RESEARCH ARTICLE
AGROBIOLOGICAL RECORDS
ISSN: 2708-7182 (Print); ISSN: 2708-7190 (Online)
Open Access Journal

EFFECTS OF MULTI-NUTRIENT BLOCK SUPPLEMENT ON THE BLOOD HEMATOLOGY GRAZING FEMALE KACANG GOATS

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ABSTRACT

The experiment aims to determine the effect of a multi-nutrient block supplement on the blood hematology of grazing female Kacang goats. The experiment was conducted from September to November 2023 on grassland in Wunga Village, Haharu District, East Sumba Regency. Nine Kacang goats were used in the study with an average body weight of 18.78±1.65kg. The experiment employed a completely randomized design (CRD) with 3 treatments and 3 replications as follows: P0: goats grazed without multi-nutrient block supplement, P1: goats grazed + 50g multi-nutrient block/head/day, P2: goats grazed + 100g multi-nutrient block/head/day. The observed variables included blood urea, blood glucose, total plasma protein, hemoglobin, packed cell volume (PCV), erythrocytes, and leukocytes. The results showed that multi-nutrient block supplementation had no effect on the blood hematology of Kacang goats raised on grassland. In conclusion, different levels of multi-nutrient block supplements had a relatively similar and normal effect on the blood hematology of female Kacang goats.

Keywords: Blood hematology, Kacang goat, multi-nutrient block, Grassland

Article History (ABR-24-271) || Received: 08-Oct-2024 || Revised: 27-Oct-2024 || Accepted: 31-Oct-2024 || Published Online: 06-Nov-2024

1. INTRODUCTION

Livestock feed for goats raised grassland typically consists of forage such as native grasses and legumes. These forage, both native grasses and legumes, commonly have low mineral and protein content and high fiber content. Poor forage quality results in low digestibility, which can lead to decreased body weight, reduced immune function or health, and lower livestock production and reproduction performance. Native grasses generally have low nutrient content, with crude protein ranging from 3-5% and crude fiber from 40-50%, as well as dry matter digestibility of 30-35% and organic matter digestibility of 28-33% (Hambakodu 2021). Additional feed, such as multi-nutrient blocks, is necessary to address the nutritional deficiencies of forages. Multi-nutrient blocks provide essential macro-minerals needed for the physiological processes of livestock, especially goats that rely almost entirely on grazing.

Multi-nutrient blocks are supplements containing a comprehensive range of nutrients, particularly minerals, vitamins, and amino acids (Reshi et al. 2022a; Adekanbi et al. 2023; Audu et al. 2024). The multi-nutrient blocks used in this context are enriched with leaf meals, including *Gamal* (*Gliricidia sepium*) and *warm* (*Hibiscus Tiliaceus*) leaf meals. *Gamal* leaf meal is used to supply protein needs derived from legumes, while *Waru* leaf meal acts as a defaunation agent for rumen microbes to suppress the growth of rumen protozoa (Armayanti et al. 2015). This multi-nutrient block contains ingredients such as palm sugar, sorghum bran, urea, salt, and mineral mix. Palm sugar serves as a source of soluble carbohydrates. As a binder and flavor enhancer, sorghum bran provides energy for microbes, urea is a non-protein nitrogen (NPN) source, salt enhances flavor, and the mineral mix supplies essential minerals.

One indicator of the successful use of multi-nutrient blocks is a favorable blood profile in livestock, particularly Kacang goats. Feed efficiency is reflected in the physiological condition of the goat, as indicated by blood hematology (Saeed et al. 2023; Zarkawi and Soukouti 2024). Supplementation with multi-nutrient blocks can enhance goat growth (Dhuha et al. 2021; Reshi et al. 2022b), increase weight (Sankar et al. 2021; Irsyad et al. 2023; Putri et al. 2024), improve ruminant performance (Wadhwa and Bakshi 2014; Worku et al. 2024; Uniyal et al. 2024) and meet mineral requirements (Sari et al. 2020). However, there is still limited data on the blood hematology picture of goats fed with multi-nutrient blocks. Therefore, it is necessary to study the effect of multi-nutrient block supplementation on the hematological profile of grazing goats in grassland.

Citation: Hambakodu M, Kiha AF and Ina YT, 2024. Effects of multi-nutrient block supplement on the blood hematology grazing female Kacang goats. Agrobiological Records 18: 54-60. https://doi.org/10.47278/journal.abr/2024.037

2. MATERIALS AND METHODS

2.1. Research Location and Time

The research was conducted from September to December 2023 in Wunga Village, Haharu Subdistrict, East Sumba Regency. It comprised one month for feed collection, two months for feed adjustment, and the data collection period. The study utilized 9 female Kacang goats, aged approximately 12 to 18 months, with an average body weight of 18.78±1.65kg and a coefficient of variation (CV) of 8.7%. The goats were housed in pens measuring 1.5×0.5m, equipped with feed and water troughs. The feed used included multi-nutrient blocks composed of sorghum bran, *Lamtoro* leaf meal, *Waru* leaf meal, urea, minerals, calcium carbonate (CaCO3), salt and palm sugar (Table 1). The basal diet consisted of native grasses available *ad libitum* in the grassland. We used native grass as control diet and Multi-nutrient block as experimental diet. Chemical composition of both are presented in Table 2. The study's equipment included a Henherr scale with a 40kg capacity and 1g precision for weighing goats and a Quantro digital scale with a 2kg capacity and 1g precision for weighing feed. Blood samples were collected using 10mL syringes and Venoject tubes as containers. Water was provided in 5-liter buckets, and additional feeding and watering equipment was used as needed.

Table 1: Composition of Multi-nutrient Block (MNB) Feed Ingredients

Ingredients	Composition (%)
Sorghum bran	25
Gliricidia Sepium leaf powder	12
Hibiscus tiliaceus leaf powder	4
Urea	8
Mineral	5
$CaCo_3$	8
Salt	3
Palm sugar	35
Total	100

Table 2: Chemical Composition of the Treatment Feed Gross Energy

Composition/Energy	Native grass	Multi-nutrient block
Dry Matter (%)	90.57	81.43
Organic Matter (%)	73.89	82.12
Crude Protein (%)	6.5	37.23
Crude Fat (%)	1.6	3.13
Crude Fiber (%)	23.06	3.85
CHO (%)	65.75	41.75
Nitrogen-free extract (%)	42.71	37.89
Gross Energy		
Mj/kg DM	16.78	13.32
Kkal/kg DM	4,041.18	4,123.25

Analysis result of Feed Chemistry Laboratory, Faculty of Animal Husbandry, Nusa Cendana University 2023.

2.2. Research Methods

The design employed was a completely randomized design (CRD) with 3 treatments and 3 replications, as follows:

P0: Kacang female goats were grazed throughout the day.
P1: P0 + Multi-nutrient Block 50g/goat/day.
P2: P0 + Multi-nutrient Block 100g/goat/day.

2.3. Implementation of the Research

2.3.1. Randomization of Livestock: The research goats were weighed to determine their initial body weight variation before initiating the randomization process. Subsequently, each goat was assigned a number or code. A random drawing was then conducted to assign goats to the different treatments.

2.3.2. Feed and Water Management: The feed provided consisted of native grasses from grassland and multi-nutrient feed blocks. Native grass was offered ad libitum while the animals were grazing. Water was provided ad libitum, and both the feed and water containers and the surrounding housing environment were monitored to ensure cleanliness.

2.3.3. Blood Collection Procedure: At the end of the study period, blood samples were collected via the jugular vein using a 14–16-gauge needle and a 3mL vacuum tube with an anticoagulant (purple top tube). Blood was collected once per goat. The blood samples were drawn in the morning before the goats were fed. The collected blood was stored in an ice chest and subsequently analyzed at the Laboratory of the Faculty of Animal Science, Nusa Cendana University.

2.4. Parameters Measured and Measurement Techniques

2.4.1. Hemoglobin: The principle of this method involves adding blood to a containing potassium cyanide and potassium ferricyanide. Ferricyanide converts the iron in the hemoglobin from a ferrous (Fe2+) to a ferric (Fe^{3+}) state, forming methemoglobin, then it reacts with potassium cyanide to form a stable pigment, cyanmethemoglobin (Dhuha et al. 2021).

2.4.2. Red Blood Cells (Erythrocytes): The erythrocyte count was performed using a Neubauer hemocytometer and a microscope with a 100× magnification. Five large squares were used to count erythrocytes in the hemocytometer, each subdivided into 27 smaller squares. The number of red blood cells in $1mm^3$ of blood was calculated using the formula provided by Dhuha et al. (2021):

Red blood cells = a × 10^4 cells

Where a is the number of red blood cells counted in 1 mm^3. According to Dhuha et al. (2021), the Mean Corpuscular Volume (MCV) and Mean Corpuscular Hemoglobin Concentration (MCHC) are calculated using the following formulas:

- MCV (fL) = Hematocrit / Σ erythrocytes × 10
- MCHC (%) = Hemoglobin / Σ erythrocytes × 10

***2.4.3. Packed Cell Volume*:** The packed cell volume (PCV) of the blood sample was determined by centrifugation at 3000rpm for 30min. Following centrifugation, the red blood cells and plasma separated. The heights of the red blood cells and plasma layers were measured and recorded to determine the PCV value (Dhuha et al. 2021)

2.4.4. White Blood Cells (Leukocytes): The leukocyte count was performed similarly to the erythrocyte count. Blood was diluted using a leukocyte pipette at a dilution factor of 200×. Each small square in the hemacytometer had an area of $1/400mm^2$ and the depth of the counting chamber was 1/10mm. Leukocytes were counted in 5 × 16 small squares, making the total counted area $80×1/400mm^2$ = $1/15mm^2$. The multiplication factor was calculated as 5×10×200 =10,000. Thus, the leukocyte count in the 5 squares was determined accordingly.

2.5. Data Analytics

Data were tabulated to calculate means and analyzed using analysis of variance (ANOVA) to determine the treatments' effects on the studied variables. If significant effects were detected, post hoc analysis was conducted using Duncan's multiple range test with SAS software.

3. RESULTS AND DISCUSSION

3.1. Hematological profile of Kacang Goat Blood

Blood is a fluid within the blood vessels that circulates throughout the body, from the heart and back to the heart. Blood consists of plasma and blood cells, including erythrocytes, leukocytes and platelets, each performing distinct functions. Hematological observation of blood, or blood profiling, serves as an indicator for assessing the health of livestock and the impact of nutritional metabolism occurring within the livestock (Mohteshamuddin et al. 2020; Saravanan et al. 2020; Rahayu et al. 2023; Espiritu et al. 2024). The hematological profile of Kacang goats fed a multi-nutrient block supplement is shown in Table 3 and Fig. 1.

Table 3: Hematological Profile of Kacang Goat with feeding of multi-nutrient block supplement

Parameters	P0	P1	P2
Urea (mg/dL)	38.06±1.53	39.15±0.40	38.14±1.85
Glucose (mg/dL)	91.97±3.31	91.30±2.50	92.03±2.43
Total plasma protein (g/dL)	6.96±0.15	6.93±0.11	6.86±0.30
Hemoglobin (g/dL)	10.11±0.27	10.00±0.17	10.08±0.60
Packed cell volume (%)	30.32±0.81	30.00±0.51	30.26±1.81

P0: Control; P1: MnB 50 g/goat/day; P2: MnB: 100 g/goat/day

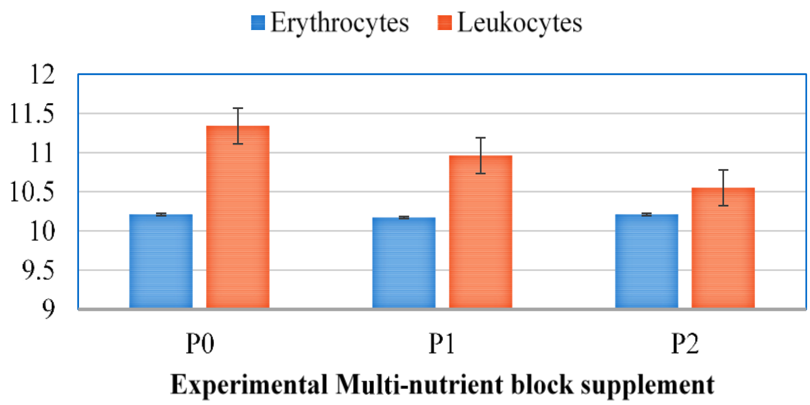

Fig. 1: Erythrocytes (10^6µL) and leukocytes (10^3µL) profile of Kacang Goat with feeding of multi-nutrient block supplement.

3.2. Effects of Treatment on Urea Content

Urea is the end product of protein metabolism in livestock and is excreted through urine. Blood urea, on the other hand, originates from ruminal ammonia and residual amino acid catabolism. In ruminants, blood urea levels can serve as an indicator of protein utilization from feed and ammonia processing by rumen microbes. In this study, the administration of multi-nutrient blocks did not have a significant (P>0.05) effect on blood urea levels. The blood urea levels in this study ranged from 38.06 to 39.15mg/dL, which are higher compared to the study by Putri et al. (2022), where the range was 18.00 to 30.71mg/dL with the addiction of moringa leaf flour in concentrates. The discrepancy in urea levels between these studies can be attributed to the difference in crude protein content. Normal blood urea levels in goats are reported to be between range 20.70 and 22.62mg/dL (Gopar et al. 2020). The similar blood urea levels observed in this study may be due to the uniform crude protein content and quantity in all treatment feeds, resulting in a consistent supply of crude protein for ammonia production, and thus, a relatively stable blood urea level. Protein in the feed undergoes catabolism or hydrolysis into amino acids within the rumen, followed by deamination processes into ammonia. Blood urea levels are related to the absorption of amino acids in the rumen; amino acids are transported to tissues for catabolism into urea (Widodo et al. 2019). Blood urea is positively correlated with the adequate protein consumption and digestibility, as well as the balance between energy and protein in the livestock. Ammonia in the rumen is utilized for the synthesis of amino acids and microbial proteins, which reduces the amount of ammonia distributed to the liver. A significant reduction in the amount of ammonia reaching the liver will reduce the conversion of ammonia into urea in the liver, thereby lowering blood urea levels.

3.3. Effects of Treatment on Glucose Levels

Blood glucose is the primary carbohydrate source of energy circulating in livestock. It is the first nutrient utilized rapidly by the body to support production and reproductive functions. In this study, the administration of multi-nutrient blocks did not significantly (P>0.05) affect blood glucose levels. The glucose levels in this study ranged from 91.30 to 92.03mg/dL. This was higher compared to the study by Nabawi et al. (2023), which reported glucose levels ranging from 27.02 to 41.79mg/dL. Normal blood glucose concentrations in goats are reported to be between 66 and 81mg/dL (Gopar et al. 2020). The elevated glucose levels observed in this study are likely due to the utilization of carbohydrates, both in the form of crude fiber and nitrogen-free extract (NFE), being consistent across treatments. Thus, it can be inferred that the carbohydrate supply for blood glucose formation was relatively similar. Carbohydrates contained in feed consumed by livestock are fermented by rumen microbes, producing volatile fatty acids (VFAs) such as acetate, propionate, and butyrate, which serve as primary energy source for ruminants. Specifically, lactate and butyrate are used for energy, while propionate acts as a precursor for glucose formation. Blood glucose levels are influenced by carbohydrate digestion and energy metabolism in the body, and their concentrations can vary with time, such as the timing of blood sampling. Higher dietary energy content typically leads to increased blood glucose levels. Conversely, if the energy content in the feed is low, blood glucose levels will decrease (Luthfi et al. 2014). Livestock blood glucose plays a critical role in regulating energy metabolism processes, including glycogen formation (Lendrawati et al. 2020).

3.4. Effects of Treatment on Plasma Total Protein Levels

Plasma Total Protein (PTP) encompasses all plasma proteins, including albumin and globulin. In this study, the administration of multi-nutrient block did not significantly (P>0.05) affect the plasma total protein levels of Kacang goats. This study's plasma total protein levels ranged from 6.86 to 6.96g/dL. These levels fall within the normal range, as reported by Nabawi et al. (2023), where total plasma protein in female goats was between 6.0 and 7.0g/dL. This suggests that the multi-nutrient block supplement provided adequate nutrients, as indicated by the total plasma protein, which reflects the nutritional adequacy of the diet. Total plasma protein indicates that the feed provided was rich in protein (Leu et al. 2022). Furthermore, plasma total protein plays a crucial role in regulating blood pH, meeting protein requirements in body tissues, particularly during fasting, supporting osmotic pressure, and contributing to immune function and the stability of blood solutions (Mapiour and Amira 2023; Dömötör and Enyedy 2023; Ragab et al. 2024).

3.5. Effects of Treatment on Hemoglobin Levels

Hemoglobin (Hb) is a protein with the capacity to bind oxygen and form oxyhemoglobin within red blood cells. Its primary function is to transport oxygen from the lungs to various tissues throughout the body. Based on the ANOVA test result, the administration of multi-nutrient blocks supplement did not significantly affect the hemoglobin levels of Kacang goats. Data presented in Table 3 indicates that the hemoglobin levels of Kacang goats ranged from 10.00-10.11mg/dL, which is within the normal range. Normal hemoglobin levels in goats are reported to be between 8,4-12g/dL (Khalil et al. 2019). Additionally, Nahak et al. (2021) reported that normal hemoglobin levels of Kacang goats range from 10.79 to 12.05g/dL. The normal hemoglobin levels observed in this

ISSN: 2708-7182 (Print); ISSN: 2708-7190 (Online)
Open Access Journal

study indicate that nutrient metabolism in the goats is functioning properly and that the nutrients required for hemoglobin formation are adequately supplied. These findings were consistent with those of Singh and Bhan (2020), who found hemoglobin levels 35-37% in buffaloes during controlled climatic condition. Similarly, Khalil et al. (2019) reported that the hemoglobin levels of Kacang goats supplemented by mineral under a tethering feeding system ranged from 8.4 to 12 g/dL.

3.6. Effects of treatment on Packet Cell Volume (PCV)

Packet Cell Volume (PCV) represents the percentage of erythrocytes of blood. To improve PCV values, attention is often given to the nutritional content of the feed, particularly the crude protein content. In this study, the administration of multi-nutrient block supplement did not significantly (P>0.05) affect the PCV of Kacang goats. The PCV observed in this study ranged from 30 to 30.32%. In comparison, PCV values for female goats supplemented with block feed minerals ranged from 22 to 38% (Khalil et al. 2019). Normal PCV values of goats were reported to be between 29.89 and 43.75% (Dhuha et al. 2021). Normal PCV levels observed in this study suggest that multi-nutrient block supplementation can be administered to goats at up to 100g per head per day. Healthy goats with adequate nutritional conditions typically maintain stable or normal PCV levels. This stability is supported by the comprehensive nutritional profile of the multi-nutrient block supplement, particularly its crude protein content.

3.7. Effects of Treatment on Erythrocyte Levels

Erythrocytes, or red blood cells, are responsible for transporting hemoglobin throughout the body. They are primarily produced in the bone marrow and are also found in small quantities in the lymphatic system. Erythrocytes bind oxygen and distribute it throughout the body tissues for metabolic needs. In this study, the administration of multi-nutrient block did not significantly (P<0.05) affect erythrocyte levels of Kacang goats. The erythrocyte count of Kacang goat ranged from 10.17 to 10.21×10^6/μL). Normal erythrocyte levels in goats are reported to range from 5 to 10×10^6/μL (Khalil et al. 2019). The similar erythrocyte levels observed in this study are likely due to consistent nutrient levels and hemoglobin levels in goats. In this study, the nutritional content of native grass consumed by the goats and the amount of multi-nutrient block supplement provided were almost identical. Under this condition, erythrocytes effectively transport hemoglobin throughout the circulation, supporting the proper cellular metabolism of the livestock.

3.8. Effects of Treatment on Leukocyte Levels

Leukocytes are white blood cells with nuclei that play an active role in the immune system. The administration of multi-nutrient blocks did not significantly (P>0.05) affect the leukocyte levels of Kacang goats. The leukocyte counts in this study ranged from 10.55 to 11.34×10^3/μL. These levels fall within the normal range, which is reported to be between 10 and 15×10^3/μL in goats (Nabawi et al. 2023). Additionally, Khalil et al. (2019) reported a normal leukocyte range of 3 to 13×10^3/μL in goats. These findings suggest that the multi-nutrient blocks supplementation maintained the health of Kacang goats and did not induce physiological disturbances or stress. Grazing in natural pastures does not cause stress to the goats, as they are accustomed to these environmental conditions. Widhyari et al. (2020) state leukocytosis refers to leukocyte levels within the normal range. In this study, the goats were not pregnant, which explains the absence of physiological change in either the quantity or function of leukocytes.

4. CONCLUSION

Providing a multi-nutrient block feed up to 100g/head/day did not adversely affect the health nor blood hematology of female Kacang goats grazing on pasture. Hematological analysis of these goats, both with and without multi-nutrient block supplementation, revealed the following blood parameters: blood urea concentration at 38.45mg/dL, glucose at 91.76 mg/dL, total plasma protein at 6.91g/dL, hemoglobin at 10.06g/dL, packed cell volume (PCV) at 30.19%, erythrocyte count at 10.19×10^6/μL, and leukocyte count at 32.85×10^3/μL. Future efforts have to focus on improving the quality of the block feed formulation to enhance its efficacy.

Conflict of interest: The authors whose names are listed have no affiliations with or involvement in any organization or entity with any financial interest or nonfinancial interest in the subject matter or materials discussed in this manuscript.

Acknowledgment: The authors would like to express their gratitude to the Institute for Research and Community Service, Wira Wacana Sumba Christian University through the Funding of Lighthouse Research Scheme Year 2023 with research agreement: 018/SB/PDM/LPPM/VIII/2023.

Author's Contributions: Conceiving and designing the experiment, as well as writing the original paper was done by Marselinus Hambakodu, and analyzing, reviewing, and editing was done by Amelia Florida Kiha and Yessy Tamu Ina.

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Citation: Hambakodu M, Kiha AF and Ina YT, 2024. Effects of multi-nutrient block supplement on the blood hematology grazing female Kacang goats. Agrobiological Records 18: 54-60. https://doi.org/10.47278/journal.abr/2024.037