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Haematology Profiles and Performance of Broiler Chickens Fed on Commercial Feed

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Abstract. The objective of this research was to investigate the effect of commercial feed on hematological and carcass profiles of broiler chickens. A total of 1800 day old chick (DOC) broilers were administered in a Completely Randomized Design (CRD) furthered by Duncan test. The treatments consisted of Feed A, B, C, D, E, and F. The observed variables included hematology profiles (erythrocyte, hemoglobin, leukocyte, heterophil, lymphocyte, and monocyte) and performance (live weight, carcass percentage, breast, thigh, wings, shank, and head). The result showed that feed treatment did not significantly affect (P>0.05) hematology profiles and performance of broiler chickens, but significantly affected live weight (P<0.05). Conclusively, different types of commercial feed did not render physiological effect to DOC and safe for feeding until 35 days old to increase the live weight of broiler chickens.
Keywords: hematology, broiler, commercial feed

Abstrak. Penelitian ini bertujuan untuk mengkaji pengaruh pemberian pakan komesial terhadap profil Hematologis darah dan karkas ayam broiler. Materi yang digunakan pada penelitian ini adalah 1800 ekor *day old chick* (DOC) ayam broiler. Percobaan dirancang berdasar Rancangan Acak Lengkap (RAL) dan uji lanjut menggunakan *Duncan*. Perlakuan yang diterapkan yaitu Pakan A, Pakan B, Pakan C, Pakan D, Pakan E, dan Pakan F. Variabel yang diukur meliputi profil hematologis darah (kadar eritrosit, hemoglobin, leukosit, heteropil, limfosit dan monosit) dan performa (bobot hidup, persentase bobot karkas, dada, paha, sayap, shank dan kepala). Hasil penelitian menunjukkan bahwa perlakuan berpengaruh tidak nyata (P>0,05) terhadap profil hematologis darah dan performa ayam broiler kecuali terhadap bobot hidup memberikan pengaruh yang nyata (P<0,05). Kesimpulan dari penelitian ini yaitu, pemberian berbagai jenis pakan komersial tidak memberikan efek fisiologis dan dapat diberikan mulai DOC sampai umur 35 hari dan meningkatkan bobot hidup ayam broiler.
Kata kunci : hematologis, broiler, pakan komersial

Introduction

Animal protein demand increases as the population grows each year. Broiler chicken is livestock that significantly contributes to fulfilling animal protein demand in Indonesia, and the demand for chicken also escalates due to the reasonable price for the society.

As alternative livestock for meat demand, broiler chicken farming is developing in small to large scale. The characteristics of broilers include fast growth, efficient ration, relatively short harvest, tender meat fibre, thick meat mound, and smooth skin. Broiler growth is highly dependent on feed as well as proper maintenance. Feed is an essential component for growth and animals need nutrition for the physiological process. Sufficient nutrient in quality and quantity is required for improving metabolism to support animal development and growth (Erniasih and Saraswati, 2006).

Broiler chicken farmers generally offer the readily-available commercial feed from the market. Commercial feed refers to various ingredients mixed at particular formulation to meet the animal dietary needs. The feed has been designed to support optimum development, growth, health, and performance. Farmers generally prefer commercial feed to self-made feed, and the choice is based on practicality, availability, price, and nutrient content. There are various types of commercial feed regarding price and ingredients produced by different companies (feed factory).

Feed efficiency could manifest into hematology profiles and performance of broiler chickens, especially body weight. Hematological blood profile is a parameter of health status because it plays a vital role in managing body physiology (Satyaningtijas et al., 2010). Blood assessment may diagnose disease or disorders in blood or body organs of livestock (Napirah et al., 2013).

Blood transports metabolic substrates that all body cells require such as oxygen, glucose, amino acid, fatty acid, and some lipids. Blood also carries metabolic products expelled by each cell, such as carbon dioxide, lactic acid, nitrogen excretion from protein metabolism, and heat (Cunningham, 2002). According to Colville and Bassert (2008), blood plays a function in transportation, regulation, and defence functions. Blood is composed of blood cells (erythrocyte, leukocyte, and thrombocyte) circulating in a fluid called blood plasma (Meyer and Harvey, 2004). Internal factors include health, stress, and nutrition status, while external factors may include the dynamic surrounding temperature and viral infection (Ginting, 2008).

Blood, which is a vital particular circulatory tissue, is composed of cells suspended in a fluid intercellular substance (plasma) with the significant function of maintaining homeostasis (Isaac et al., 2013). Hematological components, which consist of red blood cells, white blood cells or leucocytes, mean corpuscular volume, mean corpuscular hemoglobin and mean corpuscular hemoglobin concentration are valuable in monitoring feed toxicity especially with feed constituents that affect the blood as well as the health status of farm animals (Oyawoye & Ogunkunle, 2004). Blood main functions include (1) tissue oxygenation, (2) tissue nutrition, (3) balanced acid-base maintenance, and (4) metabolic waste repellent from tissue (Noercholis et al., 2013). Ali et al. (2013) stated that blood plays an intricate role in maintaining a sound physiological process so that animal productivity is optimum. The contributing factors to blood profile in an animal are age, sex, genus, disease, the surrounding temperature, geographical condition, and physical activity. Hematological values could serve as baseline information for comparison in conditions of nutrient deficiency, physiology, and health status of farm animals (Daramola et al., 2005).

Materials and Method

The research used 1800 broiler chickens reared from DOC to 35 days old and rationed to 36 cage units (50 chicken each). The chickens were offered with commercial feed available in the market.The composition and nutrient content of the feed treatment are presented in Table 1.

Table 1. Composition and nutrient content of treatment feed

Treatment	Nutrient Content						
	Moisture (%)	Protein (%)	Fat (%)	Crude protein (%)	Ash (%)	Ca (%)	P (%)
Treatment feed A	11.00	22.56	5.51	2.46	4.59	0.88	0.55
Treatment feed B	10.90	21.94	7.58	2.40	5.57	0.94	0.58
Treatment feed C	10.50	20.86	6.08	3.68	4.51	0.78	0.55
Treatment feed D	10.80	21.19	7.62	3.46	5.52	0.99	0.77
Treatment feed E	11.00	22.28	7.56	2.41	4.71	0.78	0.56
Treatment feed F	11.40	22.15	7.44	2.61	4.40	0.73	0.56

Source: Analysis result by PT. Cjeil Cjedang Tbk.(2017)

Measured variables

Blood sampling was conducted at the end of the study after the chickens have fasted for 9h. Blood was drawn 2-3 ml from vena brachialis that had been cleansed with alcohol using a 3ml syringe (23G x 1 1/4" needle) and put into an EDTA-filled tube. Hematology profile assessment included erythrocyte, hemoglobin, leukocyte, heterophil, lymphocyte, and monocyte. Total erythrocyte was calculated using a hemocytometer, and Hb level was counted following acid Hematin method using a Hemometer Sahli-Hellige (Frandson et al., 2009).

The performance of broiler chickens was measured by calculating the live weight at the end of treatment. Carcass, breast, thigh, wings, shank, and the head percentage was obtained after cutting the chicken at the jugular venous and removed the blood. Feathers, abdominal fat, feet, head, neck and innards except for the giblet (liver, heart, and gizzard). Carcass percentage was calculated by multiplying the live weight by 100%. The percentage weight of breast, thigh, wings, shank, and head was recorded by weighing each organ, divided by live weight and multiplied by 100%.

Research Methode and Data Analysis

The experiment was conducted in a Completely Randomized Design (CRD) and the obtained data were subject to a single factor analysis of variance (ANOVA) followed by Duncan test when differences were resulted (Steel and Torrie, 1980).

Results and Discussion

The result of hematology profilesis presented in Table 2. The analysis of variance showed that different commercial feed did not significantly affect (P>0.05) hematology profiles of broiler chickens. Therefore, the commercial feed currently offered to the chickens had met quality feed criteria as it did not cause any physiological disorder to the chickens. The result showed that commercial feed did not significantly affect (P>0.05) the erythrocyte level of 35-day-old broiler chickens as the total erythrocyte was within the normal range i.e. 2.41–2.83 (10^6/ml). It indicated that the commercial feed did not contain a harmful substance or potentially caused disorder on total blood cell. The result confirmed previous findings on total erythrocyte 2.3–3.5 (10^6/mm^3) (Dharmawan, 2002) and 2.42–2.75 (10^6/mm^3) (Usman et al., 2016[a]). Talebi et al. (2005) reported that the total erythrocyte of native chicken was 2.17–2.86 (10^6/mm^3) while other findings varied from 2.49±0.38–2.83±0.64 (10^6/mm^3) (Hidayat et al. 2016) to 1.75–2.18 (10^6/mm^3) (Hidayatulloh et al., 2016). Additionally, Putriani et al. (2012) stated that the hemoglobin level of broiler chickens was 7.00–13.00 g/dl.

Table 2. Hematology profilesof broiler chickens offered with different commercial feeds

Variables	Treatment					
	Feed A	Feed B	Feed C	Feed D	Feed E	Feed F
Erythrocyte (mil/µl)	2.67±0.41	2.63±0.47	2.43±0.65	2.54±0.31	2.41±0.19	2.83±0.39
Hb (g/dl)	7.07±0.38	7.17±0.61	6.85±0.87	7.02±0.38	6.87±0.42	7.27±0.55
Leukocyte (cells/µl)	8,900.00 ±2068.82	9,858.33 ±1478.65	9,541.67 ±1340.30	8,808.33 ±2862.07	9,766.67 ±2526.59	8,783.33 ±2578.11
Heterophil (%)	34.83±7.96	31.17±6.62	31.00±11.05	33.83±7.25	30.67±8.62	31.67±9.75
Lymphocyte (%)	60.17±8.66	64.33±6.59	63.33±11.18	61.00±7.21	64.50±9.42	62.50±8.53
Monocyte (%)	4.33±1.97	4.33±1.03	5.00±2.19	5.17±2.14	4.33±1.03	5.83±2.23

The different erythrocyte levels were due to many factors such as feed, age, maintenance system, the surrounding temperature, altitude, and other climate factors. Piliang and Djojosoebagio (2006) stated that the contributing factor to the erythrocyte level was nutrient sufficiency. The optimal blood condition significantly supported the productivity of broiler chickens. Erythrocyte is a tissue that transports nutrition substances from the digestion process around body parts for metabolism process (Soeharsono et al., 2010). Erythrocyte (hemoglobin) transports O_2 to all body cells with the influence of age, sex, and nutrient status in erythropoiesis process (Revsianto. 2016).

The result of statistical analysis showed that commercial feed did not significantly affect ($P>0.05$) total hemoglobin of 35-day-old broiler chickens, and the leukocyte was within the normal range, i.e. 6.85±0.87 to 7.27±0.55 g/dl. The crude protein level in the commercial feed was 21.00-23.00 % (starter) and 19.00 - 21.00 % (finisher), which was sufficient for the chickens. Protein, especially amino acid glycine and Fe mineral are the building blocks for hemoglobin; therefore, the total hemoglobin is maintained by the combined protein and Fe (Sriwati et al., 2014).

Previous findings reported hemoglobin level by 6.65–7.40 g/dl (Hidayat et al., 2016) and 5.18–9.30 g/dl (Salam et al., 2013; Varmaghany et al., 2013; Sugiharto et al., 2015). The different hemoglobin level was owing to age and nutrition – the older the chickens, the higher the erythrocyte, hemoglobin, and hematocrit. Micromineral in the form of Fe is hemoglobin precursor. Hemoglobin transports gas (O_2 and CO_2) in body tissues; therefore, the hemoglobin level significantly affects erythrocyte (Napirah et al., 2013). The other contributing factors to hemoglobin level are species and (Frandson et al., 2009). Manin et al. (2014) stated that hemoglobin functions as oxygen and carbon dioxide carrier as well as erythrocyte pigment. Total erythrocyte and hemoglobin in blood circulation are dependent on age, sex, genus, disease, surrounding temperature, geographical condition and physical activity (Ali et al., 2013) and different physiological properties (age and activity), environmental factors (temperature and humidity) and feed composition (Wahyuni et al., 2012). An open cage throughout the day supplies adequate oxygen for the chickens which result in the increased hemoglobin. Guyton and Hall (2015) reported that amino acid glycine and Fe mineral are the building blocks of hemoglobin.

Hemoglobin concentration in the blood depends on age, sex, feed nutrition, muscle activity, mental condition, season, weather pressure, and daily habit to stabilize hemoglobin in order to meet protein and Fe^{2+} demand for hemoglobin formation (Kusumasari et al., 2012).

The result of statistical analysis showed that commercial feed did not significantly affect ($P>0.05$) total leukocyte of 35-day-old broiler chickens. i.e. 8.78±2.58x10^3 to 9.86 ±1.48x10^3/ml which remains in the normal range, 12–30×10^3/ml (Arfah, 2015). Hartoyo et al. (2015) reported that leukocyte level of broiler chickens offered with up to 6% herbal supplement was 25.19±7.97x10^3/µl, which remains in the normal range.

The increased leukocyte reflects humoral and cellular response against the pathogenic agent that causes diseases. Moyes and Schute (2008) and Soeharsono et al. (2010) stated that animal health could be measured from the total leukocyte because the increased leukocyte is the parameter of body immune, and the decreased leukocyte may translate into the non-existent infection or pathogenic bacteria in the body. Bacterial infection may cause health disorder as signified by the increased white blood cell (Saputro et al., 2013).

The result of statistical analysis showed that commercial feed did not significantly affect

(P>0.05) total Heterophil of the 35-day-old broiler chickens. The average total Heterophil in this study was 31.00±11.05 to 34.83±7.96% while Purnomo et al. (2015) reported 30.4–52.0% of broiler chickens fed with fermented tapioca waste flour.

Redmond et al. (2011) stated that heterophil contains antimicrobial that correlates with disease resistance in the body and affected by the animal's genetic control. The contributing factors to heterophil level were the environment, stress level, genetic, and nutrient sufficiency.

The result of statistical analysis showed that commercial feed did not significantly affect (P>0.05) total lymphocyte of 35-day-old broiler chickens. The average lymphocyte in this study was 60.17±8.66 to 64.50±9.42%. Purnomo et al. (2015) reported that broiler chickens fed with fermented tapioca waste had 25.6–39.2 lymphocyte, while in poultry was generally 42–66% (Harahap. 2014).

The result of statistical analysis showed that commercial feed did not significantly affect (P>0.05) monocyte of 35-day-old broiler chickens. The average monocyte in this study was 4.33±1.03 to 5.83±2.23%. While broiler chickens offered with fermented tapioca waste had 6.40–12.00 monocytes (Purnomo et al., 2015) compared to normal monocyte that takes up 3 – 5% of total leukocyte in the blood (Sismanto. 2007).

In the immune system, monocyte serves as the macrophage which swallows and destroy foreign and pathogenic cells, microorganism, and materials, as well as forming body immune (Isroil et al., 2009). Frandson et al. (2009) stated that monocyte could render phagocytosis on 100 pathogenic bacteria cells and serve as homeostasis during inflammation and responds to immunity. Monocyte is mobilized together with heterophil and form the second defense layer against inflammation. Eroschenko (2008) stated that the average threshold of monocyte in broiler chickens is 3-10%. Monocyte is the differential white blood cells that belong to a granulocyte group formed in the bone marrow, matured when entering circulation, turned into macrophage and permeated the tissues. The result of broiler performance is presented in Table 3.

Analysis of variance result showed that commercial feed significantly (P<0.05) increased live weight particularly treatment feed B because feed B contains 21.94% protein, 7.58% fat, 2.4% crude protein, and 5.57% organic matter. Live weight of 5-week broiler chickens in this study was 2.27±0.36 to 2.43±0.27 kg. Risnajati (2012) compared the final weight of Cobb, Hubbard, and Hybro chickens, namely 1.970, 1.976, and 1.898 kg, respectively.

Table 3. Performance broiler chickens offered with commercial feed

Variabel	Treatment					
	Feed A	Feed B	Feed C	Feed D	Feed E	Feed F
Live weight (Kg)*	2.39±0.32	2.43±0.27^{b}	2.34±0.26	2.36±0.23^{a}	2.32±0.25^{a}	2.27±0.36^{a}
Carcass(%)	73.20±8.64	71.38±4.67	68.52±6.22	66.48±5.28	69.18±2.59	70.16±6.73
Breast (%)	27.64±2.75	28.13±2.82	26.82±1.20	24.81±2.93	26.68±2.23	27.40±2.88
Thigh (%)	21.23±2.55	18.95±2.95	19.07±1.76	19.39±1.65	19.69±2.59	20.07±3.08
Wings (%)	6.16±0.68	6.48±0.40	6.30±0.44	5.96±0.70	6.04±0.33	5.67±0.70
Shank (%)	3.58±0.71	3.62±0.36	3.39±0.28	3.35±0.58	3.65±0.60	3.38±0.46
Head (%)	2.20±0.41	2.19±0.38	2.20±0.23	2.05±0.35	2.17±0.19	2.25±0.37

Analysis of variance result showed that commercial feed did not significantly affect (P>0.05) carcass percentage, breast, thigh, wings, shank, and head because the feed contained sufficient protein and energy for the life and growth. Protein significantly (P<0.05) affects tissue growth in chicken. High protein intake would result in faster growth and affect broiler carcass (Rizal, 2006). Carcass percentage of broiler chickens in this study was 66.48±5.28 to 73.20±8.64%, higher than 65.35% to 66.56% by Daud et al. (2007). On the other hand, Massolo et al. (2016) reported that carcass percentage of broiler chickens offered with Dahlia bulb was 66.37±2.96 to 73.29±6.54%. Other findings reported 24.13%–26.79% (Resnawati. 2004) and 27.14%–28. 48% (Sari et al., 2014)

The weight percentage of other body parts included breast (24.81±2.93–28.13±2.82%). thigh (18.95±2.95–21.23±2.55%) and wings (5.67±0.70–6.48±0.40%). Massolo et al. (2016) reported average weight percentage including breast (25.05–29.51 %), thigh (24.40–27.57%), and wings (10.34–12.06%). Furthermore, Usman et al. (2016[b]) reported 9.549±0.266–11.400±0.174% of wings and 32.752±2.960–35.767±0.410% of breast.

The result of shank and head percentage in this study was 2.05±0.35–2.25±0.37% and 3.35±0.58–3.65±0.60%, respectively. Similarly, Daud et al. (2016) reported head and neck (2.99±0.20–3.41±0.32%) and shank (3.21±0.32–3.42±0.25%), while other study by Oglohobo et al. (2014) mentioned the percentage of shank (5.13–5.63%), head (0.01–0.36 %), wings (10.26 –11.25%), breast (17.30–23.75%), and thigh (10.81–12.24%).

Conclusions

Various commercial feed available in the market are safe and nutritious for main broiler feed as evidenced from the hematology profiles, the weight of carcass and its parts, he relatively similar weight of non-carcass parts and the increased live weight.

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References

Ali AS, Ismoyowati, and D Indrasanti. 2013. Total erythrocyte. hemoglobin and haematocrit level of different native duck species on probiotic supplement in ration. J. Ilm. Pet. 1(3):1001-1013.

Arfah NH. 2015. The effect of turmeric powder supplement in feed on erythrocyte, hemoglobin, PCV, and leukocyte of broiler chickens. Universitas Hasannudin Makasar. Makasar.

Colville T and JM Bassert. 2008. Clinical anatomy & physiology for veterinary technician. Missouri. Third Edition. Elsevier.

Cunningham JG. 2002. Textbook of veterinary physiology. USA: Saunders Company.

Daud MWG, Piliang, and P Kompiang. 2007. Carcass percentage and quality of broilers fed with prebiotic and probiotic in ration. JITV. 12(3):167-174.

Daud M, Zulfan and Syafriadi. 2016. Effect utilization of fermented banana peel + coconut meal + feed suplement to the weight and percentage of several broiler internal organs. JIM Pertanian Unsyiah – PET. 1(1):671-674.

Daramola. JO, AA Adeloye, TA Fatoba, and AO Soladoye. 2005. Haematological and biochemical parameters of west African dwarf goats. LRRD. 17(8):95.

Dharmawan NS. 2002. Introduction to veterinary clinical pathology (clinical hematology). 3rd Edition. Pelawa Sari. Denpasar.

Erniasih I and TR Saraswati. 2006. Penambahan limbah padat kunyit (*Curcuma domestica*) pada ransum ayam dan pengaruhnya terhadap status darah dan hepar ayam (*Gallus sp*). Buletin Anatomi dan Fisiologi. 14(2).

Eroschenk VP. 2008. Di Fiore's atlas of histology with functional correlations. 11th Edition. Lippincott Williams & Wilkins. Philadelpia.

Frandson RD, WL Wike, and AD Fails. 2009. Anatomy and physiology of farm animals. 7th Ed. Wiley-Blackwell. Iowa States USA

Ginting and A Indri. 2008. Blood profile of broiler chickens fed with castor (*Jatropha curcas* L.) leaves powder IPB: Bogor.

Guyton and JE Hall. 2015. Textbook of Medical physiology e-book. Elsevier Health Sciences.

Hidayat DA, FD Putra, S Sugiharto, and E Widiastuti. 2016. Red blood profile of broiler chickens fed with tapioca waste fermented with *Acremoniumcharticola* and/or antibiotic. National Seminar Department of Livestock. UNS.

Hidayatulloh AH, AS Wibowo, SIA Rais, MY Fajar, and TA Sartono. 2016. Red blood profile of broiler chickens fed with different doses of hatching waste powder. National Seminar Department of Livestock. UNS. 2016.

Hartoyo B, S Suhermiyati, N Iriyanti, and E Susanti. 2015. Performance and hematology profiles of broiler chickens with herbal supplement (fermenherfit). In proceedings of National Seminar Livestock Technology and Agribusiness (3rd Series): Livestock Development based on Local Resources in Facing ASEAN Economic Community (MEA). Faculty of Animal Science. Jenderal Soedirman Univeristy. Purwokerto.

Harahap RA. 2014. Blood Profile of finisher broiler chickens with feed plus herbal formula. Bogor Univeristy of Agriculture. Bogor.

Isaac LJ, G Abah, B Akpan and IU Ekaette. 2013. Haematological properties of different breeds and sexes of rabbits In: Proceedings of the 18th Annual Conference of Animal Science Association of Nigeria : p.24-27.

Isroli, S Susanti, E Widiastuti, T Yudiarti, and Sugiharto. 2009. Observation on hematological variables of Kedu chicken under intensive maintenance in: Sumarsono, LD Mahfudz, DW Widjajanto, Karno, E Pangestu, LK Nuswantoro. TA Sarjana, and Surono (Ed.). Proceedings of National Seminar. Livestock Resurgence. Semarang. 20 Mei 2009. Magister of Livestock Studies Faculty of Animal Science. Universitas Diponegoro pp. 548-557.

Kusumasari Y, VD Yunianto, E Suprijatna. 2012. Phytobiotic from god's crown (*Phaleria macrocarpa*) on hemoglobin and hematocrit level of broiler chickens. JATP 1(4).

Manin F, E Hendalia, Yatno and P Rahayu. 2014. Effect of FM probiotic on the health status of kerinci duck. J. Ilm. Ter. 1(2):7-11.

Meyer DJJW and Harvey. 2004. Veterinary Laboratory Medicine: Interpretation and diagnosis. Third Edition. St. Louis: Saunders.

Moyes CD and PM Schulte. 2008. Principles of animal physiology. 2nd Edition. Pearson International Edition. New York.

Napirah A, Supadmo, and Zuprizal. 2013. Effect of turmeric powder supplement (*Curcumadomestica valet*) in feed on hematological parameter of broiler quail's blood (*Coturnix-coturnix japonica*). Buletin Peternakan. 37(2):114-119.

Nurcholis A, M Aziz and Muftuch. 2013. Roudness feature extraction to calculate erythrocyte in fish blood cell image. *Jurnal EECIS*. 7(1).

Ologhobo AD, EI Akangbe, IO Adejumo, and O. Adeleye. 2014. Effect of moringaoleifera leaf meal as replacement for oxytetracycline on carcass characteristics of the diets of broiler chickens. Annual Research & Review in Biology. 4(2):423.

Oyawoye BM and HN Ogunkunle. 2004. Biochemical and haematological reference values in normal experimental animals. New York: Masson. p. 212-218.

Piliang WG and S Djojosoebagio. 2006. Nutrition Physiology. Vol. 2. Bogor Agricultural University Press. Bogor.

Putriani S, IG Soma, and IDK Ardana. 2012. Hematocrit value. hemoglobin and total erythrocyte of broiler chickens injected with *Tylosin* and *Gentamicin*. J. Ind. Med. Vet. 1(4): 492-504.

Purnomo D, Sugiharto, and Isroli. 2015. Total leukocyte and leukocyte differential of broiler chicken's blood due to Tapioca Waste fermented with *rhizopus oryzae* in ration. Jurnal Ilmu-Ilmu Peternakan 25(3):59 – 68.

Redmond S, BP Chuammitri, CB Andreasen, D Palić and SJ Lamont. 2011. Genetic control of chicken heterophil function in advanced intercross lines: associations with novel and with known Salmonella resistance loci and a likely mechanism for cell death in extracellular trap production. Immunogenetics. 63: 449–458.

Revsianto F. 2016. The Effect of Cage Size and Different level of protein on total erythrocyte. hemoglobin and hematocrit level of starter female kemang duck. Faculty of Animal Science. Universitas Andalas. Padang. Undergraduate Thesis in Livestock Department.

Risnajati D. 2012. The comparison of final weight. carcass weight and percentage of different broiler strains. Sains Peternakan 10(1): 11-14.

Rizal Y. 2006. Ilmu Nutrisi Unggas. Andalas University Press, Padang.

Resnawati H. 2004. Carcass parts and abdominal fat of broiler fed diet containing lumbricus rubellus earth worms meal (*Lumbricus rubellus*) In National Seminar on Animal Husbandry and Veterinary Technology. Animal Husbandry Center. Ciawi. Bogor.

Salam S, D Sunarti, and Isroli. 2013. Physiological responses of blood and immune organs of broiler chicken fed dietary black cumin powder (*Nigella sativa*) during dry seasons. JITAA. 38(3):185-191.

Saputro B, PE Santoso, and T Kurtini. 2013. The effect of vaccine administration methods to broiler on antibody tither, total erythrocyte and leukocyte. J. Ilmiah Peternakan Terpadu. (2)3:43–48.

Sismanto LH. 2007. Leukocyte Differential of Broiler after Sambiloto extract supplementation (*Andrographispaniculata* Nees) dissolved in multilevel dose prior to *Eimeria tenella* infection. Bogor University of Agriculture. Bogor.

Soeharsono L, Andriani, E Hernawan, KA Kamil, and A Musawwir. 2010. Fisiologi ternak fenomena and nomena dasar, fungsi, and interaksi organ pada hewan. Bandung: Widya Padjadjaran.

Sriwati D, E Widodo and H Natsir. 2014. The effect of white cumin powder (*Cuminum cyminum*. L) in feed on broiler blood profile. Faculty of Animal Science. Universitas Brawijaya. Malang.

Sugiharto, Isroli, E Widiastuti, and NS Prabowo. 2015. Effect of turmeric extract on blood parameters. feed efficiency and abdominal fat content in broilers. JITAA. 36(1):21-26.

Steel RGD and JH Torrie. 1980. Principles and procedures of statistics: A biometrical approach (2nd Ed.). McGraw-Hill Publishing Co., New York.

Satyaningtijas AS, SD Widhyari, and RD Natalia. 2010. The total erythrocyte count. hematocrit value. and hemoglobin concentration in broiler supplemented with feed additive. Indonesian Journal of Veterinary Sciences. 4(2).

Talebi A, SA Rezaei, RR Chai, and R Sahraei. 2005. Comparative studies on haematological value of broiler strains. Int. J. Poult. Sci. 4(8):573-579.

Usman A, AK Kamil, and A Mushawwir. 2016[a]. The Profile of hematology of laying hen fed chitosan and not chitosan in the condition of "upper thermoneutral zone". Fakultas Peternakan Universitas Padjadjaran. Bandung.

Usman Y, H Latif, and J Abdillah. 2016[b]. Prebiotics giving effect immuno forte with different level of carcass weight and percentage broiler chikens. JIM Pertanian Unsyiah – PET. 1(1):739-745

Varmaghany S, S Rahimi, MAK Torshizi, H Lotfollahian, and M Hassanzadeh. 2013. Effect of olive leaves on ascites incidence, haematological parameters and growth performance in broilers reared under standard and cold temperature conditions. Animal Feed Science and Technology 185:60-69.

Wahyuni NY, N Mayasari and Abun. 2012. The Effect of jengkol skin extract (*Pithecellobium jiringa*) in ration on hematological value of broiler chickens. Student E-J. 1(1):1-5.