The Hematological and Blood Chemical Parameters of the Female Fat Tail Sheep Raised with Fermented Complete Feed Management

Sarmin*, Amelia Hana, Pudji Astuti, and Claude Mona Airin

Department of Physiology, Faculty of Veterinary Medicine, Universitas Gadjah Mada, Yogyakarta, 55281, Indonesia

ABSTRACT

The study aimed at evaluating the hematological and chemical parameters of the blood of female fat tail sheep raised with fermented complete feed (CF) management. It used 40 adult female fat tail sheep age 24-36 months and body weight in 30-35 kg and 3-4 of body condition score, which was raised in the individual stall with fermented complete feed (CF) management. Samples of blood were drawn once from the jugular vein before feeding in the morning. The results of hematological parameters were RBC (12.1±2.18 x10⁶/µL), hemoglobin (12.4±1.96 g/dL), hematocrit (36.49±5.47%), MCV (30.46±3.38 fl), MCH (10.30±0.75 pg), MCHC (34.00±1.86 g/dL), eosinophils (3.15±7.70%), neutrophils (7.13±14.90%), lymphocytes (11.93±23.85%), and monocytes (0.30±0.88%). The results of chemical parameters were sodium (147.58±3.75 mmol/L), chloride (106.51±3.12 mmol/L), magnesium (3.66±1.38 mg/dL), albumin (3.36±0.31 g/dL) and glucose (40.28±9.12 mg/dL). The results of hematological and chemical parameters in the study could be the reference in monitoring the health of the adult female fat tail sheep raised with the fermented complete feed (CF) management.

Keywords: Blood chemistry, Female fat tail sheep, Fermented complete feed, Hematology

Introduction

Fat tail sheep are Indonesian endemic sheep with huge potential (Udo and Budisatria, 2011) of being meat-producing animals (Mulyono et al., 2009). It is necessary in breeding the sheep to establish a standard reference for their health status. Blood profile is the most important information in establishing an animal's health status, nutrition status, the diagnosis and the prognosis of metabolic disorders, and monitoring the medical treatment progress of the animal (Beigh et al., 2018). The determinant factor of blood profile variation is feed (Ghani et al., 2016), while the determinant factor of the success in animal breeding is also feed (Hastuti et al., 2011). It is necessary to innovative make use of local feed to solve the problem of limited feed. A balanced ratio of green forage and concentrate can shorten eating and ruminating time and also prolong the resting time of ruminants (Beigh et al., 2016). Fermented complete feed (CF) management can be an alternative in supplying quality local feed for a long period (Suwignyo et al., 2016). It is the best choice among the existing conventional methods in optimally making use of local agricultural feed source and in increasing animal’s productivity at minimal cost and energy (Beigh et al., 2016). It is proven that fermented CF management can replace the role of fresh forage commercial concentrate (Zakaria et al., 2015) increase the weight gain of female Ettawa goats and help animal breeders warrant the availability of feed-in dry season (Pakpahan and Restiani, 2019).

The application of CF-based fed Bajra straw by (Dhuria et al., 2010), mustard straw by Dhuria et al. (2011a), gram straw by Dhuria et al. (2011b), does not change the hematological and chemical levels of sheep. The best VFA production is found in the CF containing the stump of the Batu banana (Aswandi et al., 2012). The complete feed with liquid cow rumen microbial bio activator results in high digestibility of dry matter and organic matter and increases the consumption of nutrients and the performance of Bilongan goats (Munawaroh et al., 2015). The fermented CF of Bababusu palm gives a positive nitrogen balance and improves the stability of rumen pH and N-NH3 in goats (Moreira et al., 2016). The fermented CF with urea and EM-4 addition can increase consumption, digestibility, and body weight in Pampangan water buffalo (Riswandi et al., 2014). The application of CF is reported to increase service per conception and milk production in cows (Susilowati et al., 2020). It is reported that CF does not change the
hematology of Sahiwal cows (Kumar et al., 2013) and lambs (Tripathi et al., 2014), glucose, and protein in Barbari goats (Samanta et al., 2003). Fermented amfoer oil palm waste-based CF does not change the hematology of goats (Maululu et al., 2012). The use of CF in fat tail sheep breeding to increase meat production is very urgent, while there have not been any blood parameters of female fat tail sheep in fermented CF management. Therefore, the study aims at evaluating the hematological and chemical profile of the blood of female fat tail sheep in fermented CF management.

Materials and Methods

The location and the animals of study

The study was conducted at the sheep husbandry in Kepuh Kulon, Wirokerten, Banguntapan, Bantul, the Special Region of Yogyakarta (7.85°S 110.40°E) with an average elevation of 63 m. The animals used in the study were 40 female adult fat tail sheep of 2-4 years of age and 30-35 kg of body weight from Kediri, East Java.

The composition of feed and fermentation

The Fermented CF used in the study was obtained from Klaten district of Central Java province, consisting of ground corn (10%), pollard (10%), ground soybeans (15%), fat concentrate A (10%), ground corn cobs (40%) with the total weight of 400 kg. EM-4 microbial starter liquid (500 ml) was poured into 100 ml of water and 5 l of molasses were added and eventually stirred. And then, 400 kg of CF was added and eventually stirred. Subsequently, it was fermented in a closed feed container (anaerobic) for 3 days. It was harvested on day 3 and given to sheep. Each sheep got 0.8 kg-1 kg.

The composition of feed and fermentation

Blood samples were drawn from all of the sheep in the study after 120 days in fermented CF management. The blood was drawn before feeding in the morning on the jugular vein using a disposable syringe. Ten ml of the samples were divided into 5 ml and put into a vacutainer (Vaculab® Onemed) containing 0.05 mL of ethylenediaminetetraacetic acid (EDTA) for hematological examination. The BC-2800Vet auto hematology analyzer (RRC) was used to analyze the samples, including red blood cells, hematocrit, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), eosinophils, neutrophils, lymphocyte, and monocyte. The remaining 5 ml was put into a plain vacutainer (PT. Jayamas Medica Industri, Sidoarjo, Indonesia) and then centrifuged at 3,000 rpm for 10 minutes and the resulting serum was kept at -20°C for blood chemical analysis. Blood chemical analysis included sodium, potassium, chloride, magnesium, albumin, triglycerides, and glucose. The analysis was made using the analysis kit supplied by Roche Diagnostics in Roche/Hitachi Cobas C systems Cobas C 502 analyzers (Japan).

Data analysis

The hematological and chemical data of the blood were presented in mean and standard deviation and then compared to the textbook normal value.

Results and Discussion

The results of the physical and clinical examination of all of the sheep showed that the sheep were healthy during the study with a body condition score of 3-4. The hematological parameters of the female fat tail sheep were summarized in Table 1. The RBC level of the sheep in the study was 12.11±2.18 (x10⁶/µL), which was still in the normal limit according to the textbook (Byers and Kramer, 2010) that was 9.00-15.00 x10⁶/µL. It was consistent with the study of the sheep with CF supplementation in Exogenous Fibrinolytic Enzymes Cocktail (Beigh et al., 2018). The hemoglobin parameter of the sheep in the study were 12.40±1.96 (g/dL), which was consistent with the textbook was 9.00-15.00 g/dL (Byers and Kramer; 2010) and it was corroborated by Anbarasu et al.(2002) who conducted a study of the sheep with the basal feed of wheat straw (10.50 to 11.62 g/dL). The hemoglobin parameter in the study was higher than that found in Garut sheep with the feed made of 40% sprout waste and 60% concentrate at the level of 6.53±0.27 g/dL (Atik, 2015) and that found in Merinolandschaf sheep raise in an organic farm at the level of 9.26 g/dL (Antunović et al., 2017). The

| Parameters       | Mean        | Textbook    |
|------------------|-------------|-------------|
| RBC (10⁶/µL)     | 12.11±2.18  | 9.00-15.00* |
| Hb (g/dL)        | 12.40±1.96  | 9.00-15.00* |
| Hematocrite (%)  | 36.49±5.47  | 27.00-45.00** |
| MCV (fl)         | 30.46±3.38  | 28.00-40.00* |
| MCH (pg)         | 10.30±0.75  | 8.00-12.00* |
| MCHC (g/dL)      | 34.00±1.86  | 31.00-34.00* |
| Eosinophil (%)   | 3.15±7.70   | 0.00-10.00* |
| Neutrophil (%)   | 7.13±14.90  | 10.00-50.00* |
| Lymphocyte (%)   | 11.93±23.85 | 40.00-55.00* |
| Monocyte (%)     | 0.30±0.88   | 0.00-5.00*  |

* Byers and Kramer, 2010.
** Radostits et al., 2000.

Table 1. Hematology of female fat tailed sheep
normal hemoglobin parameter of the study was consistent with the study of the sheep fed with the Bajra straw-based CF block by Dhuria and Sharma (2010). The percentage of the hematocrit parameter of the sheep found in the study was 36.49±5.47%, which was normal according to textbooks that were 27.00-45.00% (Radostits et al., 2000) and consistent with the study of the sheep with the treatment of ammoniated and fermented (Amofer) CF by Mayulu et al.(2012), which was 33.75±0.96%. The treatment of CF resulted in normal hematocrit and it was consistent with the study of Marga sheep with Bajra straw-based CF by Dhuria and Sharma (2010) and the study of Marga sheep with gram straw-based CF by Dhuria et al.(2011)

The MCV parameter of the sheep in the study was 30.46±3.38 fl that was considered to be in the normal limit of the textbook parameter (Byers and Kramer, 2010) at level 28.00-40.00 fl and consistent with the MCV of the sheep reported by Saeed et al.(2019), which was at the level of 29.40±0.33 fl and also the MCV of the sheep with the CF supplemented with Exogenous Fibrinolytic Enzymes Cocktail, which was at the level of 27.00±0.25 fl (Beigh et al., 2018). The normal MCV parameter of the sheep in the study was consistent with the study of the sheep fed with Moringa oleifera leaf meal by (Jiwuba et al., 2016).

The MCH parameter found in the study was 10.30±0.75 pg considered to be in the normal limit according to textbooks (Byers and Kramer, 2010), which was at the level of 8.00-12.00 pg and consistent with the study of the sheep fed with Moringa oleifera leaf meal by (Jiwuba et al., 2016) and with the study of the sheep fed with the CF supplemented with Exogenous Fibrinolytic Enzymes Cocktail by (Beigh et al., 2018) at 8.93±0.09 pg.

The MCHC parameter found in the study was at the level of 34.00±1.86 g/dL and in the normal limit according to textbooks (Byers and Kramer, 2010) that was at the level of 31.00-34.00 g/dL. It was also consistent with the MCHC parameter of the sheep fed with the CF supplemented with Exogenous Fibrinolytic Enzymes Cocktail, which was at the level of 34.06±0.45% (Beigh et al., 2018) and with the MCHC level of the sheep reported by Saeed et al. (2019), which was at the level of 36.30±0.17 g/dL. The normal MCV, MCH, and MCHC levels of the fat tail sheep in the study showed that there was not any anemia indication in the sheep (Jiwuba et al., 2016) and Soul et al. (2019).

The eosinophils percentage parameter was considered to be in the normal limit according to the textbook parameter (Byers and Kramer, 2010), which was at the level of 0.00-10.00%. The eosinophils in the normal limit have been reported in the sheep fed with the CF supplemented with Exogenous Fibrinolytic Enzymes Cocktail (Beigh et al., 2018), in the free weaned sheep with the treatment of Katuk (Saurops androgynous) flour (Putranto et al., 2014), and the sheep fed with sericea lespedeza (Acharya et al., 2015).

The resulting parameter of the neutrophils percentage in the study was 7.13±14.90% considered to be in the normal limit according to the textbook parameter (Byers and Kramer, 2010), which was at the level of 10.00-50.00%, indicating that the sheep were not being infected by any pathogenic organism because neutrophils played an important role in phagocytosis and eliminated microorganism in the body (da Silva et al., 2015). The normal neutrophil level was also reported in the sheep fed with the CF supplemented with Exogenous Fibrinolytic Enzymes Cocktail (Beigh et al., 2018) and in the free weaned sheep with the treatment of Katuk flour (Putranto et al., 2014).

The resulting parameter of the lymphocyte in the study was 11.93±23.85% that was lower than the normal limit of the textbook parameter (Byers and Kramer, 2010), which was at the level of 40.00-55.00%. It has been reported that the lymphocyte parameter decreased in the goat kids with the treatment of 3% alfalfa protein-xanthophyll concentrate (Szymanowski et al., 2017) and in females pre-weaning Kacang sheep with the treatment of Katuk flour supplement (Putranto et al., 2014). Lymphocytes level was the key in sheep immunity system (Pradhan, 2016). The low lymphocytes level was indicative of the decrease in cellular immunity (Saki et al., 2018) and it might have related to the protein content of feed in addition to other possible environmental stressing factors (Acharya et al., 2015). It has been reported that lymphocyte increased in West African dwarf sheep with the treatment of Saccharomyces cerevisiae supplementation (Osita et al., 2018). Also, the report by da Silva et al. (2015) that lymphocyte did not change in the sheep with the treatment of propolis extract and sodium monensin. The resulting percentage level in the study was 0.33±0.18% considered to be in the normal limit of the textbook parameter (Byers and Kramer, 2010), which was at the level of 0.00-5.00%. The resulting monocyte in the study was lower than that found in the sheep fed with Ziziphus mucronata and Parkia biglobosa, which was at the level of 5.00 to 9.00% (Wada et al., 2014). Osita et al. (2018) also reported normal monocyte levels in the sheep fed with the feed fortified with Saccharomyces cerevisiae yeast and in the sheep fed with the CF supplemented with Exogenous Fibrinolytic Enzymes Cocktail (Beigh et al., 2018).

The chemical parameters of the blood of the female fat tail sheep were summarized in Table 2. The resulting sodium parameter in the study was 147.58±3.75 mmol/L considered in the normal limit of the textbook parameter (Radostits et al., 2000), which was at the level of 139.00-152.00 mmol/L. It was consistent with the sodium level of the sheep fed with Ziziphus mucronata and Parkia biglobosa, which was at the level of 130 to 173 mmol/L. However, it was higher than Table 2.
The mean sodium level of the sheep fed with *Ziziphus mucronata* (Wada et al., 2014). The normal sodium parameter was consistent with the study of the sheep fed with different feeds such as grass, grass mixture, and leguminous diets (Osita et al., 2018). The resulting potassium parameter in the study was 5.16±0.59 mmol/L considered to be in the normal limit of the textbook parameter (Radostits et al., 2000), which was at the level of 3.90-5.40 mmol/L. It was also consistent with the potassium level of the sheep fed with *Ziziphus mucronata* or Parkia biglobosa, which was at the level of 3.90 to 5.50 mmol/L (Wada et al., 2014). The normal potassium level was also reported in the male sheep fed with yeast-fortified feed (Shehu et al., 2014) and also in the sheep fed with different feeds such as grass, grass mixture, and leguminous diets (Osita et al., 2018). Chloride parameter represented homeostasis indicator (Piccione et al., 2012). The resulting chloride parameter in the study was 106.51±3.12 mmol/L considered to be in the normal limit of the textbook parameter (Radostits et al., 2000), which was at the level of 95.00-103.00 mmol/L. It was also consistent with the chloride parameter of the sheep fed with *Ziziphus mucronata* or Parkia biglobosa, which was at the level of 95.00-128.00 mmol/L (Wada et al., 2014). The resulting magnesium parameter in the study was 3.66±1.38 mg/dL. The lowest magnesium level was still in the normal limit of the textbook parameter (Radostits et al., 2000), which was at the level of 0.30-2.80 mg/dL. The variation of the magnesium levels was influenced by the difference in feeds (Mohammed et al., 2017).

The resulting albumin parameter in the study was 3.36±0.31 g/dL. It was higher than the textbook albumin parameter (Radostits et al., 2000), which was at the level of 2.40-3.00 g/dL. It was consistent with the study of the sheep by Anbarasu et al. (2002), which was 3.30 0.11 g/dL and also with the study of the sheep fed with the CF supplemented with Exogenous Fibrinolytic Enzymes Cocktail by Beigh et al. (2018), which was at the level of 3.57 0.05 g/dL. Normal albumin parameter was also reported in the sheep fed with the CF with a supplement (Anbarasu et al., 2002). It was reported that albumin increased in the sheep fed with grass (Osita et al., 2019) and in the growing sheep with the treatment of the supplementation of *S. cerevisiae* supplementation yeast culture (Rahman et al., 2012). However, there were also studies suggesting that albumin was not influenced by feeds (Eldaw and Ahmed, 2016).

The resulting triglyceride parameter in the study was 28.28±14.56 mg/dL considered to be in the normal range according to textbooks 8.85-36.28 mg/dL (Radostits et al., 2002), was consistent with the triglyceride level of the sheep fed with the CF supplemented with exogenous fibrinolytic enzymes cocktail (Beigh et al., 2018), which was at the level of 32.63±0.59 mg/dL. It was lower than the triglyceride level of the sheep reported by Saeed et al. (2019), which was at the level of 23.59±1.16 mg/dL. The research showing that the sheep fed with the CF had a normal triglyceride level was consistent with the study by Beigh et al. (2018).

The resulting glucose parameter in the study was 40.28±9.12 mg/dL and consistent with the textbook (Radostits et al., 2002), which was at the level of 50.0-80.00 mg/dL. It was corroborated by the study of the sheep with the treatment of supplementary feed by Anbarasu et al. (2002), which ranged from 45.42 to 49.08 mg/dL. It was also consistent with the study of the glucose level of the sheep fed with the CF supplemented with exogenous fibrinolytic enzymes (Beigh et al., 2018), which was pada level 48.70± 0.64 mg/dL and also with the glucose level of the sheep fed with fresh *L. arrecta* plus concentrate (85/15), which was at the level of 38.50 mg/dL (Ginting et al., 2011). However, it was lower than the glucose level of Barbari sheep fed with the CF for 3 weeks, which was 53.59±0.85 mg/dL (Samanta et al., 2003). The normal glucose level of the sheep fed with the CF was also consistent with the studies by Dhuria and Sharma (2010) and Beigh et al. (2018).

**Conclusions**

The hematological and chemical parameters of the blood of the female fat tail sheep could be the reference in monitoring the health of the adult fat tail sheep in fermented complete feed management.

**Acknowledgment**

The study was financed using BPPTN-BH grant of the research incentive scheme for lecturers in 2016 on the contract of the implementation of the study No. 1705/J01.1.1.22/HK4/2016 dated May 2nd, 2016. I would like therefore to thank the Dean of the Faculty of Veterinary Medicine of Universitas Gadjah Mada for the financing.
References

Acharya, M., J. M. Burke, K. P. Coffey, E. B. Kegley, J. E. Miller, G. R. Huff, E. Smyth, T. H. Terrill, J. A. Mosjidis, and C. Rosenkrans. 2015. Changes in hematometry, serum biochemistry, and gastrointestinal nematode infection in lambs fed sericea lespedeza with or without dietary sodium molybdate.I. J. Anim. Sci. 93: 1952–1961. https://doi.org/10.2527/jas.2014-8584

Anbarasu, C., N. Dutta, K. Sharma, and U. Naulia. 2002. Blood biochemical profile and rumen fermentation pattern of goats fed leaf meal mixture or conventional cakes as dietary protein supplements. Asian-Aust. J. Anim. Sci. 15: 665–670. https://doi.org/10.5713/ajas.2002.665

Antunović, Z. J. Novoselec, Ž. Klir. 2017. Poljoprivreda.23:46–52.

Aswandi, C. I. Sutrisno, M. Arifin, and A. Joelal. 2012. Efek complete feed bongol berbagai varietas tanaman pisang terhadap pH, NH3 dan VFA pada kambing Kacang. Jurnal Ilmu dan Teknologi Peternakan, 2: 99–109.

Atik. 2015. Respon fisiofisik, tingkah laku, dan hematologi domba Garut dan Jonggol jantan dengan pemberian limbah tauge pada sore hari. Thesis. Sekolah Pascasarjana Institut Pertanian Bogor.

Beigh, Y. A., A. M. Ganai, and H. A. Ahmad. 2016. Prospects of complete feed system in ruminant feeding: A review. Veterinary World, 10: 424-437. https://doi.org/10.14202/vetworld.2017.424-437

Beigh, Y. A., A. M. Ganai, H. A. Ahmad, D. M. Mir, M. A. Bhat, and S. Muzamil. 2018. Blood metabolic profile of lambs fed complete diet supplemented with exogenous fibrolytic enzymes cocktail. J. Anim. Health Prod. 6: 96-101 https://doi.org/10.17582/journal.jahp/2018/6.4.96.102

Byers, S. R. and W. Kramer. 2010. Normal Hematology of Sheep and Goats. In: Schalm’s veterinary Hematology editors Douglas J Weiss, K Jane Wardrop. Wiley Blackwell, p. 836–842.

Dhuria, R. K. and T. Sharma. 2010. Rumen and haemato-biochemical parameters in sheep fed on Bajra straw based complete feed block. Veterinary Practitioner 11: 1–4.

Dhuria, R. K., T. Sharma and D. D. Garg. 2011a. Mustard straw based complete feed blocks for lambs. Indian Vet. J. 11: 47–49.

Dhuria, R. K., T. Sharma, and G. R. Purohit. 2011b. Effect of densification of gram straw based complete feed on rumen and haemato biochemical parameters in Magra lambs. Anim. Feed Sci. Tech.11:133–140.

Eldaw, M., S.H. Ahmed, S. A. Omer. 2016. Effect of feeding graded levels of Prospis juliflora (MESKIT) pods on some hematological and biochemical parameters of Sudanese Nubian goats kids. Int. J. Sci. Technol. 4: 127–132.

Ghani, A. A. A., M. S. Shahudin, M. Z. Saad, A. B., Zuki, H. Wahid, A. Kasim, M. S. Salisi, A. Hafandi, H. Hamzah, N. H. A. Daud, and H. A. Hassim. 2016. Feed formulation based on local feed resources and its effects on nutritional-related blood profile in breeder goats. Proceedings of International Seminar on Livestock Production and Veterinary Technology, 276–283. https://doi.org/10.14334/Proc.Intsem.LPVT -2016-p.276-283

Ginting, S. P., A. Tarigan, and R. Krisnan. 2011. Konsumsi fermentasi rumen dan metabolit darah kambing sedang tumbuh yang diberi silase I. arrecta dalam pakan komplit. Jurnal Ilmu dan Teknologi Peternakan 17: 49–58.

Hastuti, D., S. N. Awami, and B. I. M. Tampoebolon. 2011. Pengaruh perlakuan teknologi amofer (amoniafer fermentasi) pada limbah tongkol jagung sebagai alternatif pakan berkualitas ternak ruminansia. Medilago 7: 55–65.

Jiwuba, P. D., C., F. O. Ahamefule, O. S. Okechukwu, and K. Ikwunze. 2016. Feed intake, body weight changes and haematology of West African dwarf goats fed dietary levels of Morina oleifera leaf meal. Agricultura 13: 71–77. https://doi.org/10.1515/agricultura-2017-0009

Kumar, D., C. Datt, L. Das, and S. S. Kundu. 2013. Effect of different dietary protein levels on feed intake and blood parameters profile in growing Sahiwal calves. Indian J. Anim. Nutr. 30: 370–373.

Mayulu, H., Sunarso, C.I. Sutrisno dan Sumarsono. 2012. Profil darah kambing yang diberi CF amofer. Jurnal Ilmu dan Teknologi Peternakan. 2:10–19.

Mohammed, A., A. Khan, I.S. Pargass, B. Puran, A.E. Edwards, H.S. Stewart, F.G. Youssef, S. Sieuchand. 2017. Serum mineral levels in goats of various physiological stages in serum mineral levels in goats of various physiological stages in the dry and wet seasons in Central Trinidad. Mirovyejvstvo V Medvedive. 18: 17–27. https://doi.org/10.19112/2413-6174-2017-18-2-17-27.

Moreira, A.L., A.A. Alves, M.A.M. Filho, D.C. da Silva, B.S. Garcez, V.R.Vasconcelos. 2016. Ammoniated babassu palm hay in anglo-nubian goat diets. Ciênc. Agrotec. 40: 688–697. https://doi.org/10.1590/1413-70542016406010316.

Mulyono, R. H., A. Gunawan, and C. Sumantri. 2009. Characteristics of size and shape of body dimension of Madura and Rote (Indonesia) fat-tailed sheep using principal
component analysis. The 1st International Seminar on Animal Industry, Faculty of Animal Science, Bogor Agricultural University, pp 253–258.

Munawarah, L. L., I. G. S. Budisatria, and B. Suwignyo. 2015. Pengaruh pemberian fermentasi complete feed berbasis pakan lokal terhadap konsumsi, konversi pakan, dan feed cost kambing Blagon jantan. Buletin Peternakan 39: 167. https://doi.org/10.21059/buletinpeternak.v39i3.7984

Osita, C. O., A.O. Ani, C. Ezema, C. E. Oyeagu, I. E. Uzochukwu, and I. E. Ezemagu. 2018. Hematological and biochemical Indices of West African Dwarf Sheep fed diets containing yeast (Saccharomyces cerevisiae), grass, grass/legume (50:50) and legume. Pak. J. Nutr. 16: 34–41. https://doi.org/10.3923/pjn.2019.34.41

Pakpahan, S. and R. Restiani. 2019. The effect of fermented complete feed based on local feed resources on weight gain of female Peranakan Etawah goats in Samigaluh Subdistrict. Proceedings of the 2nd International Conference on Bioscience, Biotechnology, and Biometrics. AIP Conf. Proc 2199: 050009-1-050009.

Putranto, H. D., Nurmeliasari, S. M. Ginting, Y. Yumiati, and A. Zueni. 2012. Seasonal variations of some serum electrolyte concentrations in sheep and goats. Comp. Clin. Path. 21: 911–915. https://doi.org/10.1007/s00580-011-1198-3

Radosits, O. M., D. C. Blood and C. C. Gay. 2002. Veterinary Medicine: A Textbook of the Diseases of Cattle, Sheep, Pigs, Goats and Horses. 8th edn. Bailliere Tindall, London. p. 1819–1822

Rahman, H.A., G.A. Baraghit, A.A. Abu El-Ella, S.S. Omar, F.F. Abbo Ammo and O.F. Kommona. 2012. Physiological responses of sheep to diet supplementation with yeast culture. Egypt. J. Sheep Goat Sci. 7: 27-38.

Riswandi, A.I.M. Ali, S. Sandi and Muakka. 2014. Application of Ammoniation-fermentation Technology based on Palm Plantation Waste for Increasing Productivity of Pampangan Buffalo. APCBEE Procedia. 8:93–98. http://dx.doi.org/10.1016/j.apcbee.2014.03.007

Saeed, O.A, A.Q. Sazili, H. Akit, A.R .Alimon, A.A. Samsudin. 2019. Effects of Corn Supplementation into PKC- Urea Treated Rice Straw Basal Diet on Hematological, Biochemical Indices and Serum Mineral Level in Lambs. Animals. 91-13.

Saki, A. A., V. Khoramabadi, A. R. Nourian, and P. Zamani. 2018. Immune response, blood parameters and growth performance in broiler fed reduced protein diet supplemented with β-hydroxy-β-methyl butyrate and conjugated linoleic acid. Acta Scientiarum. Anim. Sci. 40:1-6 https://doi.org/10.4025/actasciansci.v40i1.38000

Samanta, A. K., K. K. Singh, M. M. Das, S. B. Maity and S. S. Kundu. 2003. Effect of complete feed block on nutrient utilisation and rumen fermentation in Barbari goats. Small Rumin. Res. 48: 95–102. https://doi.org/10.1016/S0921-4488(02)00262-6

Shehu, B. M., J. O. Ayo, B. A. Ayanwale, E. Z. Jiya, and D.N. Tsado. 2014. Growth performance and nutrient digestibility of weaned rabbits fed diets supplemented with varying levels of baker's yeast (Saccharomyces cerevisiae). Int. J. Agri. Rural Dev. 17 : 1619–1627.

Soul, W., J. Mupangwa, V. Muchenje and T. C. Mpendulo. 2019. Biochemical indices and hematological parameters of goats fed lablab purpureus and vigna unguiculata as supplements to a chloris gayana basal diet. Vet. Anim. Sci. 8: 109. https://doi.org/10.1016/j.vas.2019.100073

Susilowati, S., W. Wurlina, S. Mulyati, S. Utama, and D. K. Meles. 2020. Pemberian silase, complete feed, dan growth promoter pada sapi perah kawin berulang terhadap Services per Conception dan produksi susu. Ovozoa 9: 28–34.

Suwignyo, B. A. Agus, R. Uomo, N. Umami, B. Suhartanto and C. Wulandari. 2016. Penggunaan fermentasi pakan komplet berbasis hijauan pakan dan jerami untuk pakan ruminan. Jurnal Pengabdian kepada Masyarakat (Indonesian Journal of Community Engagement) 1: 255–263. https://doi.org/10.22146/jpkm.10611

Szymanowisk, A., T. M. Gruszczek and A. Miduch. 2017. Blood metabolic profile of goat kids fed a diet supplemented with alfalfa protein-xanthophyll (PX) concentrate during rearing with their dams. Scientific Annals of Polish Society of Animal Production 13: 21–30.

Tripathi, P., T. K. Dutta, M. K. Tripathi, U. B. Chaudhary and R. Kumar. 2014. Preparation of complete feed pellet from monsoon herbage (Dactylotennum aegypticum, Cenchrus ciliaris and Tephreria purpurea) and its utilisation in kids. Indian J. Anim. Nutr. 20. 31–36.

Udo, H. M. J. and I. G. S. Budisatria. 2011. Fat-tailed sheep in Indonesia; an essential resource for smallholders. Trop. Anim.
Sarmin et al. The Hematological and Chemical Parameters of the Blood of Female Fat Tail Sheep

Health Prod. 43: 1411–1418. https://doi.org/10.1007/s11250-011-9872-7

Wada, N. I., A. A. Njidda, M. Adamu and C. I. Chibuogwu. 2014. Variation in haematological and serum biochemical indices of sheep fed *Ziziphus mucronata* and *Parkia biglobosa* (A comparative study). Global J. Biol. Agric. Health Sci. 3: 39–47.

Zakaria, Y., Yurliasni, and C. I. Novita. 2015. Study on complete feed fermentation of agricultural by-product on performance of Etawah Goat. Integrated Approach in Developing Sustainable Tropical Animal Production. The 6th International Seminar on Tropical Animal Production, Yogyakarta.