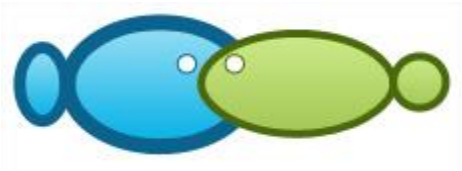

A combination of turmeric and ginger powder supplementation through feed to increase the immunity of *Clarias gariepinus* (Burchell, 1822) fry

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Abstract. Consumer needs and demands for catfish continue to increase due to its delicious taste, easy availability in the market, and relatively low price. This causes catfish cultivation to be carried out intensively by increasing stocking density. Cultivation with high stocking density causes more feed and feces to settle at the bottom of the pond, potentially producing high ammonia, which ultimately decreases the immunity of the population cultivars and makes them susceptible to disease. To anticipate this, it is necessary to provide safe immunostimulant supplementation, namely a combination of turmeric (Curcuma longa) and ginger (*Zingiber officinale*) powder. The study used a completely randomized design with 3 treatments and 1 control, each with 3 replications. The treatments given were T1: supplementation (600 + 4550) mg kg-1 feed, T2 (750 + 3750) mg kg-1 feed, T3 (900 + 3000) mg kg-1 feed and control (T0) for 40 days. The parameters measured included hematocrit, leukocrit, and survival rate. The study results showed that a combination of turmeric and ginger powder supplementation can improve the immunity of catfish, with an optimal dose of 900 mg turmeric + 3,000 mg ginger/kg of feed, representing 60% of the optimal dose of turmeric powder and 40% of the optimal dose of ginger powder. The combination of turmeric and ginger powder supplementation can be used to enhance the immunity of catfish.
Key Words: *Clarias gariepinus*, herbal combination, immunity, turmeric, ginger.

Introduction. North American Catfish, *Clarias gariepinus* (Burchell, 1822) widely favored by the public due to their several advantages that consumers perceive as beneficial. African catfish are relatively easy to cultivate, relatively inexpensive, and readily available in both traditional markets and supermarkets. African catfish production in Banyumas Regency in 2017 was 841,750 tons, increasing by 140.18% to 1.18 million tons in 2018 (MMAF 2018). To meet consumer and market demand for North American catfish, intensive farming of this species is being carried out.

In intensive fish farming, increasing stocking density leads to increased feed and fecal residue settling at the bottom of the pond. This can be dangerous because ammonia and nitrite levels in the water can increase, endangering the survival of the fish. Furthermore, intensive fish farming causes changes in water quality, such as temperature, pH, and oxygen solubility, causes environmental changes which can potentially reduce immunity and increase the risk of infectious diseases. As reported by Mendrofa & Zebua (2025), water quality is a major factor affecting fish health. Decreased water quality parameters such as pH, temperature, and dissolved oxygen concentration can significantly impact fish growth and health, increasing their susceptibility to infection. Infections can be caused by viruses, bacteria, or parasites and are usually treated with antibiotics. Pathogenic organisms can include viruses, fungi, parasites, and bacteria. Antibiotics can be administered to prevent infections and disease outbreaks. However, administering antibiotics at inappropriate doses over a long period can lead to resistance, leaving residues

in the fish's body and environmental pollution. Therefore, alternative treatments are needed, one of which is the administration of immunostimulant compounds with immunomodulatory properties. Alternative treatments that are more environmentally friendly and do not cause bacterial resistance are needed, namely the use of herbs. Administering herbal compounds is safer, easier to obtain, doesn't cause resistance, and isn't harmful to the environment. As reported by Payung & Manoppo (2015), medicinal plants are becoming important as an environmentally friendly and sustainable alternative treatment for fish. Turmeric and ginger are important natural ingredients with immunostimulant properties.

Turmeric is a type of herbal plant that has many benefits. Turmeric can treat Motile Aeromonas Septicemia (MAS), reducing the clinical signs and symptoms of MAS. The most effective dose of turmeric for boosting the immune system in fish is 0.9 g kg^{-1} of pellets in *C. batrachus* fish against *A. hydrophila* infection (Riauwaty et al 2021). Turmeric contains curcumin, which can increase the digestibility of nutrients in the digestive tract. The essential oil and curcumin content in turmeric can increase appetite, stimulate the liver to produce bile, and stimulate the pancreas to produce enzymes such as amylase, lipase, and protease to facilitate digestion (Musthofa et al 2025).

In addition to turmeric, ginger rhizomes are known to be effective in increasing appetite and enzyme performance, which can aid the digestive process in processing feed. Ginger contains digestive enzymes, namely protease and lipase, which are used to digest protein and fat, respectively (Robiansyah et al 2018). The results of research by Payung & Manoppo (2015) proved that the addition of ginger to fish feed at a dose of 2.5-7.5 g kg^{-1} of feed can have a significant effect on the non-specific immune response in tilapia for 4 weeks of administration.

This study aims to determine the effect of providing a combination of turmeric and ginger powder supplementation through feed to increase the immunity of North American Catfish fish seeds.

Material and Method. The research was conducted in a biofloc pond in Karangsari, Purwokerto, Indonesia, using 240 North American Catfish fingerlings measuring 6-7 cm with an average weight of 2.5 g. The feed provided was commercial pellets, branded MSPrima Feed PF 1000, produced by PT Matahari Sakti Surabaya, with a protein content of 39-41%, fat content of 5%, crude fibre content of 6%, maximum ash content 11% ash content of 16%, and moisture content of 10%.

This study used a laboratory experimental method, with a Completely Randomized Design consisting of 4 treatments and 3 replications for 40 days. The turmeric dose used as a reference was 1,500 mg kg^{-1} feed (Wahyuningtyas 2020), while the ginger dose used as a reference was 7,500 mg kg^{-1} feed (Habibah 2020). The treatment doses used in this study were a combination of turmeric and ginger herbal powder as follows:

Table 1

Dosage of the herbal combination treatment of turmeric flour and ginger flour

Treatment	*Turmeric powder (optimum dose 1,500 mg kg^{-1})*	*Ginger powder (optimum dose 7,500 mg kg^{-1})*	*Feed*
Control (To)	0 mg	0 mg	1 kg
T1	600 mg (40% of Optimum dose)	4,550 mg (60% of Optimum dose)	1 kg
T2	750 mg (50% of Optimum dose)	3,750 mg (50% of Optimum dose)	1 kg
T3	900 mg (60% of Optimal dose)	3,000 mg (40% of Optimal dose)	1 kg

The study used 16 plastic buckets with a volume of 30 liters, each containing 15 catfish fry seeds. Before use, the buckets were sterilized using a chlorine solution and then soaked in water to a height of ±30 cm for 24 hours. After 24 hours, the chlorine water was discarded, then rinsed thoroughly and dried. Before the study began, the test fish were acclimatized for 7 days to ensure comfort and stress-free conditions. During adaptation, the fish were

fed twice a day, at 08.00 am and in the afternoon at 05.00 p.m, as much as 3% of their biomass weight. During the study, the fish were treated with pellet feed mixed with turmeric powder and ginger powder for 40 days.

***Blood** sampling*. Fish blood samples were taken using a 1 mL syringe pre-treated with 10% EDTA anticoagulant. Blood was drawn from the caudal vein, collected in a microtube, and then flowed into a microhematocrit tube until it was three-quarters full. Next, one end of the hematocrit tube was plugged with Critoseal or stopper wax. Hematocrit, leukocrit, and survival rates were calculated using the following formula:
Hematocrit = (Red blood cell volume length: Total blood volume length) x 100%
Leukocrit = (White blood cell volume length: Total blood volume length) x 100%
Survival rate = (Number of fish surviving: Total number of fish) x 100%

Data analysis. The research data obtained were presented as mean ± SD (standard deviation). To determine whether the treatment affected immunity, the data were analyzed using Analysis of Variance (ANOVA) with an F-test at the 95% confidence level. If a significant difference was found, the Duncan Multiple Range Test (DMRT) was performed at the 95% confidence level.

Results and Discussion. Hematocrit is the ratio of the length of the column of red blood cells the length of red blood cells to the total length of the column of red blood cells. Hematocrit measurements were performed to observe changes in hematocrit levels after feeding African catfish fry a combination of turmeric and ginger powdered feed. The results of observations of the hematocrit levels of North American Catfish fry after 40 days of treatment are presented in Figure 1.

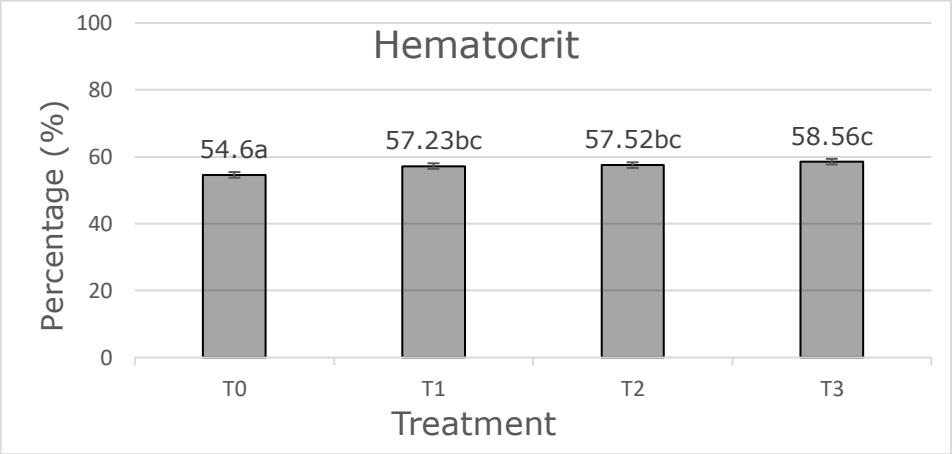

Figure 1. Hematocrit in North American Catfish after supplementation of turmeric and ginger powder through feed for 40 days of research.

Statistical analysis results showed that feeding a mixture of turmeric and ginger powder significantly affected the hematocrit percentage in African catfish. The control group was significantly different from T1, T2, and T3. The highest hematocrit percentage was in the T3 treatment with an average of 58.56%, while the lowest hematocrit percentage was in the control group with an average of 54.60%. The hematocrit percentage in each treatment experienced different increases. The high hematocrit value in T3 is strongly suspected to be influenced by the difference in curcumin content in turmeric powder, with a higher dose in T3 (60%) compared to T2 (50%) and T1 (40%). This is in accordance with the research of Saragih et al (2016), who reported that Striped catfish, *Pangasianodon hypophthalmus* fish experienced an increase in hematocrit percentage after being given turmeric extract at doses of 0.3 g kg^{-1} feed, 0.5 g kg^{-1}, and 0.7 g kg^{-1} through soaking. Furthermore, dietary curcumin supplementation can enhance non-specific immune responses, antioxidant capacity, and increase resistance to high ammonia stress in juvenile *S. dumerili* (Khieokhajonkhet et al 2023). Other research results showed that dietary supplementation

of turmeric extract at 2-3 g kg^{-1} in feed can increase stress resistance (cortisol and glucose levels), coloration, strengthen immunity, and reduce stress in goldfish (*Carassius auratus*) (Khieokhajonkhet et al 2023).

The significant increase in hematocrit percentage at the T3 dose, in addition to the dominant role of turmeric powder (60%), could also be due to the role of ginger powder, even though it was only 40% in the combined dose in this study. The results of the study were confirmed by Elsayed & Mohamed (2019), who stated that the addition of ginger powder through feed can increase the hematocrit value of tilapia. This is in accordance with the reports of Hassanin et al (2014) and Aysel et al (2016), who stated that the bioactive compounds found in ginger can increase the hematocrit percentage, the number of erythrocytes, and the hematopoietic function of Nile tilapia. Similarly, Fajriyani et al (2017) reported that administering ginger powder through feed to catfish can increase hematocrit values, although not significantly. A high hematocrit percentage indicates an increase in the number of erythrocytes, while a low hematocrit percentage indicates a decrease in the number of erythrocytes and can make fish susceptible to disease (Undari 2015).

Leukocrit is the percentage of white blood cells (leukocytes) in the blood. The results of leukocrit observations over the 40-day study are presented in Figure 2.

Figure 2. Leucocrit in North American Catfish after supplementation of turmeric and ginger powder through feed for 40 days of research.

The analysis results showed that T0 (control) was significantly different from T1, T2, and T3, but there was no significant difference between the treatments. Based on Figure 2, the leukocrit percentage in each treatment experienced different increases, with the highest to lowest average being achieved by T1 (3.95%), T2 (3.92%), T3 (3.82%), and T0 (1.97%). Leukocrit is a measurement that indicates the percentage of leukocytes, or white blood cells, as a component of the body's immune system in response to infection. The leukocrit percentage can also be used as a basis for determining the health condition of fish. According to Sulastri et al (2014), the normal leukocrit percentage in animals is around 1-4%. A low leukocrit percentage indicates infection, poor nutritional quality, and vitamin deficiency. Meanwhile, a high leukocrit percentage indicates the early stages of infection and stress.

The study's results showed a significant effect of the combination of turmeric and ginger powder in feed on the percentage of leukocrit compared to the control in North American Catfish fry. The high leukocrit value at T1 is thought to be due to the greater function of ginger powder (60%) compared to turmeric powder (40%) in the combination at dose T1. Ginger contains flavonoid compounds and gingerol, which act as antioxidants, maintain, and form cells in the body, including blood cells involved in the immune system (Sarjito et al 2017). Payung & Manoppo (2015) added that the mechanism of ginger's action is to stimulate the immune system because this compound contains gingerol, which can increase IL-6 activity. The increase in the percentage of leukocrit is not only due to the more dominant ginger powder supplement (60%), but also supported by the function of turmeric powder (40%) in the combination dose T1. As reported by Pridayem, Windarti, &

Fitria (2022), fish fed turmeric-enriched pellets showed improved hematological conditions, significantly altering leukocyte composition, increasing lymphocyte percentage, and thus enhancing immunity. This increased immunity makes the fish less susceptible to pathogen infection.

Survival. The ability of catfish to survive gradually over a specific period. The results of survival observations over the 40 days of the study are presented in Figure 3.

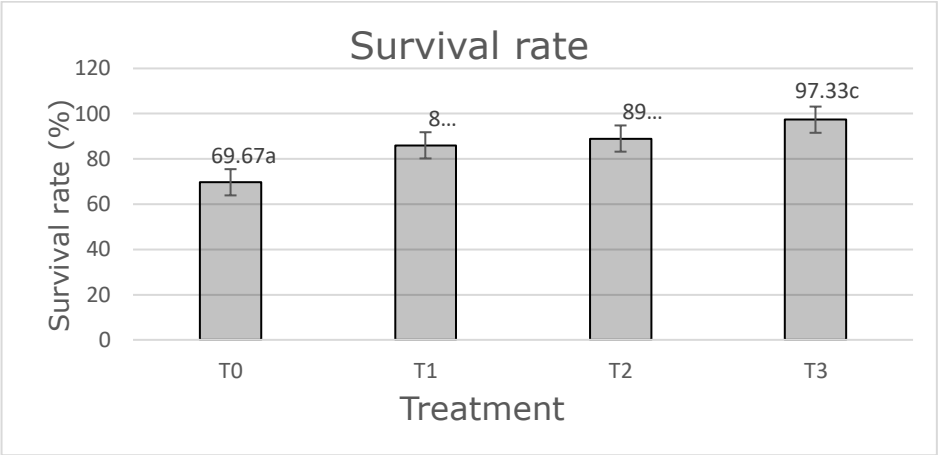

Figure 3. Survival of North American catfish after supplementation with turmeric and ginger powder through feed during 40 days of research.

The results of the survival analysis showed that T0 was significantly different from T1, T2, and T3, and the highest survival rate was achieved in the T3 treatment with an average of 97.33%, while the lowest was in the T0 (control) treatment with an average of 69.67%. Based on Figure 3, the survival rate for each treatment experienced different increases.

The high survival rate at T3 indicates a significant effect of the treatment, particularly turmeric powder, which contributed 60% of the combined dose, with ginger powder at only 40%. Turmeric powder contains curcumin, which can inhibit microbial infections, protect the body against foreign objects in the water media for maintenance, and improve the body's immune system. This is in accordance with the results of research conducted by Bertha et al (2015), which found that the survival rate of catfish given turmeric extract through soaking and then infected with *A. hydrophilla* during the study had a significant effect. This is thought to be because the curcumin in the turmeric extract can inhibit MAS infection and can improve the immunity of catfish. Furthermore, Sarjito et al (2017) reported that catfish given ginger powder supplements in their feed for 40 days of research can increase survival.

Conclusions. The combination of turmeric and ginger powder supplementation in North American Catfish significantly affected non-specific immunity and survival. The optimal dose capable of increasing immunity and survival in African catfish was treatment T3, a combination of 900 mg turmeric (60% of the optimal dose) and 3,000 mg ginger kg^{-1} of feed (40% of the optimal dose).

Conflict of interest. The authors declare that there is no conflict of interest.

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