and 0.2% turmeric flour were added to the basal diet, and the results showed that fish fed a diet containing 0.09% turmeric flour produced growth performance. better than the other groups. Implementation of different doses of turmeric flour as additive through the feed for basal diet in various studies related to specific fish species. In addition, the inclusion of fish

in the diet of carp at a dietary level of 2.0 g kg^{-1} can increase growth and feed utilization and improve fish health (Abdel-Tawwab & Abbass, 2017).

2. Survival Growth Rate (SGR)

Turmeric diet in carp *Cyprinus carpio* can improve aspects of growth performance such as final weight, relative growth rate, and daily growth rate (SGR). Similarly, a turmeric diet can increase the growth rate of *C. carpio* when challenged with *Flexibacter columnaris*. In addition, the addition of turmeric to commercial feed increased the survival rate of carp challenged with pathogenic bacteria. This proves that turmeric powder supplementation given through feed can be applied in cultivation (Abdul & Hassan, 2017). The results of a similar study also proved the protective effect of curcumin, as reported by (Manju, Akbarsha, & Oommen, 2012), a diet of 0.5 and 1% curcumin through a feed containing 40% protein for approximately three weeks led to a significant increase in protein in the tissues, which ultimately results in better growth performance. The results prove the previous explanation that turmeric can affect digestibility and absorption which in turn affects growth performance and carcass analysis.

Giving turmeric flour can stimulate the liver to secrete bile and stimulate the pancreas for the secretion of digestive enzymes such as lipase, maltase, amylase, trypsin and also stimulates pancreatic activity and protects red blood cells (Srinivasan, 2005).

3. Feed Conversion Rate (FCR) and Feed Efficiency (FE)

Manju et al. (2012) reported that curcumin has a protective effect and enhances growth performance. In this case, turmeric consumption by fantail guppies (*Poecilia reticulate*) led to a decrease in FCR and an increase in growth performance (Mukherjee *et al*., 2009). The decrease in feed conversion at the same time showed an increase in feed efficiency (FE) in the administration of turmeric flour through feed and an increase in growth performance. As reported by (Abdul & Hassan, 2017), administration of turmeric flour mixed with feed can increase feed efficiency which can be seen from increased growth performance and decreased feed conversion (FCR). The increase in the activity of the enzymes amylase, lipase, trypsin and chymotrypsin caused an increase in carcass protein concentration, growth performance, and feed efficiency (FE) by decreasing the conversion of FCR feed-in *Andinocara rivulatus* fish fed turmeric flour through their feed *(Mooraki et al*., 2019).

According to Asai & Miyazawa (2001) turmeric contains volatile oil of 1-3%, alcohol sesquiterpenes, turmerone, zingiberen, 8% protein, 30% carbohydrates, 3% fat, and the rest consists of vitamin C, salts, and minerals. mineral salts such as iron, phosphorus, and magnesium. Turmeric also contains 9.61% curcumin compounds (Sinurat *et al*., 2009). Curcumin functions in regulating fat metabolism. The cholagogum activity of curcumin can stimulate bile to secrete more bile which will help in the breakdown of fat (Alappat & Awad, 2010) so that it affects growth.

CONCLUSION

The results showed that supplementation of turmeric flour through feed reared in the biofloc system could increase weight and length growth, daily growth rate, feed conversion ratio, and feed efficiency. The optimal dose was obtained in the treatment of 1.125 g kg^{-1} feed (B), proving that supplementation of turmeric flour through feed has the potential to be applied to fish culture using the biofloc system.

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