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Original Article

The effect of ketapang leaf extract (*Terminalia catappa* L.) on the number and type of leukocytes in broiler chickens

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ABSTRACT

Broiler are popular meat-producing birds in Indonesia because they contain high levels of animal protein. Apart from being used in the treatment of infectious diseases, antibiotics are also used as antibiotic growth promoters (AGP). However, the use of antibiotics as feed additives has been prohibited, a natural substitute for AGP is katapang leaves (*Terminalia catappa* L.). This study aims to determine the effect of administering katapang leaf extract (*Terminalia catappa* L.) on the number and type of leukocytes in broiler. This study used 24 Cobb strain broiler which were divided into four treatment groups, each group consisting of six replications. The treatment groups were P0 = only given 1% CMC-Na solution, P1 = Katapang leaf extract solution with 5% concentration, P2 = Ketapang leaf extract solution with 10% concentration, P3 = Katapang leaf extract solution with 15% concentration. The treatment is given orally with a syringe, given to chickens aged 21–35 days. At the end of the study, 2 ml–3 ml of blood is taken from the brachial vein. Data were analyzed using Analysis of Variance and continued with Duncan's Multiple Range Test. The results showed that administration of ketapang leaf extract showed that P0, P1, P2, and P3 produced a total number of leukocytes in the normal range, around 12.2–15.8 x 10^3/mm^3. In research, counting leukocyte types shows the percentage of leukocyte types. Heterophils 24.51–32.95%, eosinophils 2–2.5%, basophils 0–1%, monocytes 3–4.2%, lymphocytes 54.93–63.70%. The results of research on the number and counting of leukocyte types in broiler given katapang leaf extract were still within the normal range.

Keywords: Ketapang leaf extract, leukocyte, antibiotic growth promoters, broiler

Introduction

Broiler chickens are poultry that specifically produce meat so they are very popular in Indonesia and are very popular because they contain high-quality animal protein and are cheap and easy to obtain. The potential in raising broiler chickens is quite large because raising broiler chickens has a fairly profitable economic value, from harvests that require a relatively short time and require a relatively narrow place (Dahlan and Hudi, 2011).

Broiler chickens themselves require good maintenance in order to get optimal results. Success in raising broiler chickens is seen from the performance of the chickens which can be measured through mortality, feed consumption, final body weight, Feed Conversion Ratio (FCR) and Performance Index (IP). Efforts to achieve chickens that have good performance, the things

that influence are seeds, feed, and management (Saracila *et al*., 2021), these three aspects are the main factors in raising broiler chickens. The seed aspect itself is related to the genetics of chicken seeds to achieve good final stock results, in the feed aspect it is closely related to nutrition, feed consumption and efficiency/conversion of feed given to broiler chickens and the management aspect itself is the overall maintenance management both in feed, cages and health for success in the broiler chicken business (Puvača *et al*., 2022). Environmental changes also greatly affect the growth of broiler chickens which can inhibit and make broiler chickens stressed, causing the chicken's immune system to decrease and be very susceptible to disease. Broiler chickens that are attacked by disease can reduce feed efficiency and growth, and can even cause death of broiler chickens (Tamalluddin, 2012). Farmers make various efforts in these conditions by adding antibiotics as a treatment for disease, increasing productivity and stimulating growth (Muteeb *et al*., 2023).

Antibiotics are not only used in the treatment of infectious diseases but also used as antibiotic growth promoters (AGP) to improve growth performance by improving intestinal health in broiler chickens, increasing nutrient absorption and utilization. The use of AGP is the most common way to optimize broiler chicken performance (Paul *et al*., 2022). It is estimated that the suppression of the pathogenic microbial population in the intestine is one way AGP works to increase growth or production, AGP is also absorbed in meat, milk, and eggs so that indirectly consumers will get antibiotics in low amounts (Kompiang, 2009). The use of antibiotics as feed additives has been prohibited for broiler chickens and other poultry as stated in article 16 of Permentan No. 14/2017, because it allows residues in livestock that cause health problems and bacterial resistance to antibiotics (Irham, 2016).

The prohibition of the use of antibiotics as feed additives in livestock, the solution that can be done is to use alternative antibiotics derived from natural ingredients that contain many bioactive ingredients, bioactive compounds themselves have benefits for livestock, one of which is to increase livestock productivity. The development of alternative AGP is carried out to maintain broiler chicken performance and production costs, alternative antibiotics that can be used are probiotics, prebiotics, antimicrobial peptides, polyphenols, and natural extracts or phytobiotics used as broiler chicken feed additives (Huyghebaert *et al*., 2011). Phytobiotic feed additives have shown many beneficial effects on broiler chicken production so they are very good to be used as a substitute for AGP, natural, non-toxic, and residue-free ingredients (Grashorn, 2010). The pharmacological properties of phytobiotics produced naturally from herbal ingredients, spices, and extract oils can increase endogenous enzyme secretion, antioxidant status, encourage feed consumption, and show antimicrobial effects (Gheisar and Kim, 2018). Natural ingredients that can be used as a substitute for AGP are ketapang leaves (*Terminalia catappa* L).

Ketapang plant (*Terminalia catappa* L.) is a plant from the Combretaceae family that is widely found in Southeast Asia. The uses of this plant are numerous, one of which is as an antibacterial. Extracts from this plant also contain compounds that are thought to be antibacterial (Tampemawa *et al*., 2016). Ketapang extract contains compounds such as alkaloids, saponins, triterpenoids, steroids, tannins, and flavonoids (Neelavathi *et al*., 2013). Ketapang is also one of the herbal plants that has great potential as an antibacterial and has been widely used as a medicine, parts of the ketapang plant that can be used as medicine are; bark, fruit and leaves. Tannin and flavonoid compounds are antibacterial compounds found in ketapang (*Terminalia catappa* L.) which are immunomodulators (Wahjuningrum *et al*., 2008).

Blood plays an important role in regulating the physiological functions of the body. Blood is also a benchmark for determining health in animals. White blood cells (leukocytes) are cells that play a role in the body's defense system which is very sensitive to infectious agents. Leukocytes have the task of protecting the body by phagocytosis

and producing antibodies to attack diseases (Purnomo *et al*., 2015). There are several factors that affect the number of leukocytes, including environmental conditions, age and nutritional content of feed, among these factors feed has an important role in the formation of leukocytes (Addas *et al*., 2012; Etim *et al*., 2014).
Based on the statement above, it is necessary to conduct research to determine the effect of ketapang leaf extract (*Terminalia catappa* L.) on the number and type of leukocytes in broiler chickens. Because ketapang leaves are widely used as a treatment for fish, research was conducted on broiler chickens.

Materials and methods

Research design

This study used cobb strain broiler chickens raised from 1 day old chicks (DOC) purchased from a poultry shop. This study used 24 broiler chickens aged 35 days as samples. The specimens tested were 1-3 ml of blood from the brachial vein. The preparation of ketapang leaf extract was carried out at the Pharmacology Laboratory of the Department of Basic Veterinary Medicine, Faculty of Veterinary Medicine, Airlangga University, Campus C, Surabaya and examination of the number and type of leukocytes was carried out at the Clinical Pathology Laboratory, Faculty of Veterinary Medicine, Airlangga University, Campus C, Surabaya. This study was conducted in March 2023–June 2023.

Extraction of ketapang leaves (Terminalia catappa L.)

This study requires ketapang leaves taken from Jl. Kapas Gading Madya, Dukuh Setro Gang IV, Tambaksari District, Surabaya City. Ketapang leaves (*Terminalia catappa* L.) are washed first then aired and separated from the leaf stems, then the ketapang leaves (*Terminalia catappa* L.) are dried using an oven at a temperature of 50°C until completely dry, after drying the leaves are ground into a fine powder and sieved, the powder from the ketapang leaves is then macerated using 96% technical methanol for 3 x 24 hours. After maceration, the solution is filtered using flannel to separate the residue and filtrate. The filtrate obtained is then evaporated using a rotary evaporator machine at a temperature of 40° C with a pressure of 100 mBar to obtain a thick extract.

Treatment of ketapang leaf extract on broiler chickens

Broiler chickens were adapted starting from the age of 14 days, on the 14th day the chickens were grouped according to the control and treatment groups, at the age of 21 days the broiler chickens were given 1% CMC-Na in the control group and ketapang leaf extract (*Terminalia catappa* L.) in the treatment group which had been determined by weight per day, given for 2 weeks. The treatment group received a dose of ketapang leaf extract (*Terminalia catappa* L.) with a concentration of 5%, 10%, 15%, the extract was measured based on each concentration and dissolved in a 1% CMC-Na suspending agent solution. The extract was given orally using a syringe (with a syringe without a syringe). Broiler chickens aged 21 days were weighed then the weight of the chicken was obtained and then the extract was given according to the weight of the chicken with a ratio of 1 ml of ketapang leaf extract: 1 kg of chicken weight.

The treatments given to the broiler chicken groups are as follows:

P0 (Control): broiler chicken group that was not given ketapang extract (*Terminalia catappa* L.) and was given aquades solution with 1% CMC-Na
P1: Broiler chicken group that was given 1% CMC-Na solution and ketapang extract (*Terminalia Catappa* L.) with a concentration of 5%
P2: Broiler chicken group that was given 1% CMC-Na solution and ketapang extract (*Terminalia catappa* L.) with a concentration of 10%.
P3: Broiler chicken group that was given 1% CMC-Na solution and ketapang extract (*Terminalia catappa* L.) with a concentration of 15%.

Specimen collection

Blood specimens were taken from 35-day-old broiler chickens through the brachial vein as much as 1-3 ml using a sterile syringe. The specimens were inserted into an EDTA vaculab. After that, a leukocyte count was performed using the Natt & Herrick method and a leukocyte type count was performed using the blood smear method at the Clinical Pathology Laboratory of the Faculty of Veterinary Medicine, Airlangga University.

Leukocyte count examination

Blood is sucked through a thoma pipette to the 0.5 ml mark then the tip of the pipette is inserted into the Natt & Herrick solution, holding the blood at the 0.5 mark. The pipette is positioned at a 45° angle and the Natt & Herrick solution is sucked slowly to the 101 mark (so that no air bubbles arise during suction). Lift the pipette from the liquid, cover the tip of the pipette with the tip of the middle finger, remove the rubber suction. The pipette is shaken for 15-30 seconds by covering the tip of the pipette with the middle finger and the base of the pipette (where the rubber suction has been removed) with the thumb followed by a perpendicular movement to the long axis of the pipette. A clean counting chamber equipped with a cover glass is attached to the microscope. The pipette containing the blood specimen is shaken for 3 minutes, 3–4 drops of liquid in the capillary stem of the pipette are discarded, then the tip of the pipette at a 30' angle is touched to the surface of the counting chamber by touching the edge of the cover glass. The counting chamber is left to fill with its own fluid slowly using its capillary action for 2-3 minutes so that the leukocytes settle (Bijanti *et al*., 2010).

The formula for calculating total leukocytes/µl is: (Total leukocytes in 9 large fields) + (10% of the total number of leukocytes) x 200.

Leukocyte count examination

Blood is taken using a pipette, then placed on a glass object as much as 1 drop and then removed using another glass object at a 45° angle to produce a thin smear, after getting the results, the blood smear is left until the blood smear is dry. The dried blood smear is fixed by dripping Wright stain solution on the blood layer until it is completely covered. Fixation takes 2 minutes, then a pH 6.4 buffer solution is dripped onto the preparation until the preparation is completely covered, by blowing occasionally and leaving it for 20 minutes so that the cells are properly stained. Wash the preparation with distilled water or plain water slowly until clean then dry the preparation in a vertical position and do not dry it using cotton etc. (Bijanti *et al*., 2016).

Data analysis

Data hasil penelitian jumlah dan hitung jenis leukosit disajikan dalam bentuk tabel berupa nilai rata rata dan simpangan baku. Untuk mengetahui pengaruh perlakuan terhadap variabel jumlah total leukosit dan hitung jenis leukosit dianalisis dengan Analysis of variance (ANOVA) dan dilanjutkan dengan uji Duncan's Multiple Range Test (DMRT).

Result

Broiler chicken leukocyte count

The results of the calculation of the number of leukocytes in broiler chickens given ketapang leaf extract (*Terminalia catappa* L) using Oneway Analysis of Variance (ANOVA) on the average number of leukocytes showed a significant difference ($p<0.05$). Based on the Duncan's Multiple Range Test, P0 was not significantly different ($p>0.05$) from P1 and P3, but significantly different ($p<0.05$) from P2. Treatment P2 showed a significant difference ($p<0.05$) from P0, P1, and P3.

Table 1. Mean value of leukocyte count in broiler chickens given ketapang leaf extract (*Terminalia catappa* L).

Treatment	Total leukocyte count (cells/µL) (mean ± SD)
P0	12.2^{a} ± 0.81
P1	12.6^{a} ± 2.43
P2	15.8^{b} ± 1.36
P3	13.4^{a} ± 1.44

Note: Different superscripts in the same column indicate significantly different results ($p<0.05$).

Table 1 shows that the total number of leukocytes in broiler chickens given ketapang leaf extract (*Terminalia catappa* L) was highest in treatment P2 at 15.8 x 10^3/µg, while the same total leukocytes were found in treatment P0 at 12.2 x 10^3/µg, P1 at 12.6 x 10^3/µg, and P3 at 13.4 x 10^3/µg. The normal range for the total number of poultry leukocytes is in the range of 9–31 x 10^3/µg, so the total number of leukocytes is within the normal range.

Number of types of leukocytes in broiler chickens

The results of the calculation of leukocyte types in broiler chickens given ketapang leaf extract (*Terminalia catappa* L) using Oneway Analysis of Variance (ANOVA) and Duncan's multiple range test (DMRT). Based on the Duncan's Multiple Range Test, the results of the heterophil type count P0 were not significantly different (p>0.05) from P1 and P3 but were significantly different (p<0.05) from P2 but were still within the normal range. The results of the eosinophil, basophil, monocyte and lymphocyte type count P0 were not significantly different (p>0.05) from P1, P2, and P3 but were still within the normal range.

Table 2. Mean value of leukocyte count of broiler chickens given ketapang leaf extract (*Terminalia catappa* L.)

Types of leukocytes	Treatment			
	P0	P1	P2	P3
Heterophile (%)	24.51[a]	25.01[a]	32.95[b]	25.55[a]
Eosinophils (%)	2.00[a]	1.33[a]	1.83[a]	2.50[a]
Basophils (%)	0.49[a]	0.64[a]	1.01[a]	1.08[a]
Monocytes (%)	3.03[a]	4.21[a]	3.33[a]	4.13[a]
Lymphocytes (%)	54.93[a]	60.40[a]	63.70[a]	58.73[a]

Note: Different superscripts in the same column indicate significantly different results (p<0.05).

Table 2 shows the results of the leukocyte count of broiler chickens given Ketapang Leaf Extract (*Terminalia catappa* L) in the heterophil type, the highest was in the P2 treatment of 32.95% while the lowest was in the P0 treatment of 24.51% but within the normal range. In the eosinophil type, the results showed P0 2.0%, P1 1.3%, P2 1.8% while P3 was 2.5%. in the basophil type, the results showed P0 0.4%, P2 0.6%, P2 1% while P3 was 1%. In the monocyte type, the results showed P0 3%, P1 4.2%, P2 3.3% while P3 was 4.1%. In the lymphocyte type, the results showed P0 54.93%, P1 60.40%, P2 63.70% while P3 was 58.73% but still within the normal range.

Discussion

Broiler chicken leukocyte count

Based on the results of the study of the number of leukocytes in broiler chickens given ketapang leaf extract (*Terminalia catappa* L) showed that the ketapang leaf extract gave a significant difference in the total leukocytes of broiler chickens at the age of 35 days. The results of ANOVA continued with the Duncan Test showed significant results (p <0.05).

The effect of Ketapang leaf extract (*Terminalia Catapa* L) showed that P0, P1, P2, and P3 produced a total number of leukocytes in the normal range, around 12.2–15.8 x 10^3 / mm^3, this is in accordance with the opinion of (Bijanti *et al.*, 2010) that normally, the number of white blood cells in broiler chickens is in the range of 9–31 × 10^3 / mm^3. Based on the data in table 1, it can be seen that there was an increase in the P2 treatment, but the increase in the number of leukocytes was still within the normal range. The increase in leukocytes in the P2 treatment can be caused by flavonoid compounds, these compounds can stimulate an increase in lymphocyte cells, both T lymphocytes and B lymphocytes (Kurnianingtyas, 2013). Flavonoid compounds contained in plants provide immunostimulant effects on humans and animals, and are able to increase the production of interferon cells and NK cell activity. Interferon can help in the percentage of antigens and has a role in humoral immunity (Zhong *et al.*, 2021).

In this case, giving a dose of 5%, 10%, and 15% of ketapang leaf extract is appropriate. An increase in leukocytes in the blood is the body's response to attacking pathogenic agents, an increase in the number of leukocytes cannot be assumed that the livestock is sick but rather a humoral and cellular response in fighting disease-causing pathogenic agents (Soeharsono

et al., 2010). An increase in the number of leukocytes other than from attacking bacteria can be caused by environmental stress that can affect the physiological process to become abnormal and affect hormonal balance in chickens, this condition can be seen from the broiler chicken maintenance environment. High environmental stress will increase the production of corticosteroids and glucocorticoids which have a negative effect on health and reduce the chicken's body's defenses (Falahudin *et al*., 2016).

Counting the types of leukocytes in broiler chickens

Based on the results of the study, the leukocyte count of broiler chickens given Ketapang leaf extract (*Terminalia catappa* L) showed a significant effect on the leukocyte count of broiler chickens at the age of 35 days. The results of ANOVA followed by Duncan's Test showed significant results between all treatments ($p < 0.05$).

The percentage of heterophils in the blood of broiler chickens with the administration of ketapang leaf extract (*Terminalia catappa* L) showed significant results.

The percentage based on the results was in the range of 24.51–32.95%. Hendro *et al*. (2015) stated that the normal standard for the number of heterophils in broiler chickens ranges from 20–40%. The increase in heterophils occurred in the P2 treatment but was still within the normal range, heterophils are a type of leukocyte with a phagocytosis mechanism that increases in conditions of infection, inflammation and stress (Davis *et al*., 2008). Heterophils are part of the leukocytes that are included in the front line in fighting diseases that cause infection or inflammation. The heterophil work system is as a pathogen destroyer through the oxygen independent pathway (lysosome, proteolytic enzymes and cationic proteins) and oxygen dependent (Baratawidjaja and Rengganis, 2012).

The percentage of eosinophils in the blood of 35-day-old broiler chickens given Ketapang leaf extract (*Terminalia catappa* L) showed no significant effect. Based on the results, it was in the range of 2–2.5%, which is included in the normal range of eosinophils, the normal range of eosinophils is 2–14% (Arfah, 2015). Eosinophils are part of the leukocytes formed in the spinal cord which function as a parasitic, inflammatory and allergic response. Eosinophils have two main functions, namely being able to attack and destroy pathogenic bacteria and being able to produce enzymes that can neutralize inflammatory factors, the entry of infection into the body, eosinophils work through chemical functions enzymatically (Jacobsen *et al*., 2012).

The results of the study showed that the percentage of basophils in broiler chickens given Ketapang leaf extract (*Terminalia catappa* L) showed results that did not have a significant effect. Based on the results, it was in the range of 0.4–1%, and these results were still in the normal category. The number of basophils in broiler chickens ranged from 0–1% (Bijanti *et al*., 2010). The function of basophils in poultry is considered exactly the same as basophils in mammals, because their cytoplasmic granules contain histamine, and also play a role in the process of inflammation and hypersensitivity reactions. Basophil granules have an affinity for blue or basic dyes and contain serotonin, heparin and histamine which work in preventing blood clotting, blood vessel stasis in areas experiencing inflammation (basophil granules contain heparin and serotonin as anticoagulants) (Bijanti *et al*., 2010).

The results of the study showed that the percentage of monocytes in broiler chickens given ketapang leaf extract (*Terminalia catappa* L) showed results that did not have a significant effect. Based on the results, the percentage was in the range of 3–4.2%, these results were still within the normal range of monocytes, according to Eroschenko (2008) monocytes owned by poultry ranged from 3–10%. Frandson *et al*. (2009) said that monocytes are able to phagocytose 100 pathogenic bacterial cells and become a regulatory system when inflammation occurs and responds to immunity. Monocytes are mobilized together with Heterophils so they are called the second defense against inflammation.

The results of the study showed that the percentage of lymphocytes in broiler chickens given ketapang leaf extract (*Terminalia catappa* L) showed results that did not have a significant effect, the results of the study were in the range of 54.93–63.70% and these results were classified as normal range. This is in accordance with the opinion of (Harahap, 2014) that normal lymphocytes are normally in the range of 42–66%. Lymphocytes are tasked with responding to antigens and stress by increasing antibody circulation in the development of the immune system (Salasia and Hariono, 2010). The biggest factor that data affects the number of lymphocytes in poultry is a hot environment and stress, because a hot environment reduces the weight of the thymus lymphoid and bursa of fabricius which has an impact on decreasing lymphocytes (Puvadolpirod and Thaxton, 2000).

Conclusion

Based on the results of this study, it can be concluded that the effect of ketapang leaf extract (*Terminalia catappa* L.) on the number and type count of broiler chicken leukocytes is that ketapang leaf extract (*Terminalia catappa* L.) with a concentration of 10% affects the number of broiler chicken leukocytes but is still within normal limits. In addition, ketapang leaf extract (*Terminalia catappa* L.) with concentrations of 5%, 10%, and 15% does not affect the type count of broiler chicken leukocytes which are in the normal range (eosinophils, basophils, monocytes and lymphocytes) but affects the type count of leukocytes (heterophils) at a concentration of 10%.

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