Local mineral formulas for supplementation of kacang goat's feed based on wild forages, rice bran and sago stalk

IOP Conf. Series: Journal of Physics: Conf. Series **1469** (2020) 012016 doi:10.1088/1742-6596/1469/1/012016

Local mineral formulas for supplementation of kacang goat's feed based on wild forages, rice bran and sago stalk

K Khalil*, A Abbadiah, A Andri and E Evitayani

Department of Animal Nutrition and Feed Technology, Faculty of Animal Science, Andalas University, Padang, Indonesia

*khalil@ansci.unand.ac.id

Abstract. Supplementation is required to satisfy mineral requirement of traditional grazing kacang goat. The present research was aimed to design of mineral supplement for better nutrition of kacang goat fed based on wild forages, rice bran and sago stalk. Crude nutrient and mineral composition of feed which are normally consumed or fed to kacang goat were analyzed for dry matter (DM), crude protein (CP), crude fibre (CF), and minerals (Ca, P). Samples of forages were collected from three areas, i.e. coconut plantations, banana plantations and idle lands. Mineral feed was then formulated by using locally available materials: Bukit Kamang's stone powder, roasted fresh water mussel shell meal and bone ash. The local minerals were prepared in loose and block forms and offered to 12 young kacang goat males for 14 weeks in three treatments: P0: no supplementation (control), P1: supplemented with loose local mineral, and P2: supplemented with block local mineral. Each treatment consisted of 4 goats as replication. Parameters measured included: body weight gain, feed intake, feed conversion ratio (FCR), blood minerals (Ca, P), blood hematology (hemoglobin [HGB], mean corpuscular Hb concentration [MCHC], total red blood cell [RBC], white blood cell [WBC], hematocrit concentration [HCT]) and total protein. Results showed that there were seven kinds of wild forages consumed by grazing goat. The average crude nutrient and mineral content of the forages were as follows: DM: 17.2%, CP: 16.5%, CF: 18.20%; Ca and P: 4.5 dan 2.1g/kg DM, respectively. The average daily body weight gain was 35.4, 31.7 and 41.2 g/head, and FCR was 22.8, 26.0 and 21.3 for P0, P1 and P2, respectively. The mineral concentration, total protein and hematological values of blood of P2 ranged in normal values, except WBC. It was concluded that mineral supplementation in block lick form gave positive effect on growth performance and feed utilization efficiency.

1. Introduction

Kacang goats (*Capra hircus*) in West Sumatra region are mainly found in the districts of Padang Pariaman, 50 Kota, Pasaman Timur, Dharmasraya, Agam, Tanah Datar dan Solok Selatan. They are commonly raised by small farms semi intensively by free grazing starting at noon until late afternoon around villages or farm areas. They consume wild vegetation growing in idle lands, coconut plantation, banana plantation, river bank and road sides. They are often unable to meet their feed requirement due to limited forage availability and grazing time and competition with other livestock (cattle, buffalo). Forage intake is also limited by selective foraging behavior of goat.

Of the nutritional inadequacies, kacang goat farms in the district Padang Pariaman, for example, fed their goat using mixture of rice bran and sago stalk as concentrate. The use of concentrated feed might

be able to fulfill the energy and protein requirement, but the grazing goat are presumably deficient in minerals, especially calcium and phosphorus. Forage feed derived from wild vegetation had generally low mineral content [1,2]. Ca and P are two minerals that are normally included in dietary formulations for livestock animals due to their important roles in various body functions and in metabolism. The mineral deficiency is presumably causing for slow growth and reproductive performances of kacang goat. The local goat performances could be optimized by use of mineral supplement which could be produced by using locally available ingredients. There are four local materials that are potentially used as Ca and P sources, i.e. stone meal of Bukit Kamang, fresh water mussel shell, limestone and bone ash [3,4,5].

The present research was aimed to determine crude nutrient and mineral content of feed consumed by goat and to evaluate the beneficial effect of mineral supplement to grazing kacang goat fed based on wild forages, rice bran and sago stalk on body weight gain, feed intake, feed utilization efficiency; hematological values, mineral and protein concentration of blood.

2. Materials and method

2.1. Forage sampling and analyzing

The study was initiated by taking and analyzing of crude nutrient and mineral of samples of rice bran, sago stalk and plants which are normally or consumed or fed to kacang goat in Kaluat villages, East Pariaman sub-district of Pariaman city. Samples of plants were collected from three sites where kacang goat are normally grazed, i.e. coconut plantations, banana plantations and idle lands. Each sampling sites located in three different locations as replication, so that there were in total 9 samples. Goats were watched grazing in the selected areas before aerial portions of plants were cut with a stain less steel knife according to the choice of the animal or parts consumed. The individual samples were placed in individual plastic bag, weighed then chopped and mixed together in the same species. Three representative samples of about 150 g from each species were taken, so that there were in total of 21samples (7 species and 3 replicates). The representative samples were then dried in a forced draught oven at 60ºC for 24 hours and ground in meal form prior to analysis for dry matter (DM), crude protein (CP), crude fiber (CF), crude ash and minerals (Ca, P). DM and nutrient contents of CP, and CF of forages were determined using official proximate procedures described by AOAC [6]. Samples for mineral analysis were prepared by wet digestion method using concentrated sulfuric acid and hydrogen peroxide. The concentration of minerals was determined using a BUXX2000 atomic absorption spectrophotometer. All analysis results were reported on DM basis.

2.2. Mineral formulation and feeding trial

Mineral feed was then formulated by considering mineral composition of feed and standard of mineral requirement of goat. Mineral was formulated with main component of locally available materials: Bukit Kamang's stone powder, roasted fresh water mussel shell meal, limestone and bone ash. The local mineral was prepared in loose and block forms containing 10.0-11.5% Ca and 3.7-4.1% P. The trial utilized 12 young kacang goat males of 5-6 months of age with an average body weight of 9.92±2.35 kg. Goats were stratified by 4 different body weight and assigned to. The treatments were: P0: no supplementation (control), P1: supplemented with loose local mineral, and P2: supplemented with block local mineral. Goats were stratified by 4 different body weigh tin Each treatment consisted of 4 goats in 4 different body weights as replication. The goats were kept in a pen equipped with individual stalls. They were fed forage and concentrates of mixture of sago stalk and rice bran before they were allowed to free graze starting at noon until late afternoon and offered additional feed. The mineral in loose form were fed as much as 15 g/head/d by mixing with concentrate, while the block mineral was placed wooden boxes. Parameters measured included: body weight gain, feed intake, feed conversion ratio (FCR), blood minerals (Ca, P), blood hematology (hemoglobin [HGB], mean corpuscular Hb concentration [MCHC], total red blood cell [RBC], white blood cell [WBC], hematocrit concentration [HCT]) and total protein. Hematological values and serum concentration of total protein, Ca and P were

analyzed by auto-analyzer (Mindray) using commercial kits at the Chemical Laboratory of National Veterinary Service Institute in Baso, Bukittinggi, West Sumatra, Indonesia.

2.3. Statistical analysis

The data obtained were expressed as mean and standard deviation (mean ± S.D.) and statistically analyzed using analysis of variance (ANOVA). Data on crude nutrient and mineral composition of forages were statistically analyzed in a completely randomize design with seven different plant species collected in three different locations as replication. Data on feeding trial of body weight, feed intake, FCR, blood hematological, chemical and mineral values were analyzed in a block randomize design with three treatments of mineral supplementation and 4 goats in different body weight as replications. Duncan's Multiple Range (DMRT) was applied to separate means. Differences were considered at $P<0.05$ [7].

3. Results and discussion

3.1. Crude nutrient and mineral composition of feed

As shown in table 1, there were seven kinds of plant consumed by grazing goats which composed of three native grasses (*Axonopus compressus*, *Cyperus rotundus*, *Paspalum conjugatum*), three broadleaves (*Asystasia gangetica*, *Ageratum conyzoides*, *Stachytarpheta jamaicensis*) and a fern (*Polypodium vulgareae*). *A. compressus* and *A. gangetica* were also identified as predominant dominant plant species fed to goat in Payakumbuh region [2]. DM content varied from 11.7 to 23.5%. There were three species (*A. gangetica*, *P. conjugatum* and *A. conyzoides*) with relatively low dry matter of 11.7-14.1%. *A. gangetica* had the lowest DM content of 11.7%. Other four species with relatively high dry matter content were *P. vulagrea, A. compressus* and *A. jamaicensis*. The highest DM was fern of 23.4%. Crude protein content varied from 14.0-20.9% DM. There were two plant species of *A. conyzoides* and *A. gangetica* with considerable high protein of 20.9% and 19.8%, respectively. Other five species of *A. compresus, C. rotundus*, *P. conjugatum*, *S. jamaicensis* and *P. vulgareae* contained relatively low crude protein of 14.0-16.0%. Crude fiber content ranged 12.9-30% DM. *P. conjugatum* had the highest CF of 30.5%, followed by *A. compressus* (21.2%) (Table 1). Sago stalk contained low crude protein and fiber, while rice had considerably high crude fiber of 44%. The present results were comparable to the previous study on wild forages derived from diverse wild vegetation conducted by Khalil who found that that protein and crude fiber content ranged from 11-18% and 37-46%, respectively [8].

Except for A. conyzoides with Ca content of 9.7 g/kg DM, in general, forage and concentrates consumed by kacang goat had poor mineral. Ca and P content of forages ranged 1.7 to 5.4 and 0.16-5.1 g/kg DM, respectively. The present results were comparable to the previous study on wild forages by Khalil who reported Ca content ranged between 7 to7.7 g/kg, while mineral P varied from 0.5 to 1.3 g/kg DM [8]. The amounts of nutrients, including minerals, in the forages greatly vary depending on soil, plant species and management factors [9]. Ca and P deficiency could be relatively common in kacang goat grazing wild forages in Pariaman region, particularly when the wild vegetation is dominated by low quality grass with little or no legume. Deficiency signs include slow growth rates, decreased appetite, listlessness and poor fertility.

By daily DM feed intake of about 0.7 kg/head/d (Table 2) and Ca dan P utilization efficiency in forages of 30 and 60%, respectively [10], forages and concentrates consumed by kacang goats could supply only 0.75 g/head/d or about 40% of Ca and P standard requirement of goat of 2 and 1 g/head/d [11]. These data proved that mineral Ca and P derived from natural feedstuffs in Pariaman are often inadequate and require supplementation to satisfy goat requirements. Mineral deficiencies have adverse effect on both animal production and health [12]. According to Suttle, calcium deficiency manifests itself by rickets, milk fever (especially after kidding) [12]. Lack of Vitamin D will also help promote this, since it is required for retention of Ca in the bones. Phosphorous deficiency causes 'poor thrift,' lower milk yields and general lethargy. Ca and P work on the thyroid gland together with iodine to govern the metabolic rate.

3.2. Effects of mineral supplementation

Results of feeding trial presented in Table 3 showed there was no statistically significant effects (P>0.05) of local mineral supplementation on feed intake, body weight gain, FCR and biochemical and mineral blood parameters. However, goats supplemented with local mineral in block form (P2) had the highest growth rate (41.2 g/head/d) and the best FCR (21.2). The mineral concentration and hematological values of blood also ranged in normal values, except WBC, HGB and Ca concentration. WBC were above the normal standard in all groups of goats. Supplementation of block mineral (P2) gave also positive effect on hemoglobin, total protein, Ca and P concentration of blood. On the other hand, supplementation of local mineral in loose form (P2) depressed goat's growth and feed utilization efficiency. As shown in Table 2, goats supplanted with loose mineral (P2) had the lowest body weight gain (31.7 g/head/d) and poorer FCR (25.9) than control (P0) of 35.4 g/head/d and 22.7, respectively. It was presumably due caused negative effect of high salt in the formula, because the loose minerals were consumed by goat in short time with concentrates.

The present results demonstrated that there were positive effects of local mineral supplemented in block lick form to growth performance and feed utilization efficiency of kacang goat. Advantages of mineral feed in blocks over supplementation of loose minerals in concentrated feed are that they are consumed slowly. The average block mineral intake was 11.7 g/head/day. As shown in Fig. 1, goats had adapted well to mineral block by slow increase of consumption during the trial. These ensure mineral supply into rumen and satisfy the requirement of rumen microorganisms resulting in increasing host animal performances.

4. Conclusion

It can be concluded that mineral supplementation in block lick form gave positive effect on growth performance and feed utilization efficiency. Local mineral offered in block lick had better effect than that in the loose form as mineral supplement for kacang goat. The findings of this study may serve as references for better nutritional purposes in goat feeding with limited availability and quality of forage and concentrates.

Acknowledgement

This study is part of a project entitled "Design of Mineral Formulas for Nutritional Improvement of Goat's Feed Based on Forages and Agroindustry Byproducts" (Contract No: 46/UN.16.17/PP.RGB/LPPM/2018), financially supported by the Ministry of Research, Technology, and Higher Education of the Republic of Indonesia. The authors wish to acknowledge the co-operation and technical support of Arif Trisman, S.Pt., M.Biotek as research assistance and Drh. Rudi Harso Nurgroho, M.Biomed of Veterinary Research Center, Bukittinggi, West Sumatra.

References

[1] Khalil K, Lestari M N, Sardilla P and Hermon H 2015 *Media Peternakan* **38**(1) 34-41
[2] Khalil K 2016 *Pakistan J. of Nutr.* **15**(9) 867-872
[3] Khalil K, Wati W, Hidayat F and Evitayani E 2018 *Int. J. Poult. Sci.* **17** 116-125
[4] Khalil K, Reswati R, Ferawati F, Kurnia Y F and Agustin F 2017 *Pak. J. of Nutr.* **16**(6) 426-434
[5] Khalil K and Awar S 2008 *Jurnal Pengembangan Peternakan Tropis* **34**(3) 174-180
[6] AOAC (Association of Analytical Communities) 2005 Official Methods of Analysis of AOAC International *18th ed. Assoc. Off. Anal. Chem., Arlington*
[7] Steel R G D, Torrie J H and Dicky J H 1997 *Principles and Procedures of Statistics: A Biometritrical Approach. 3rd Ed.* (New York: McGraw-Hill Book Co. Inc.)
[8] Khalil K 2013 *Proceeding the 3rd AINI Int. Seminar. September 24-25, 2013*
[9] Ramires R G, Heinlen G F W and Nunez-Gonzales M A 2001 *Small Ruminant Res.* **39**(2) 153-159
[10] NRC (National Research Council) 2007 *Nutrient Requirements of Small Ruminants: Sheep, Goats, Cervids, and New World Camelids* (Washington DC: The National Academies Press)

[11] McDowell L R and Arthington J D 2005 *Minerals for Grazing Ruminants in Tropical Regions (4th ed.)* (Gainesville, FL, USA: University of Florida, IFAS)
[12] Suttle N F 2010 *Mineral Nutrition of Livestock. 4th Ed.* (Pentland Science Park, Midlothian, UK: Moredun Foundation)