

Effect of Giving Turmeric Flour (*Curcuma domestica*) on Differential Leukocytes, Antibody Titers of Avian Influenza and Newcastle Disease Super Native Chickens

Adyatma Muhammad Nur¹, Sri Purwanti^{2*}, Djoni Prawira Rahardja² and Dewi Mutisari³

¹Postgraduate in Animal Science and Technology, Faculty of Animal Science, Hasanuddin University, Makassar, Indonesia

²Faculty of Animal Science, Hasanuddin University, Makassar, Indonesia

³Disease Investigation Center Maros, Directorate General of Livestock and Animal Health Services, Ministry of Agriculture, Maros, Indonesia

*Corresponding author email: sripurwanti@unhas.ac.id

Abstract. In order to raise super-native chickens without the usage of antibiotics, herbal plants with a phytobiotic function may be used as feed additions. This study aims to examine the effect of turmeric flour (*Curcuma domestica*) given through drinking water on leukocyte differentials, AI antibody titers, and ND antibody titers as indicators of immunity status in super-native chickens. Five treatments and four tests, each with five super native chicks, were used in the experiment, which was carried out utilizing an experimental methodology. The treatment (P) given included P0 as a negative control (drinking water without treatment), P1 as a positive control (drinking water + 0.1 g/L PromuneC[®]), P2 (drinking water + 1 g/L turmeric flour), P3 (drinking water + 3 g/L turmeric flour) and P4 (drinking water + 5 g/L turmeric flour). All the data gathered for this study were evaluated using Analysis of Variance, and Duncan's test using SPSS version 25 was required if there were any significant differences. The 56-day-old AI and ND antibody titer reached a protective level where the best dose for AI antibody titer increase was 5 g/L of drinking water with AI log₂ 9.5 of titer and the best dose for ND antibody titer increase was 3 g/L of drinking water with ND log₂ 7.5 of titer. According to statistical analysis, the addition of turmeric powder to drinking water had no discernible effects on the mean of lymphocytes, monocytes, or eosinophils but had a significant impact (P<0.05) on the mean of basophils. The treatment also had a noticeable effect on AI antibody titers (P<0.05) but had no noticeable effect on ND antibody titers. In conclusion, giving turmeric powder (*Curcuma domestica*) in drinking water is useful as an immunomodulator by maintaining normal levels of differential leukocytes, and increasing protection against AI and ND super-native chicken so it can be used as a natural feed additive.

Keywords: turmeric flour, super native chicken, leukocyte differential, antibody titer

Abstrak. Pemanfaatan tanaman herbal sebagai feed additive yang memiliki fungsi fitobiotik dapat menjadi salah satu alternatif pengganti penggunaan antibiotik pada budidaya ayam kampung super. Penelitian ini bertujuan untuk menguji pengaruh tepung kunyit (*Curcuma domestica*) yang diberikan melalui air minum terhadap diferensial leukosit, titer antibodi AI, dan titer antibodi ND sebagai indikator status imunitas pada ayam kampung super. Penelitian dilakukan dengan metode eksperimen dengan menggunakan Rancangan Acak Lengkap (RAL) yang terdiri dari lima perlakuan dan empat pengujian yang masing-masing terdapat lima ekor ayam kampung super. Perlakuan (P) yang diberikan meliputi P0 sebagai kontrol negatif (air minum tanpa perlakuan), P1 sebagai kontrol positif (air minum + 0,1 g/L PromuneC[®]), P2 (air minum + 1 g/L tepung kunyit), P3 (air minum + 3 g/L tepung kunyit) dan P4 (air minum + 5 g/L tepung kunyit). Semua data yang dikumpulkan untuk penelitian ini dievaluasi menggunakan Analisis of Variance, dan uji Duncan menggunakan SPSS versi 25 dilakukan jika ada perbedaan yang signifikan. Titer antibodi AI dan ND umur 56 hari mencapai tingkat protektif dimana dosis terbaik untuk peningkatan titer antibodi AI adalah 5 g/L air minum dengan titer log₂ 9,5 dan dosis terbaik untuk peningkatan titer antibodi ND adalah 3 g /L air minum dengan titer log₂ 7,5. Analisis statistik menunjukkan bahwa penambahan tepung kunyit dalam air minum berpengaruh nyata (P<0,05) terhadap rerata basofil tetapi tidak berpengaruh nyata terhadap rerata limfosit, monosit, dan eosinofil. Perlakuan juga memiliki efek nyata pada titer antibodi AI (P<0,05) tetapi tidak memiliki efek nyata pada titer antibodi ND. Kesimpulannya, pemberian bubuk kunyit (*Curcuma domestica*) dalam air minum bermanfaat sebagai imunomodulator dengan mempertahankan kadar leukosit diferensial normal, dan meningkatkan perlindungan terhadap AI dan ND ayam kampung super sehingga dapat digunakan sebagai feed additive alami.

Kata kunci: tepung kunyit, ayam kampung super, diferensial leukosit, titer antibody

Introduction

The development of the local chicken business in Indonesia has very promising potential, as does the increasing consumption of local chicken meat. According to the Ministry of Agriculture (2019), consumption of local chicken meat in Indonesia in 2018 reached 0.73 kg/capita per year, up from 0.53 kg/capita per year in 2015. In rural areas, the majority of people cultivate local chickens extensively. Indonesia's domestic chicken population increased to 308 million in 2020 from 301 million in 2019, reaching a new high (Central Bureau of Statistics, 2021). From these data it shows that the growth conditions of native chicken farms in Indonesia are still increasing and have a very promising economic impact for the people of Indonesia.

In order to increase the health and production of chickens, more feed must be provided. Antibiotics are frequently added to feed as growth enhancers. However, since the government outlawed the use of antibiotics and established regulations for the classification of veterinary drugs in Regulation of the Minister of Agriculture of the Republic of Indonesia Number 14/Permentan/Pk.350/5/2017, the use of antibiotics to promote the growth of poultry has been decreasing. The removal of antibiotic growth promoters (AGPs) was problematic for growth performance and led to an increase in the incidence of disease outbreaks, especially sub-clinical necrotic enteritis which can cause immunosuppression in poultry. This has led to discovery of alternatives to AGPs (Huyghebaert et al., 2011).

To improve the immune system, one of the things that can be done is by giving immunomodulators, namely chemical compounds that can increase the activity of the immune system. One of the compounds that function as an immunomodulator is curcuminoids. Curcuminoids are active ingredients contained in rhizome plants, especially in turmeric rhizomes (*Curcuma*

domestica) (Nurkholis et al., 2014). A perennial herb with rhizomes, turmeric (*Curcuma domestica*) belongs to the Zingiberaceae family, which also includes ginger. This South Asian native tropical plant needs temperatures between 20°C and 30°C as well as a lot of annual rainfall to grow. The plant can reach a height of three to five feet and has oval pointed leaves with yellow funnel-shaped blooms. The natural form of turmeric extract, a yellow-orange polyphenol, is a dry yellow powder that is oil-soluble. The plant's rhizome is the component that is utilized in medication (Khan et. al, 2012).

The results of the present study regarding the immune response coincide with the findings of Qasem et al. (2015) confirming that turmeric powder supplementation at the rates from 1.0 up to 2.0% significantly improved antibody titer against ND, while the titer against IBD was significantly higher when turmeric powder was added in the feed at the rates of 1.4 and 1.6%. There are studies that demonstrate the benefits of a feed additive with turmeric on physical function and humoral immunity in broiler chickens (Ali et al. 2014). As a comparison control for the efficacy of curcumin as an antioxidant, we also used a combination of vitamin E, selenium, and vitamin C in this investigation. One of the most crucial natural antioxidants, vitamin E works to prevent cells and tissues from being harmed by lipoperoxidation free radicals (Tamzil, 2014). The glutathione peroxidase enzyme, which eliminates free radicals in the cytoplasm, contains selenium as one of its constituent parts. Selenium also serves as an antioxidant for the body's defence mechanisms, body resistance, and cattle reproduction (Lubis et al., 2015). According to Winarsi (2007), vitamin C improves immune function by promoting the synthesis of interferon (a protein that protects cells from viral attacks).

Kumari et al. (2007) reported an increase in antibody titers of NDV and IBD vaccines in broiler chickens by adding turmeric to the ration.

Supplementation of broiler chicken feed with turmeric increases serum Zn concentrations which can be associated with antioxidant mechanisms in increasing the body's defenses. Pristiwanti et al. (2017) in their research reported that giving turmeric boiled water to broiler drinking water was able to improve the white blood cell profile in the form of leukocyte count and leukocyte differential. This study aims to determine the effect of adding turmeric powder (*Curcuma domestica*) in drinking water to the differential values of leukocytes, AI and ND antibody titers of super native chicken.

Materials and Methods

This research has been carried out in May-June 2022. The maintenance of super native chickens is carried out in the cages of the native chicken farm PT Surya Pangan Indonesia, Bollangi, Gowa Regency, South Sulawesi. The study lasted for 30 days.

The research material used was 100 DKS (DOC Kampung Super) Platinum Super Slope genetic chickens at Gunung Kawi Berline Farm aged 26 days to 56 days of mixed sex with an average initial body weight of 230 ± 16.37 grams. Previously, the DOC of native chicken had been vaccinated in the hatchery using the inactivated ND and AI vaccine (H5N1 strain 2.3). A total of 20 experimental cages made of split bamboo measuring 60 x 60 x 80 cm (length x width x height) were equipped with husk litter with a thickness of about 10 cm, a place for feeding and drinking water. During the maintenance period, each experimental cage unit was equipped with a 5-watt lamp that served as lighting. Feed and drinking water were provided ad libitum with the composition of the 8201-Star feed used as presented in Table 1. During the study, additional light was provided as lighting starting from 17.00-06.00 WITA. Other materials used were Profectan[®] disinfectant, turmeric powder, Promune-C[®] feed supplement containing

vitamin E, selenium, and vitamin C as positive controls, hanging scales and 0.1-gram analytical scales.

Turmeric is cleaned and peeled using a knife, which is used in the content or flesh. The turmeric filling is cut into small pieces and withered to dry in the room for 48 hours then ground with a mixer into flour. Turmeric is mixed in drinking water with a certain dose according to the research treatment (Kasse *et.al.*, 2021). In this study, the purpose of adding turmeric powder to drinking water was to get the best dosage which would later make it easier for farmers to apply it in the field.

This study used an experimental method with a completely randomized design (CRD) consisting of five treatments, and four replications and each replication consisted of five super native chickens. The treatments given included P0 (drinking water without turmeric flour), P1 (drinking water + Promune-C[®] 0.1 g/L), P2 (drinking water + turmeric flour 1 g/L), P3 (drinking water + turmeric flour 3 g/L), P4 (drinking water + turmeric flour 5 g/L). Nutrient content of starter feed 8201-Star produced from PT. Malindo Feedmil Tbk. used are presented in Table 1.

A sampling of blood serum for testing AI and ND antibody titers was carried out when super native chickens were 56 days old as many as 20 samples representing each treatment and replication. Blood samples were taken using a 3 mL disposable syringe through the brachial vein as much as 1.5 mL. The blood sample that has been taken is allowed to stand until there is a separation between the blood cells and blood serum. The blood serum was then put into an Eppendorf tube and labelled according to the treatment. Furthermore, the serum in cold conditions was sent to the Disease Investigation Center Maros to be analyzed for antibody titer using the Hemagglutination Inhibition (HI) test for AI and ND antibody titers.

Table 1. The nutritional content of a commercial feed

Nutritional Content	
Moisture Content	Max. 13 %
Ash	Max. 8 %
Crude Protein	Min. 19 %
Crude Fat	Min. 3 %
Crude Fiber	Max. 7 %
Calcium	0,8 - 1,2 %
Phosphor with Phytase Enzyme \geq 500 FTU/kg	Min. 0.45 %
Urea	-
Aflatoxin	Max. 50 ppb
Lysine	Min. 0,90 %
Methionine	Min. 0,40 %
Methionine + Cystine	Min. 0.70 %
Threonine	Min. 0.65 %
Tryptophan	Min. 0.18 %
Enzyme	+

Source: PT. Malindo Feedmil Tbk.

Serological tests were carried out using the standard hemagglutination inhibition (HI) method (OIE, 2021). Each well of the micro v bottom plate was filled with PBS pH 7.2 as much as 25 L using a micropipette. The serum sample tested was 25 L diluted in multiples of two starting from the 1st microplate well to the 10th well. A total of 25 L of viral antigen (AI / ND) 4 HAU was added to each well of the microplate starting from the 1st to the 11th well and then shaken with a mini shaker for 20 seconds at 300 rpm and then allowed to stand for 15 minutes. The calculation of the antigen value of 4 HAU is done by dividing the antigen titer by four (because the antigen titer used is 4 HAU). The results of the division are then made into a ratio, one part is an antigen, and the remaining ratio is PBS. After being allowed to stand for 15 minutes, 25 L of 1% red blood cells were added to wells 1 to 12 and then shaken again for 20 seconds at 300 rpm (OIE, 2021).

The results of the hemagglutination inhibition test can be read after 30 minutes of incubation. Hemagglutination inhibition was indicated by the presence of teardrops of red blood cells that appeared together with the control when the microplate was tilted 45 degrees. The serum titer is read until the dilution

shows a teardrop of red blood cells that appears and falls together with the control (Kusumastuti et al. 2015).

The differential count of super native chicken blood leukocytes was determined by the counting of blood smear preparations with *Wright giemsa stain* staining. It is then read with a light microscope magnifying the lens of the object 40 to 100, then the leukocyte differential cell is calculated up to 100 cells. Each leukocyte differential cell is then divided by 100 to obtain the percentage result of each leukocyte differential cell. The coverslip technique is applied when preparing a blood review (Purnomo et al. 2015).

Research Variables

Titer of AI and ND antibodies

Titers of AI and ND antibodies obtained from serology test were carried out by the inhibition hemagglutination (HI) method according to standards (OIE, 2021).

Differential counting of leukocytes

Leukocyte differential count results were compared with the normal scale of leukocyte differentials based on standards from Smith and Mangkoewidjojo (1988) and Johnson-Delaney (2008).

Data Analysis

The research data were processed through variance based on a completely randomized design, if the treatment had a significant effect ($P < 0.05$), then further tests were carried out using Duncan's multiple region tests (Steel and Torrie, 1991) using SPSS 25 software.

Results and Discussion

Effect of Treatment on Leukocyte Differential

Indicators such as white blood cells and their differentiation are frequently used to determine the health state of livestock, such as broiler chickens (Sugiharto, 2014). The number of leukocytes in each individual animal varies from time to time, and these variations are typically brought on by a variety of factors, such as physiological activity, age, nutrition, stress, and others. The quantity of abnormally high leukocytes is correlated with the animal's state of health (Suriansyah et al., 2016). The effect of turmeric flour in drinking water of different levels on the average differential leukocytes of super-native chickens is shown in Table 2.

Table 2 shows that the treatment had a substantial impact ($P < 0.05$) on the mean basophils but there was no significant difference ($P > 0.05$) on the average lymphocytes, monocytes, and eosinophils. The results of Duncan's further test showed that the average percentage of basophils in the P4 treatment showed a significant difference ($P < 0.05$) with the P0, P1, P2 and P3 treatments.

Based on the results of the study in Table 2, the mean percentage of lymphocytes in the blood of super native chickens aged 56 days with the addition of turmeric flour (*Curcuma domestica*) in drinking water was not significantly different between treatments. Based on the research results, the average percentage of lymphocytes in the blood of super native chickens is in the range of 45.25%-70.25%, where the results that have been found are in the normal range. Johnson-Delaney (2008) states that the normal percentage of lymphocytes in chicken blood is in the range of 29% -84%. One potential organ for maintaining and controlling the immune system in chickens is the spleen. Spleens are secondary lymphoid organs that support lymphocyte proliferation and serve as the location of antigen-presenting cells (Sandford et al., 2011). The white pulp frequently contains antigen-presenting cells. The immune system's white pulp is located within the splenic tissue. There are numerous white blood cells, including lymphocytes, in this tissue (Zhang et al., 2017). Lymphocytes are white blood cells that belong to the agranulocyte group. Salasia and Hariono (2010) stated that lymphocytes are responsible for responding to antigens and stress by increasing the circulation of antibodies in the development of the immune system. Curcumin can increase lymphocyte proliferation so that there is an increase in the number of lymphocytes in the blood circulation (Sulistyowati et al. 2010).

Table 2. The average lymphocytes, monocytes, eosinophils, and basophils of 56-day-old super native chickens were given turmeric flour of different levels

Variable	Treatment					Normal Range
	P0	P1	P2	P3	P4	
Lymphocytes (%)	70,25±12,31	45,25±11,95	60,75±18	60,25±15,64	60,50±7,54	29-84 ²
Monocytes (%)	17±5,88	17,75±19,18	16,75±2,87	15,25±10,21	16,25±2,63	0-30 ¹
Eosinophils (%)	13,50±13,30	35,25±2,43	22,50±16,13	22,25±16,58	13,25±7,04	0-16 ²
Basophils (%)	1,25±1,25 ^b	1,75±0,95 ^b	0,75±0,5 ^b	1±1,41 ^b	7,25±4,03 ^a	0-8 ²

Description: ^{a,b} Different superscripts on the same rows show a significant difference ($P < 0.05$). P0 (drinking water without turmeric flour), P1 (drinking water + Promune-C® 0.1 g/L), P2 (drinking water + turmeric flour 1 g/L), P3 (drinking water + turmeric flour 3 g/L), P4 (drinking water + turmeric flour 5 g/L). ¹Smith and Mangkoewidjojo (1988), ²Johnson-Delaney (2008).

Curcumin can activate T lymphocyte cells and B lymphocyte cells which are part of lymphocytes (Priosoeryanto, 2009). According to studies, the main plant constituents in the *Curcuma* species are curcuminoids, especially curcumin, which has been shown to have a variety of immunomodulatory effects (Yuandani et al., 2021).

The results also showed that the addition of turmeric powder (*Curcuma domestica*) in drinking water had no significant effect on the percentage of monocytes in the blood of 56-day-old super native chickens. The percentage of monocytes obtained in this study ranged from 15.25-17.75%, which was normal. This is the opinion of Smith and Mangkoewidjojo (1988) who said that the acceptable range for monocyte values in chicken blood is 0-30%. Monocytes are differential white blood cells belonging to the agranulocyte group which are formed in the bone marrow and undergo maturation when they enter the circulation so that they become macrophages and enter the tissues. Frandson et al. (2009) said that monocytes can phagocytose 100 pathogenic bacterial cells and become a regulatory system when inflammation occurs and the immune response. Monocytes are mobilized together with heterophils so that they are called the second line of defence against inflammation. s

The results also showed that the addition of turmeric powder (*Curcuma domestica*) in drinking water did not have a significant effect on the percentage of eosinophils in the blood of super-native chickens aged 56 days. The percentage of eosinophils obtained in this study ranged from 13.25-35.25%, where the results of P0 (negative control) and P4 (drinking water + 5 g/L turmeric flour) were normal while the results of P1 (drinking water + feed supplement), P2 (drinking water + 1 g/L turmeric powder) and P3 (drinking water + 3 g/L turmeric flour) experienced an increase in the average percentage of eosinophils. The results of P0 and P4 are to the opinion of Johnson-Delaney (2008)

which states that the normal limit for eosinophil values in chicken blood is 0-16%.

The increase in the average percentage of eosinophils can be affected by the presence of parasitic diseases, tissue trauma, trauma to the skin (pulling feathers, cannibals, flying accidents, drug injections), and respiratory disorders (smoke inhalation). The differential leukocytes generated in the spinal cord include eosinophils, which are responsible for allergic, inflammatory, and parasite responses. Eosinophils can fight and kill harmful germs, according to Lokapirnasari and Yulianto (2014), and they can also create enzymes that can neutralize inflammatory factors. . In preventing the entry of infection into the body, eosinophils work with chemical functions enzymatically.

The results showed that the addition of turmeric flour (*Curcuma domestica*) in drinking water had a significant effect ($P < 0.05$) on the percentage of basophils in the blood of 56-day-old super-village chickens. The percentage of basophils obtained in this study ranged from 0.75-7.25%, where the results were classified as normal according to the opinion of Johnson-Delaney (2008) which stated that the normal range of basophils in chicken blood was 0-8%. Basophils are white blood cells that play a role in allergic reactions. Although the presence of basophil cells in blood circulation is very small, their presence is very important because basophil cells contain heparin which can inhibit the blood clotting process (Ulupi et al., 2014). An increase in the percentage of basophils in the blood can be an indication of stress caused by hyperthermia and lack of drinking water (Johnson-Delaney, 2008).

Effect of Treatment on AI and ND Antibody Titers

Naturally, exposure to viruses in animals will stimulate a humoral immune response in the body which forms antibodies. Antibody titers can be detected through a serological test, namely the inhibition hemagglutination test (HI).

The effect of giving turmeric powder in drinking water with different levels on the average antibody titers of AI and ND super native chickens can be seen in Table 3.

In Table 3 it can be seen that the treatment had a significant effect ($P < 0.05$) on the average AI antibody titer but had no significant effect on the average ND titer ($P > 0.05$). The results of Duncan's follow-up test showed that the average AI titer of 56-day-old chicks in the P4 treatment showed a significant difference ($P < 0.05$) with the P2 and P3 treatments but was not significantly different between the P0 and P1 treatments. Based on the observations, the average AI antibody titer was good. Negative control (P0), positive control (P1) and treatment with the maximum level of adding turmeric powder to drinking water (P4) did not show a significant effect. This may be caused by several factors, such as vaccine quality (Nurhandayani, 2004), individual chicken factors (Dharmayanti et al., 2005), and the insensitivity factor of the HI titer test method so a more sophisticated test is needed.

The results also showed that the addition of turmeric powder (*Curcuma domestica*) in drinking water had no significant effect ($P > 0.05$) on the average ND antibody titer in super-native chickens aged 56 days. The average ND titers obtained in this study showed that the lowest titer was produced by the P2 treatment ($\log_2^{4.75}$) and the highest was produced by the P3 treatment ($\log_2^{7.50}$).

The results of the average AI and ND antibody titers showed that the addition of turmeric powder (*Curcuma domestica*) and feed supplements as an immunomodulator to the

drinking water of super native chickens could increase the titers of AI and ND antibodies to a protective level. The average AI titers obtained ranged from \log_2 7.25-9.50. According to OIE1 (2012), an AI antibody titer value above 2^4 indicates a protective result. While in native chickens, titers of not less than 2^3 HI Units three weeks postvaccination showed protective titers against infection with AI virus subtype H5N1 (Indriani et al., 2004). The average ND titers obtained ranged from \log_2 4.75-7.50. According to OIE3 (2021), an ND antibody titer value above 2^4 indicates a protective result.

Additionally, after immunization, the group treated with curcumin had an increase in lymphocytes and produced antibodies against AI and ND. It makes sense because lymphocytes produce antibodies, and greater titer antibodies are frequently produced by more active cells. It is comparable to how Abou-Elkhair et al. (2014) demonstrated the effectiveness of curcumin in encouraging higher antibody titers in broiler chickens. The activation of antigen-presenting cells, which influences B cells to control antibody presentation and T lymphocytes in direct antigen killing, was hypothesized to be the mechanism by which curcumin increased lymphocytes and titer antibodies against AI and ND virus.

This study also demonstrates that curcumin's ability to act as an immunomodulator can have the same effects on the immune system as a mixture of selenium, vitamin E, and vitamin C. The innate non-adaptive and acquired adaptive immune systems were strengthened by selenium supplementation, which increased the synthesis of IL-2, T-cell and lymphocyte proliferation,

Table 3. Average AI and ND antibody titres of super native chickens aged 56 days given different levels of turmeric powder in drinking water

Variable	Treatment				
	P0	P1	P2	P3	P4
AI (\log_2)	8,75±0,5 ^{ab}	8,50±0,57 ^{ab}	8,00±1,15 ^b	7,75±0,95 ^b	9,50±0,57 ^a
ND (\log_2)	7,25±1,70	7,25±1,70	4,75±2,21	7,50±0,57	7,00±2,8

Description: ^{a,b} Different superscripts on the same rows show a significant difference ($P < 0.05$). P0 (drinking water without turmeric flour), P1 (drinking water + Promune-C® 0.1 g/L), P2 (drinking water + turmeric flour 1 g/L), P3 (drinking water + turmeric flour 3 g/L), P4 (drinking water + turmeric flour 5 g/L).

interleukin (IL)-2 receptor expression, and the cellular immunological response to living vaccinations (Pagmantidis et al., 2008). However, the immunomodulatory effects of turmeric powder were mediated through the control of T and B macrophages, heterophils, natural killer cells, and dendritic cells. Chickens given turmeric may have increased spleen weight as a result of B lymphocyte production and mild to moderate lymphoid follicle hyperplasia in the spleen (Shihab, 2017). Due to the increased expression of anti-inflammatory cytokines, feeding birds turmeric boosts their immune responses (Huang and Lee, 2018).

Conclusions

The administration of turmeric flour (*Curcuma domestica*) as an immunomodulator in drinking water for super native chickens able to maintain AI and ND antibody titers to a protective level where the best dose for increasing AI antibody titers was 5 g/L drinking water with an AI titer of $\log_2^{9.5}$. and the best dose for increasing the ND antibody titer is 3 g/L of drinking water with an ND titer of $\log_2^{7.5}$. The treatment also had a significant effect ($P < 0.05$) on the mean of basophils but had no significant effect on the mean of lymphocytes, monocytes, and eosinophils. The provision of Turmeric Flour (*Curcuma domestica*) in drinking water as an immunomodulator is beneficial in increasing protection against Avian Influenza and Newcastle Disease-so it can be used as a natural feed additive.

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