Studies on Crude Nutrient and Macro Mineral Composition of Forages and the Use of Local Mineral Formulas as Supplemented Feed for Beef Cattle

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ABSTRACT

The objective of the present research was to study the diversity of crude nutrient and mineral contents of forages from different sources and to evaluate the beneficial effect of supplementation of beef cattle with mineral formulated by using Bukit Kamangs' limestone mixed with other locally available materials on their performances. The research was initiated by sampling and analyzing the nutrient and mineral contents of forages from different sources to study diversity of forages quality. Forage samples were collected from 4 different locations, i.e. pasture, palm oil estate, teak wood plantation and idle lands. Samples were then analyzed for crude nutrient (CP, CF, ash and DM) and macro mineral content of Ca, P, Mg, K, Na and S. Feeding trial was then conducted to evaluate the beneficial effect of supplementation of local mineral formulas (LMF) produced by using locally available materials of Bukit Kamang's limestone meal, fresh oyster shell meal, rice bran and cane sugar on the performances of cattle. The feeding trial was conducted for 6 weeks by using 9 Cross-Simmentals heifers subjected to 3 treatments, i.e. P1: only grass without supplementation, P2: grass + LMF and P3: grass + concentrates. Parameters measured included: body weight gain, feed intake, FCR, feed cost and net return. Results showed that the available forages contained relatively high fiber and low DM, CP and minerals. Nutrient content of CP, CF and ash varied widely, from 10.4 to 18.2%, 30.2 to 45.5% and 8.8 to 12.1%, respectively. Minerals of Na, K, Mg and Ca were varied from 11-18 g/kg, 8-13 g/kg, 8-10 g/kg and 7-8 g/kg DM, respectively, while P were found the lowest, varied from 0.5 to 1.3 g.kg DM. Heifers supplemented with LMF (P2) showed higher body weight gain, FCR and net return than those of fed only grass (P1). The best biological performances were shown by heifers supplemented with concentrates (P3), but the most profitable feeding strategy was by supplementation of heifers with local mineral formulas.

Key Words: Forage quality, Local mineral, Ruminant nutrition

INTRODUCTION

In their effort to increase revenue, more farmers in West Sumatra shift from local to raise exotic cattle breeds with higher body size and meat-carcass portion like Simmentals. In addition to limited land and capital, the constraints faced by farmers in raising the exotic breed are the limited availability of feed in term of quantity and quality. The livestock are almost entirely dependent on feeds consisting of grasses which come from non-developed pastures and diverse sources such as: crop and plantation areas, river banks, rice fields, forest edges and roadsides. These feeds are often of poor quality, usually deficient in protein and minerals. Supplementation of ruminants with minerals or concentrated feed is not a common practice, so that the production performances of cattle are not optimal according to their genetic potencies.

The efficiency of utilization of the available feed resources can be optimized by the use of supplements that provide the deficient nutrients. These supplements can be produced by using locally available ingredients and agro-industrial by-products. As mineral sources there

are limestone of Bukit Kamang and fresh water oyster shells which contain highly Ca of about 40 % and 35%, respectively (Khalil and Anwar, 2007; Khalil, 2004). Bukit Kamangs' limestone is also rich in essential micro minerals of Mn (205 ppm), Fe (295 ppm) and Se (388 ppm) (Khalil and Anwar, 2007). These mineral feeds can be mixed with local cane sugar and rice bran as energy sources in readily consumable formula form, because supplementation of ruminants with concentrated feed is not a common practice. Besides as mineral sources, the local mineral formula serve as sources of fermentable carbohydrates and nitrogen to satisfy the requirement of rumen microorganisms and to ensure forage fiber fermentation resulting in increasing host animal performances.

The objective of the present research was to study the diversity of crude nutrient and mineral contents of forages from different sources and to evaluate the beneficial effect of supplementation of beef cattle with mineral feed formulated by using locally available materials in compare to concentrated feed on their performances.

MATERIALS AND METHODS

Sampling and analyzing nutrients and minerals of forages: The research was initiated to study the diversity of crude nutrients and macro minerals of forage samples collected from four different sites located around Limau Manis campus of Andalas University, Padang West Sumatra in September 2012: teaching farm pasture, palm oil plantation, teak wood plantation and unutilized or idle land areas that were scattered in different campus sites.

Forage samples were collected at 5 sampling points each by using quadrats plate mater of 0.5 x 0.5 m in size. Plant materials in plate meter were cut at ground level and placed in individual plastic bag. The fresh samples were weighed and then separated into species and then weighed for determination of botanical composition. All samples of each sampling point were mixed and chopped. Representative samples of about 100-150 g were dried in a forced draught oven at 60ºC for 24 hours and ground in meal form prior to analysis for dry matter (DM), crude ash, crude protein (CP), crude fiber (CF) and macro minerals of Ca, P, K, Na, Mg and S.

Feeding Trial: Feeding trial was aimed to evaluate the beneficial effect of using local mineral formula (LMF) compared with concentrated feed on the performances of beef cattle. The trial consisted of 3 feeding's treatments as follows:

a. Treatment 1 (P1): Grass without LMF (control)
b. Treatment 2 (P2): Grass supplemented with LMF
c. Treatment 3 (P3): Grass supplemented with concentrates.

Local mineral mixture of Bukit Kamang's limestone and fresh water oyster shell meal was prepared by mixing with other locally available materials, i.e. cane sugar and rice bran as fermentable carbohydrate sources. Other components were the common materials used in making urea molasses block (UMB), i.e. iodized kitchen salt, urea, cement and commercial mineral premix. The feeds were offered to 9 Cross-Simmentals heifers with average live body weight of about 318 kg/head. The animals were divided into 3 groups based on body weight, i.e. small (261-300 kg/head), medium (303-330 kg/head) and big (337-381 kg/head. Each group consisted of 3 animals in accordance with treatments, so that each treatment consisted of 3 animals as replication.

Feeding trial was lasted for 12 week. LMF were offered to the animals in fresh dough forms of about 350 g/head/day. All heifers were fed chopped Kings' grass with nutrient content of 10% CP, 37% CF, 0.66% Ca and 0.26% P based on dry matter basis. Concentrates composed of rice bran, coconut meal, urea, salt and mineral premix with nutrient content of 13% CP,

22% CF, 0.71% Ca, 1.21% P and 66% TDN. Parameters measured included: body weight, feed intake, FCR, feed cost and net return over feed cost.

RESULTS AND DISCUSSION

Nutrients and mineral contents of grass. The crude nutrient and DM content of forages from 4 different sources ranged from 10.4 to 18.2% CP, 30.2 to 45.5% CF, 8.8 to 12.1% ash and 18-29% DM, respectively. Forages from palm oil plantation showed significantly higher crude protein of about 18%, while three other sources showed relatively low variation of about 10-12% CP. Crude fibers were varied among the feed. Forages from teak wood plantation contained the highest crude fiber of about 46%, followed by teaching farm of 43% and palm oil plantation of 37%, while the lowest fiber was found in forages from idle land of about 30.2% ($P<0.05$). Forages from teak wood plantation had the highest crude ash, but was not statistically different from other feed sources ($P>0.05$), while the lowest DM content of about 18% was found in forages from idle lands ($P<0.05$).

The highest mineral content was Na, but it varied from 11-18 g/kg, followed by K (8-13 g/kg), Mg (8-10 g/kg and Ca (7-8% DM). In terms of Ca, the findings of present study revealed that Ca content of forages on campus were considered high, while optimum level of Ca in plants ranged from 4 to 6 g/kg (Georgievskii, 1982). On the other hand, compare to minimum level of Ca in cattle diet of about 35 g/kg to fulfill its maintenance and production requirement (NRC, 1996), the optimum Ca content of forages should range between 17 to 42 g/kg (Sultan et al., 2008). Mineral P was found the lowest, varied from 0.5 to 1.3 g/kg DM, while the average P content in tropical grasses varied from 0.2 to 0.6 g/kg of plant dry matter (Skerman and Riveros, 1990).

Effect of LMF on Cattle Performances. Table 1 showed the mean body weight, feed intake, FCR, feed cost and net return of heifers fed with grass and supplemented with LMF for 6 weeks.

Table 1. The mean biological and economic performances of heifers supplemented with LMF

Parameters	Feeding groups:		
	Only Grass(No supplements)	Grass + LMF	Grass + Concentrates
	P1	P2	P3
Initial body weight, kg/head	318.7 ± 61.3	317.7 ± 27.6	317.3 ± 34.5
Final body weight, kg/head	327.7± 58.9	335.7 ± 31.8	341.7± 48.7
Body weight gain, g/head/day	214.3^{c} ± 63.0	428.6^{b}± 74.6	579.4^{a}± 49.5
Dry matter feed intake, kg/head/day	4.2^{b} ± 0.3	4.4^{b} ± 0.4	9.5^{a} ± 0.3
Feed conversion ratio	109.3^{a}± 8.7	64.7^{b} ± 7.2	72.6^{b} ± 7.5
Feed cost, Rp/head	133,308.5	201,597.7	1,018,923.2
Net return over feed cost, Rp/head	267,304.8	561,163.6	7,866.8

The mean body weight was increased from about 318 kg/head to 335 kg/head during 6 weeks of feeding trial. Dry matter intakes of about 9.5 kg/head/day by heifers supplemented with concentrates were significantly higher ($P<0.05$) than that of animals in group P1 and P2 of about 4.2-4.5 kg/head/day. Heifers fed with LMF (P2) showed higher body weight gain (429 g/head/day) and much better FCR (64.7) ($P<0.05$) than those of fed only with grass (P1) with mean body weight gain of only 214 g/head/day and FCR of 109.3. This increased body weight and feed utilization efficiency may be related to the improved intake and digestibility of grass. The availability of better fermentable energy sources (cane sugar and rice bran)

from LMF might have also enhanced the digestibility of dry matter and organic matter when compared with heifers fed only grass (P1). Singh et al. (1999) also reported body weight gain improvement in their experiment on goats. Supplementation of heifers with concentrates gave the best performances in terms of feed intake and body weight gain of about 579 g/head/day ($P<0.05$). This treatment was, however, found the most expensive treatment with the total feed cost of about Rp.1,018,923/head and the lowest net return of about Rp.7,867/head (Table 1).

The cheapest feed cost was obtained in the heifer fed only with grass (P1). Such low-input/low-output feeding system was widely practiced by traditional small-scale farmers in West Sumatra as a response to limited resources and skill. Supplementation of heifers with LMF increased feed cost of about Rp. 68,289/head (from Rp.133,309 of P1 to Rp.201,598 of P2), but net return increased by Rp. 534,459 (from Rp.267,305 of P1 to Rp. 561,164 of P2). In term of economic parameters, the most profitable treatment was obtained in heifers supplemented with LMF of P2 with the highest net return of about Rp. 561,164/head.

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