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Hematology and Blood Chemistry Status of Most Frequently Consumed Ruminants in Community

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Abstract

Hematological and chemical status of blood in livestock can be used to diagnose the disruption of the hematologic system as well as help to diagnose many organ and systemic diseases. This study aimed to determine the hematology and blood chemistry status of various types of most frequently consumed ruminants in community. Types of ruminants used were cattle, goats and buffaloes. The research design was Completely Randomized Design (RAL) with 3 treatments on 3 types of male ruminants at slaughter age. Each treatment consisted of 3 times repetition. The animals used came from slaughterhouses in Kudus (cattle and buffaloes) and Semarang (goats). Observations of hematology and blood chemistry parameters were conducted on blood samples taken in the morning (at 03.00 a.m.). The parameters measured were the number of erythrocytes, hemoglobin (Hb) content, number of leukocyte and blood chemistry consisted of HDL and LDL cholesterol. The data obtained were analyzed by ANOVA and followed by Duncan test. The results showed that the highest number of erythrocytes and hemoglobin content was found in goats, whereas the highest LDL content was found in cattle. It can be concluded that goat has the best hematological status compared to cattle and buffalo.

How to Cite

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INTRODUCTION

One of the directions of the General Policy of Food Sovereignty in the National Medium-Term Development Plan (RPJMN) 2015-2019 is the guarantee of food safety and quality with increased nutritional value. Consumption of Animal Source Food (ASF) is one of the performance indicators of the Food Security Agency related to its function to ascertain the diversity and adequacy of family's ASF consumption that will affect the quality of human resources in the family. Consumption of ASF is mostly not yet varied according to the Food Expectation Pattern, and still in the dominance of ASF from poultry, while the other ASF is still less consumed (Kementan, 2017). The average daily supply of calories (measured in kilocalories per person per day) for average energy and protein sufficiency in Indonesia population is 2,150 kilocalories and 57 grams per person per day at consumption level (BPS, 2016; Kemenkes, 2013). The average per capita meat consumption of Indonesia's population in 2016 was 6.778 kg. The most consumed animal was broiler chicken of 5.110 kg, while the consumption of beef was only 0.417 kg. Per capita per day calorie consumption for meat in 2016 was 56.02 kcal from meat weighing 3.35 grams (Ditjenpkh, 2017).

Effort to build a diversification of meat consumption according to the source of livestock commodities is defined as an effort to meet the improvement of nutrition in order to improve the quality of human resources of Indonesian society. Ruminants livestock as a business opportunity in world trade globally also can increase the foreign exchange for the country. This effort can be done if the ruminant livestock can initially meet the needs of domestic meat nationally. The main sources of ASF can come from several types of livestock such as cattle, buffaloes, goats, sheeps, horses, poultry and pigs which for the last ten years show their high potential production seen from the their population that tends to increase (Soedjana, 2011).

Consumption of animal protein in Indonesia experiences repeated ups and downs. Commodities that continue to increase in consumption are the products of poultry and dairy, while the one that are still experiencing a decrease in public consumption is ruminant meat (red meat) (BPS, 2015). However, in 2017, the total production of major meat-producing ruminants in Central Java consisting of cattle, buffaloes, goats reached 73,655 tons (59,708 tons cattle, 1,785 tons buffaloes and 12,162 tons goats). When compared to 2016, cattle and goat production increase by 3 percent and 4 percent, while the buffalo decrease by 1 percent (Ditjenpkh, 2017). This data shows that cattle is the highest produced commodity with the highest demand compared to other ruminant commodities (goat and buffalo).

The population of beef cattle in Central Java in 2016 was 1,674,573 head. By 2017, it increased to 1,718,206. For buffalo, in 2017 there were 64,477 more buffaloes compared to 2016. Moreover, the goat population was 4,134,034 in 2017. It showed an increase compared to the previous year with 4,066,654 head (Ditjenpkh, 2017). An increase in availability of meat-producing ruminants in Central Java has made no excuses for people not to diversify their meat consumption as a source of animal protein. Meat is one of the sources of animal protein that is important in meeting nutritional needs. In addition to its high protein quality, the meat contains complete and balanced essential amino acids as well as several types of minerals and vitamins.

An optimal animal health status is one of the requirements in the effort to get a high quality meat products that are worth consuming. Animal health status is highly related to the hematological status. Haematological status is a good indicator of the physiological condition of livestock (Etim *et al.*, 2013), as well as livestock health (Togun *et al.*, 2007). Hematological status has important functions in the circulation and defense of the body. It also plays a role in the regulation of acid-base conditions, electrolyte balance, body temperature and used on organism's defense against disease.

Hematological status changes in livestock can be used to detect metabolic disorders, diseases, structural damage to organ, and stress (Kubkomawa *et al.*, 2015; Iheidioha *et al.*, 2012). Hematologic examination may help monitoring livestock metabolism conditions (Lager & Jordan, 2012), which can then determine the physiological and livestock health conditions. Hematologic analysis is not only relevant for diagnosing disorders of the hematologic system but also helps in the diagnosis of many organ and systemic diseases. Although the diagnosis of a disease can sometimes only be based on a complete blood cell count, the hemogram can contribute valuable informations in the diagnosis, control, and formulation of prognosis about future disease progression in individuals. The health of ruminant livestock such as goat, cattle and buffalo determines the quality of their meat.

This study aimed to determine the number of erythrocytes, hemoglobin (Hb), leukocytes, as well as blood chemistry status which consisted of HDL and LDL cholesterol. This study revealed some informations as an important basis to determine the condition of blood status and physiological health of livestock.

METHODS

The study was conducted from March to September 2017. The study design used was Completely Randomized Design (RAL) with 3 types of ruminants i.e. goats, buffaloes and cattle at slaughter age, each treatment was conducted with 3 times replications. Cattle and buffaloes blood samples were taken from slaughterhouses in Kudus Central Java, while goats blood was taken from slaughterhouses in Semarang. Blood sampling was performed by collecting the blood in vacuum tubes containing *Ethylenediamine Tetraacetic Acid* (EDTA) anticoagulant. Then the bottle was inserted into a vacuum flask containing ice as the way to transport the blood to the laboratory for further analysis. Blood samples were taken in the morning at 3:00 am, at that time the slaughtering was done. Then before the dawn, the cleansed meat would be distributed to the market. Blood hematologic observation was performed to calculate the amount of erythrocytes by using Improved Neubauer count chamber with 200 times dilution in erythrocyte pipette. It was conducted to get the amount of erythrocytes per ɥl blood as many as 5 x 10 x 200 = 10,000 (Hamidah *et al.*, 2017). Hb level and leukocyte count was determined by using hematology analyzer. Observation of blood chemistry (LDL and HDL cholesterol) was conducted by using miniscreen spectrophotometer. LDL analysis was performed by using KIT from DiaSys System (Diagnostic System) and CHO-PAP method. The first stage was filling the 2 tubes, the first tube was filled with 100 μL sample and 1000 μL precipitating reagent and the second tube was filled with 100 μL standard and 1000 μL reagent Cholesterol. Then the mixture was incubated for 15 minutes at room temperature. The process was continued with the centrifugation for 20 minutes until a clear liquid formed (supernatant). 100 μL clear liquid (supernatant) from the first stage was transferred into the third tube and 1000 μL cholesterol reagent was added. The third tube was incubated for 5 minutes at 37^{o} C. Absorbance read of the sample for standard within 45 minutes agains reagen blank. Measurements of LDL levels were performed by using a photometer with a wavelength of 546 nm and a factor of 676 (Aetin *et al.*, 2017). The data were processed by using guidance from Mattjik & Sumertajaya (2006) and analyzed by using analysis of variance (ANOVA) continued with Duncan Test at 95% confidence level. Data processing was done with the help of SPSS 16.00 program.

RESULT AND DISCUSSION

Erythrocyte and hemoglobin are important components in maintaining the health of ruminants. Erythrocytes and hemoglobin play a role in the transport of nutrients and oxygen for the body's metabolism (Yanti *et al*, 2013). Erythrocytes have an average diameter of 5-6 μm in cattle, smaller than in other species. The main function of erythrocytes is to transport the oxygen, which is bound to hemoglobin. Erythropoiesis, which takes about 5 days, is stimulated by erythropoietin and occurs in the bone marrow parenchyma. Cattle erythrocytes have a relatively long life span of 130-160 days (Brockus, 2011; Wood & Quiroz-Rocha, 2010).

The result of data analysis showed that the number of goats erythrocytes (9.4 million / μL) was not significantly different compared to cattle erythrocytes (9.3 million / μL). However, both goats and cattle's erythrocytes were significantly different compared to the buffaloes' (8.6 million / μL) (Figure 1). Hemoglobin levels of goats (8.39 grams / dL) and cattle (8.56 grams / dL) were significantly different with buffaloes' (9.61 grams / dL) (Figure 2). The amount of cattle erythrocytes mentioned above was still higher than that one obtained by other researchers of 6, 263 million / μL with the hemoglobin levels of 10, 79 grams / dL (Calamari *et al.,* 2011; Diparayoga, *et al.*, 2014). Meanwhile, Siswanto (2011) from his research in RPH Sanggaran Bali got lower erythrocyte amount of 5.2 million / ɥL and hemoglobin level of 8.7 gram / dL. Furthermore, it was submitted that clinically the cattle were slaughtered in a healthy condition. On the other hand, bali beef cattle have a good feed conversion and can live in less suitable environment. The hemoglobin level of buffaloes that had been examined before was 13, 20 gram / dL (Pandeya *et al.*, 2015). The existence of hemoglobin in the erythrocytes allows for the ability to carry the oxygen, as well as causes the red color. Hemoglobin is a complex organic compound consisting of four red porphyrin pigments (heme), each containing an iron atom and globin which is a globular protein consisting of four amino acid chains (Frandson, 1992). The main function of hemoglobin in the body is to bind the oxygen in the lungs and then release the oxygen in peripheral tissue capillaries where the oxygen gas pressure is much lower than in the lungs. Oxygen is not bonded with the 2 positive bonds of iron in the hemoglobin molecule but is loosely bonded with one of the bonds called the iron coordination complex. This bond is very loose, so that the combination becomes very reversible. Furthermore, oxygen is transported to tissues not in the form of ions but in the form of molecules (consisting of 2 oxygen atoms) due to loosening and highly reversible bond (Guyton & Hall, 2006). With the presence of hemoglobin, blood can carry about 60 times more oxygen than water in the same amount and conditions (Frandson, 1992). Erythrocytes also contain large amounts of carbonic anhydrase, an enzyme that catalyzes the reversible reaction between carbon dioxide (CO2) and water (H2O) to form carbonic acid (H2CO3), which can increase the rate of this reaction several thousand times. This phenomenon allows the water in the blood to transport large quantities of CO2 in the form of carbonate (HCO3-) ions from tissues to the lungs. The ions are converted in the lungs and released into the atmosphere as a waste product of the body. Hemoglobin contained in cells is a good acid-base buffer (common in most proteins), so that erythrocytes are responsible for the acid-base buffer power of the blood (Guyton & Hall, 2006).

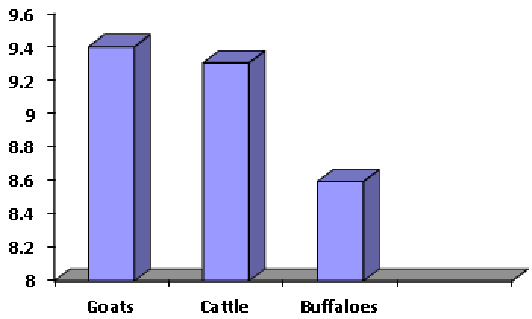

Figure 1. The number of goats, cattle and buffaloes erythrocyte (million/ɥl)

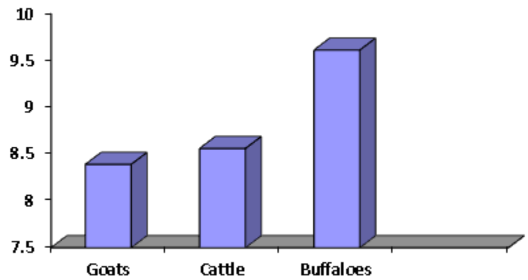

Figure 2. The levels of Hemoglobin in goats, cattle and buffaloes (g/dL)

The results of the leukocyte count showed no significant difference between the number of goat leucocytes (6.73 thousand / μL) and cattle's (6.79 thousand / μL), but they were significantly compared to the buffalo leukocytes (7.24 thousand / μL) (Figure 3). The results are in accordance with research by Calamari *et al*. (2011), which obtained 6.449 thousand / μL for cattle leukocytes. Leukocytes have an important role in immune defense. They are produced and matured in the bone marrow. The percentage of leukocyte counts in the blood is small and always fluctuates depending on the pressure and velocity of the blood flow (Kraft & Dürr, 2005; Krimer, 2011). Leukocytes work in two ways to prevent disease,the first is by completely destroying bacteria or viruses that invade through phagocytosis and the second is by forming sensitized antibodies and lymphocytes. One or both can destroy or make the infectious agent becomes inactive (Guyton & Hall, 2006). The main benefits of leukocytes are they can be transported specifically to infected areas or those with serious inflammation, thereby providing a rapid and robust defense against infectious agents. In general, haematological parameters highly fluctuate depending on the individual and other factors of race, species, age, gender, nutrition, altitude and weather (Weiss & Wardrop, 2010).

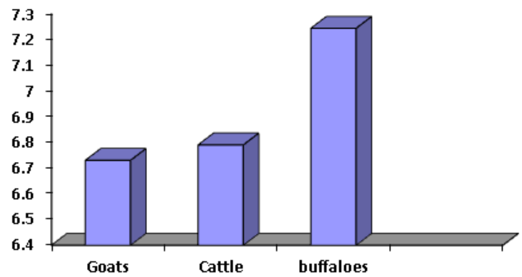

Figure 3. The number of goats, cattle and buffaloes leukocytes (thousand/ɥl)

The blood chemistry parameters analyzed were HDL and LDL cholesterol. Cholesterol forms Low Density Lipoprotein (LDL) emulsions, Very Low Density Lipoprotein (VLDL) and High Density Lipoprotein (HDL). The main benefits of cholesterol is to form membranes and colic acids in the liver. As much as 80% of cholesterol is converted to colic acid that serves to form bile salts to improve digestion and fat absorption. While, the small amount of cholesterol are used by the adrenal glands to form the adrenocortical hormone and also used by gonads (ovaries and testes) to form the progesterone, estrogen and testosterone hormone. Large amounts of cholesterol are deposited in the corneum layer of skin. The cholesterol can be along with other lipids making the skin more resistant to the absorption of water-soluble substances and also improve the work of various chemicals. Cholesterol and other skin lipids are highly inert against substances such as acids and various solvents that can penetrate into the body easily. These lipids also help preventing water evaporation from the skin; without this protection the amount of evaporation can reach 5 to 10 liters per day (as is the case in patients whose loses skin from burns) whereas the usual water loss is only 300 to 400 milli liters (Guyton & Hall, 2006). Cholesterol is needed by the animal body for various processes, but if cholesterol, especially LDL, rises above the normal limit it will lead to some diseases (Barret *et al.*, 2010). The results showed that the LDL level of cattle (107.12 mg / dL) was significantly different from the buffaloes' (88.52 mg / dL) (Figure 4). Low density lipoprotein (LDL) is a lipoprotein with high cholesterol content. It can be inferred that catle have a high level of LDL in the blood, allegedly also have a high cholesterol content in the meat. The lowest HDL level was found in cattle (39, 84 mg / dL), which is significantly different compared to HDL level in buffaloes at (46.58 mg / dL) (Figure 5). Other reports (Soedjana, 2011) suggested that cholesterol level in goat or lamb meat is lower (41 - 53 mg / 100 g) than beef (55 - 66 mg / 100 g). This fact provides a viewpoint that goat or lamb meat can serve as a source of food in which the nutrient content and benefits are the same or even more than the beef.

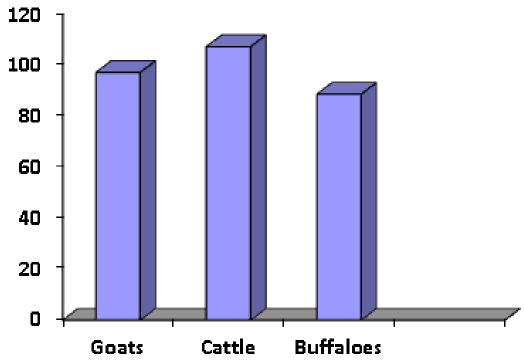

Figure 4. LDL cholesterol levels in goats, cattle and buffaloes (mg/dL)

Cholesterol is a fatty substance that circulates in the blood and is produced by the liver (Murray *et al.*, 2003). Cholesterol is an essential component of mammalian cell membranes. Cholesterol is the precursor of some other steroids (estrogens or estradiol, progesterone and corticosteroids such as cortisol or cortisone, aldosterone, and testosterone), vitamin D, and bile salts (Murray *et al.* 2003; Soeparno, 2011). Goat, cow and buffalo cholesterol levels are strongly influenced by the type of feed and its activity, in addition to species differences (large ruminants and small ruminants) (Oramari *et al.*, 2014). Several factors related to the cholesterol content of fresh meat and cooked meat are the carcass parts, preparation methods (dry heat or moist heat), carcass or meat grade, meat types (red meat versus white meat), species, race and age of livestock, marbling content, and also the slaughter age (Soeparno, 2011). HDL cholesterol is a parameter used as an indicator of animal health, the higher the HDL level the higher the level of health. On the contrary, the lower the HDL level, the level of health will get worse (Barret *et al.*, 2010). HDL is also known as a good cholesterol (Fogelman, 2004).

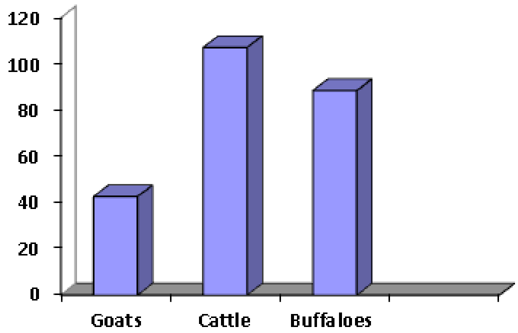

Figure 5. HDL cholesterol levels in goats, cattle and buffaloes (mg/dL)

The results of hematological and blood chemistry analysis may be helpful in the diagnosis, monitoring and prognosis of the disease. In livestock, changes in hematological or blood chemistry condition may not be as obvious as in other species even during severe disease. Therefore, the diagnosis or prognosis should not be taken only based on hematological or blood chemistry analysis but should also from clinical examinations or other diagnostic procedures (Roland *et al.*, 2014).

CONCLUSION

Buffalo is a large ruminant that has a better level of health than cattle, while goat is a small ruminant with the equivalent level of health compared to the buffalo.

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