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HEMATOLOGICAL RESPONSE OF SANGKURIANG CATFISH (CLARIAS SP.) ON FEED WITH SUBSTITUTION MADE OF DUCKWEED FLOUR (LEMNA MINOR)

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ABSTRACT
Catfish is one of the fish that is in demand for cultivation activities because it has high market absorption, adequate nutrition, and is relatively easy to maintain. The research aims to analyze the hematological response of Sangkuriang catfish (Clarias sp.) after being given a feed substitute made from Duckweed flour (Lemna minor). The research was conducted in Palangka Raya City, Central Kalimantan Province. Feed from each treatment A (Commercial feed, feed without the addition of duckweed meal), B (Feed with 0% duckweed meal: 100% soybeans), C (Feed with 50% duckweed meal: 50% soybeans), D (Feed with 75% duckweed meal: 25% soybeans), and treatment E (Feed with 25% duckweed meal: 75% soybeans) was weighed at 5% of each fish's weight in the treatment container. The hematological response of Sangkuriang catfish given feed substitution made from Duckweed flour (Lemna minor) with parameters of hematocrit, leukocrit, hemoglobin, and blood plasma of Sangkuriang catfish for 45 days of research had a positive impact on fish health in this condition due to the content of Duckweed flour (Lemna minor). can help control the health of sangkuriang catfish.

KEY WORDS
Catfish, hematological study, substitution, duckweed.

Fulfilling the production targets for catfish cultivation can be achieved by means of intensive fish cultivation. Intensive cultivation minimizes dependence on natural food, so that artificial food becomes the only source of food for the organisms being raised (Ekasari, 2009). Pomeroy et al. (2006), that feed is one of the production costs which contributes 65% of total production costs, so there is a need for alternative feed ingredients that can reduce feed costs.

Catfish is one of the fish that is in demand for cultivation activities because it has high market absorption, adequate nutrition, and is relatively easy to maintain. Feed plays an important role in producing products, such as broodstock, seeds and fish that are ready for consumption. Feed must be provided in sufficient quantities and have adequate nutritional content. This aims to produce products as expected and, under certain conditions, to avoid the cannibalism of catfish.

Research by Nekoubin and Sudagar (2013) shows that giving 20% Lemna sp. Fresh grass carp produced a specific growth rate of 0.55% which was greater than the control of only 0.33%. Sulawesty, et al., 2014, that pellet feed of 1.5% of fish weight and fresh L. perpusilla equivalent to 1.5% of fish weight in dry weight can produce a specific growth rate of goldfish (Cyprinus carpio L) of 2.00± 0.09% compared to pellet feed only 1.75 ± 0.03%. Research on the combination of 75% pellets + 25% fresh L. perpusilla on tilapia resulted in an absolute weight growth of 30.95 grams which was not significantly different from feeding 100% pellets (Ilyas, et al., 2014). This shows that Lemna sp. has great potential as an alternative feed.

Artificial feed is food made from a mixture of natural and processed ingredients which is then processed and made in a certain shape so that it attracts (stimulates) fish to eat it easily and with gusto. Pellet flour feed contains 40% protein, 5% fat, 30% carbohydrates. Research conducted (Madinawati et al. 2011), regarding the provision of different feeds on the growth and survival of African catfish (Clarias gariepinus Burchell.)

Feed is an important factor in the survival of fish, especially in the cultivation process, both qualitatively and quantitatively. The availability of alternative feed that is economical and contains sufficient nutrients for fish growth is deemed necessary to be able to cultivate fish in large enough quantities (Haetami et al., 2017). Lemna minor is known internationally as duckweed, which is a freshwater plant from the Lemnaceae family which usually invades rice fields and areas that have lots of nutrients. Lemna is a macrophyte that lives floating in water that can be found throughout the world and is often found in nutrient-rich fresh water. Lemna as stated by Said (2006) better known as a weed in waters which tends to be difficult to control. The presence of Lemna sp in large quantities can reduce the aesthetic value of a body of water. The Lemna or Duckweed plant consists of 14 types or species, and those that are often used are from the Lemna and Azolla genera.

Duckweed has other advantages, namely a very fast growth rate of up to 40 percent per day, a life span of around 10 days and the ability to produce up to 20 chicks that attach to their mother. Duckweed also has high nutritional value, especially protein. This plant is also a phytoremediation agent for processing liquid waste, cleaning water from nutrients and other pollutants, such as organic materials, nutrients and heavy metals. The research results of Cedergreen and Madsen (2002) stated that Lemna minor absorbs NH4 and NO3 through its roots and leaves. The ability of L. gibba to remove several pollutants including nitrate, ammonium, orthophosphate, copper, lead, zinc and cadmium (El-Kheir et al., 2007). Duckweed can be used as fish feed by giving it fresh or alive to herbivorous fish species, and duckweed can be used as a raw material for feed in the form of paste or flour in making feed formulations. Fish health is a condition where the fish has a strong body, is free from disease, and is able to carry out its physiological functions well.

Fish health is very important in aquaculture because healthy fish will grow well, have high productivity, and be more resistant to negative factors that can affect their growth and survival. One important factor in maintaining fish health is providing the right and balanced type of feed. Providing new types of feed, whether the main feed or additional feed, can affect the health of the fish which will result in disruption to the level of fish production. Fish blood images can be used for various purposes in monitoring fish health and the cultivation environment.

Chemical parameters of fish blood can be used as an indicator to determine the health condition of fish. This parameter can provide important information about the physiological status of fish, both influenced by processes within the fish's body and the observed living environment (Hastuti and Subandiyono, 2015). The blood profile plays an important role in the body's metabolic and physiological activities, as well as a defense component against disease attacks that enter the fish's body (Lavabetha et al., 2015). The research aims to analyze the hematological response of Sangkuriang catfish (Clarias sp.) after being given a feed substitute made from duckweed flour (Lemna minor).

MATERIALS AND METHODS OF RESEARCH

The research was conducted in Palangka Raya City, Central Kalimantan Province. The maintenance container in this study used a plastic container with a diameter of 35 cm and a height of 32 cm. The plastic container is filled with 20 liters of water. This research used African catfish seeds as test samples with an average length of 10-12 cm. Before use, the test fish were acclimatized for 3 (three) days, during acclimatization the fish were not given food. After acclimatization, the test fish were taken at random and placed in plastic containers with a total of 10 fish per container.

Feed management in this research is as follows:

- The catfish in each treatment container with a stocking density of 10 individuals was weighed for the total biomass weight;
- Feed from each treatment A (Commercial feed, namely feed without the addition of duckweed meal), B (Feed with 0% duckweed meal: 100% soybeans), C (Feed with 50% duckweed meal: 50% soybeans), D (Feed with 75% duckweed meal: 25%

soybeans), and treatment E (Feed with 25% duckweed meal: 75% soybeans) was weighed at 5% of each fish's weight in the treatment container;

- Feed that has been weighed is then given to each treatment;
- The feed from each treatment is put into plastic and ready to be applied twice a day.

Hematological measurements of fish were carried out by taking blood samples from each treatment using a 1 ml disposable syring that had been moistened with anti-coagulant (EDTA) on the fish. Next, the blood is collected in an EDTA Vacutainer tube. The parameters observed are hematocrit, leukocrit, hemoglobin and blood plasma.

RESULTS AND DISCUSSION

Results of research on the hematological response of Sangkuriang catfish (Clarias sp.) to feed substitution made from Duckweed flour (Lemna minor) with Hematocrit, leukocrit, hemoglobin and blood plasma parameters of Sangkuriang catfish during 45 days of research.

Hematocrit is the percentage of erythrocyte volume in fish blood or the ratio between the volume of blood cells and blood plasma. The hematocrit value can be calculated from the number of red blood cells contained in fish blood (Januarty, 2012). The hematocrit content also depends on nutritional factors, age, sex, and body size of the fish. Hematocrit of Sangkuriang catfish with 5 different feed substitution treatments made from Duckweed flour (Lemna minor). Treatment A (Control), B (Composition of Duckweed 1000%: Soybean 0%); C (Duckweed Flour 50%: Soybeans 50%); D (75% Duckweed Flour: 25% Soybeans) and E (25% Duckweed Flour: 75% Soybeans).

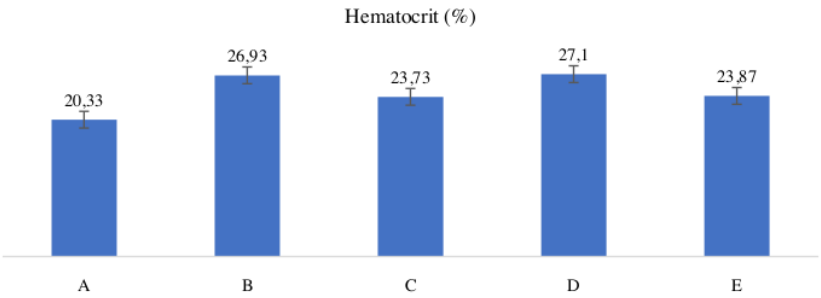

Figure 1 – Hematocrit of Sangkuriang Catfish

Figure 1 shows that the hematocrit of Sangkuraing catfish during the study was 20.33% to 27.10%, which means that all the hematocrit values of Sangkuriang catfish were still classified as normal. Treatment A (Control) average hematocrit was 20.33%; treatment B (Composition of Duckweed 1000%: Soybean 0%) average hemtocrit was 26.93%; treatment C (Duckweed Flour 50%: Soybean 50%) average hemtocrit was 23.73%; Treatment D (75% duckweed flour: 25% soybeans) had an average hematocrit of 27.10% and E (25% duckweed flour: 75% soybeans) had an average hematocrit of 23.87%.

Providing feed substitution made from duckweed flour (Lemna minor) to sangkuriang catfish showed the best hematocrit in treatment D (75% duckweed flour: 25% soybeans), namely 27.10%. The results of analysis of diversity (ANOVA), showed sig (1.14) < F table 0.05% (2.20). This means that H0 is accepted and H1 is rejected, giving substitute feed made from Duckweed flour (Lemna minor) to Sangkuriang catfish, there is no difference in the hematocrit maintained for 45 days.

According to Abdullah (2008) in Faizah (2013) freshwater fish are said to be healthy if their hematocrit levels range between 22-60%. A hematocrit concentration of <22% indicates that the fish is anemic and the fish may be sick or stressed. Feed substitution made from

Duckweed flour (Lemna minor) is effective in supporting the health of Sangkuriang catfish, making it suitable for use as a natural nutrient in feed, especially to maintain fish health.

Fish leukocrit is part of the body's non-specific defense system. Leukocrit circulates in various types in the blood vessels. There are fewer circulating leukocrits than red blood cells. Leukocrit of Sangkuriang catfish with 5 different feed substitution treatments made from Duckweed flour (Lemna minor). Treatment A (Control), B (Composition of Duckweed 1000%: Soybean 0%); C (Duckweed Flour 50%: Soybeans 50%); D (75% Duckweed Flour: 25% Soybeans) and E (25% Duckweed Flour: 75% Soybeans).

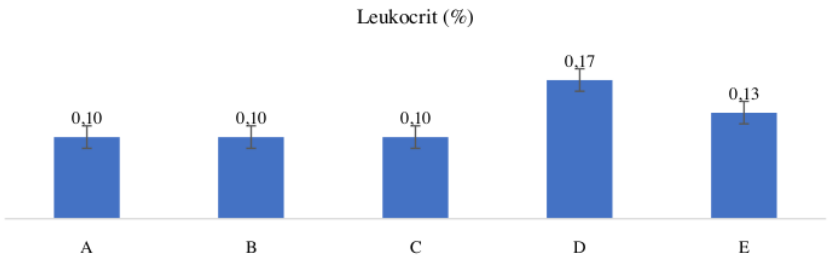

Figure 2 – Leukocrit of Sangkuriang Catfish

Figure 2 shows that the Leukocrit value of Sangkuraing catfish during the study was 0.10% to 0.17%, which means that all the Leukocrit values of Sangkuriang catfish are still classified as normal because they are interrelated with the hematocrit value. Treatment A (Control) average Leukocrit is 0.10%; treatment B (Composition of Duckweed 1000%: Soybean 0%) average Leukocrit is 0.10%; treatment C (Duckweed Flour 50%: Soybeans 50%) average Leukocrit is 0.10%; Treatment D (75% duckweed flour: 25% soybeans) had an average leukocrit of 0.17% and E (25% duckweed flour: 75% soybeans) had an average leukocrit of 0.13%.

Providing feed substitution made from Duckweed flour (Lemna minor) to Sangkuriang catfish showed the best leukocrit in treatment D (75% Duckweed Flour: 25% Soybean), namely 0.17%. The results of analysis of diversity (ANOVA) showed sig (1.25) < F table 0.05% (2.20). This means that H0 is accepted and H1 is rejected, giving substitute feed made from Duckweed (Lemna minor) flour to Sangkuriang catfish there is no difference in leukocrit maintained for 45 days.

Leukocrit is the percentage of leukocrit volume in the blood volume (Morgan and Iwama, 1997). Based on the results of leukocyte analysis during the research period, it was still within the normal range, namely between 0.1-1%. According to Titrawani et al (2014), research on the leukocrit levels of male and female paweh fish for each size class was not significantly different, namely ranging from 1.72-3.12%. The leukocrit levels in catfish in this study are different from those stated by Anderson and Siwicki (1990), the leukocrit levels in rainbow trout are 1-2%, but the leukocrit levels in catfish in this study are not much different from the leukocrit levels in goldfish reported by Lukistyowati et al. al,. (2007) ranges from 1%. The differences in the results of this study may be due to differences in areas and types of fish. High leukocrit levels are due to stress in fish due to poor and polluted water quality. An increase in the number of leukocrit is called leukocritosis (Erika, 2008). The number of leukocrit is influenced by several factors, namely fish species, age, nutrition and stress (Modra et al., 1998). Fish produce more white blood cells which is the fish's response to disease infection. Sick fish will produce more white blood cells to produce antibodies (lymphocytes) or phagocytose bacteria (heterophils and monocytes). According to Arry (2007), the increase in the number of leukocrit occurs due to the response of the fish's body to poor environmental conditions, fish health factors and disease infections.

Figure 3 shows that the blood plasma of Sangkuraing catfish during the study was 33.83% to 40.50%, which means that the entire blood plasma value of Sangkuriang catfish

was still classified as normal because it is interrelated with the hematocrit and leukocrit values. Treatment A (Control) average blood plasma is 40.50%; treatment B (Composition of Duckweed 1000%: Soybean 0%) average blood plasma was 33.83%; treatment C (Duckweed Flour 50%: Soybean 50%) average blood plasma was 37.10%; Treatment D (Duckweed Flour 75%: Soybean 25%) average blood plasma is 37.27% and E (Duckweed Flour 25%: Soybean 75%) average blood plasma is 37.10%.

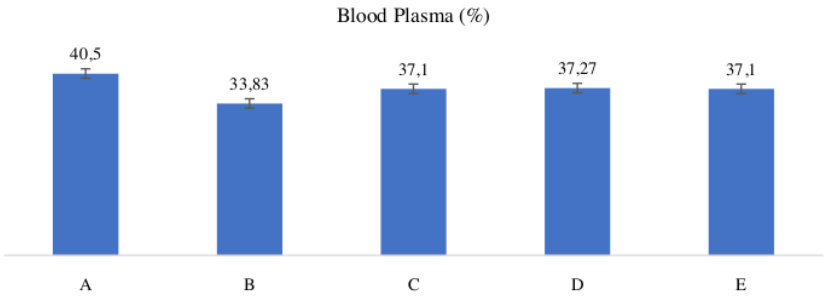

Figure 3 – Blood Plasma of Sangkuriang Catfish

Providing feed substitution made from Duckweed flour (Lemna minor) to sangkuriang catfish showed the best blood plasma in treatment A (Control), namely 40.50%. The results of analysis of diversity (ANOVA) showed sig (0.16) < F table 0.05% (2.20). This means that H0 is accepted and H1 is rejected, giving a feed substitution made from Duckweed (Lemna minor) flour to Sangkuriang catfish makes no difference to blood plasma maintained for 45 days.

Table 1 – Blood Plasma Color of Sangkuriang Catfish

Treatment and Repetition	Blood Plasma Color
A1	Turbid yellowish
A2	Clear
A3	Clear
B1	Turbid yellowish
B2	Clear
B3	Slightly turbid
C1	Clear
C2	Clear
C3	Clear
D1	Slightly turbid
D2	Slightly turbid
D3	Clear
E1	Turbid yellowish
E2	Turbid yellowish
E3	Slightly turbid

According to Andreson and Siwicki (1994) in Faizah (2013) that clear and slightly yellowish blood plasma indicates normal results, while yellow blood plasma is caused by erythrocytes being lysed due to fragile cells. Blood plasma contains 90% water and solutions of various substances amounting to 7%-10%, proteins 7%, salts 1%, pleats 0.6%, glucose 0.1%. Substances contained in blood plasma, namely food essence, hormones, enzymes, minerals, antibodies and waste substances such as CO2 and protein dismantling residues. These food juices are absorbed by the small intestine. Hematocrit is the percentage of red blood cells in the blood, if the hematocrit level is 40% it means that the blood consists of 40% red blood cells and 60% plasma and white blood cells. The results of the hematocrit examination can be used as an indicator to determine the health condition of the fish. Freshwater fish are said to be healthy if their hematocrit levels range between 22-60%. If the

fish's hematocrit is less than 22%, it indicates anemia, similarly if the hematocrit value is greater than 60%, it indicates that the fish is in a state of stress (Tsuzuki et al in Winarni 1997). This hematocrit level varies depending on nutritional factors, fish age, gender, body size and spawning period (Kuswardani, 2006).

Hemaglobin of Sangkuriang catfish with 5 different feed substitution treatments made from Duckweed flour (Lemna minor). Treatment A (Control), B (Composition of Duckweed 1000%: Soybean 0%); C (Duckweed Flour 50%: Soybeans 50%); D (75% Duckweed Flour: 25% Soybeans) and E (25% Duckweed Flour: 75% Soybeans).

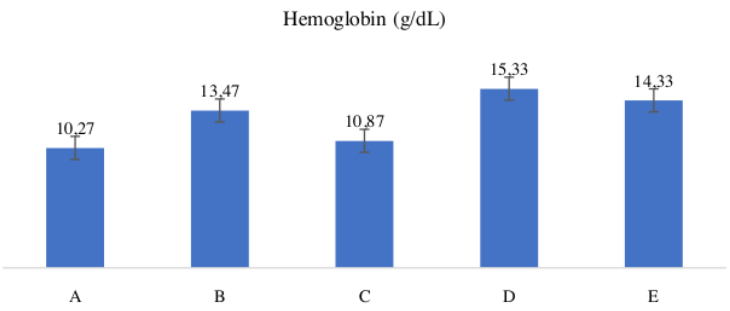

Figure 4 – Hemoglobin of Sangkuriang Catfish

Figure 4 shows that the hemoglobin of Sangkuraing catfish during the study was 10.27 g/dL to 15.33 g/dL, which means that all hemoglobin values of Sangkuriang catfish were still classified as normal. Treatment A (Control) average hemoglobin was 10.27 g/dL; treatment B (Composition of Duckweed 1000%: Soybean 0%) average hemoglobin was 13.47 g/dL; treatment C (Duckweed Flour 50%: Soy 50%) average hemoglobin was 10.87 g/dL; Treatment D (Duckweed Flour 75%: Soybean 25%) average hemoglobin was 15.33 g/dL and E (Duckweed Flour 25%: Soybean 75%) average hemoglobin was 14.33g/dL.

Providing feed substitution made from Duckweed flour (Lemna minor) to sangkuriang catfish showed the best hemoglobin in treatment A (Control), namely 15.33g/dL. The results of analysis of diversity (ANOVA), showed sig (1.17) < F table 0.05% (2.20). This means that H0 is accepted and H1 is rejected, giving a feed substitution made from Duckweed (Lemna minor) flour to Sangkuriang catfish does not make a difference in hemoglobin maintained for 45 days.

Hemoglobin is an erythrocyte pigment consisting of conjugated complex proteins containing berries (Faizah, 2013). Salasia et al., (2001) stated that the hemoglobin concentration of freshwater fish ranges from 5.05 to 8.22 gr/dL. Fish with hemoglobin levels between (10-12.3 g/100 ml) are in healthy condition while those below the normal range are likely to experience abnormal conditions or stress. Hartanti., et. al., (2013) stated that healthy African catfish hemoglobin ranges from 12-14 g/dL. Low hemoglobin levels cause the metabolic rate to decrease and the energy produced to be low. Hemoglobin functions to bind oxygen which is used for the catabolism process so that energy is produced (Aminah, 2021).

CONCLUSION

The hematological response of Sangkuriang catfish given feed substitution made from Duckweed flour (Lemna minor) with parameters of hematocrit, leukocrit, hemoglobin, and blood plasma of Sangkuriang catfish for 45 days of research had a positive impact on fish health in this condition due to the content of Duckweed flour (Lemna minor). can help control the health of sangkuriang catfish.

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