PJN

ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet

308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

Pakistan Journal of Nutrition 14 (12): 849-853, 2015
ISSN 1680-5194

Effect of Minerals S, P and Cassava Flour Leaf Supplemented with Ammoniation Palm Leaves on the Performance of Beef Cattle

Suyitman, L. Warly, A. Rachmat and Dear R. Ramadhan
Faculty of Animal Husbandry, Andalas University, Campus Limau Manis,
Padang, West Sumatra, Indonesia

Abstract: This study aims to determine the effect of refined palm leaves supplemented with mineral S and P and cassava leaves flour on cattle performance. This research is carried out starting from May 01 to September 15, 2015. Palm leaf sample, ration and feces are analyzed in Proximate and Van Soest at Ruminant Nutrition Laboratory of the Faculty of Animal Husbandry, University of Andalas, Padang. The research is an experimental study using randomized block design with 5 treatments and 4 replications. Treatment consists of: A = grass+concentrate (60:40%) as a control; B = best processed palm leaf in stage I+concentrate (60:40%); C = B+S and P mineral supplementation; D = B+cassava flour and E = C+cassava leaf flour. Data is analyzed using analysis of Variance (ANOVA). Differences between treatments were tested by Duncan's Multiple Range Test (DMRT). The results show that the treatment gave a significantly different effect on the performance of beef cattle ($p<0.05$). The results of the average consumption of dry matter ration ranged from 10.54 to 11.25 kg/head/day; Dry matter digestibility: 51.51 to 61.59%; body weight gain: 0.62 to 0.94 kg/head/day; ration efficiency: 5.74 to 8.36%. The results of the study can be concluded that ammoniation palm leaves supplemented with mineral S and P as well as cassava leaves flour can replace 100% grass feed of beef cattle and provide better performance than the control diet (grass) in terms of body weight gain.

Key words: Palm leaf processing, ammoniation, mineral S and P supplementation, cassava leaf flour

INTRODUCTION

One of the farm wastes potential to be used as a source of green feed is palm leaves (*Elaeis guineensis* Jacq.). Leaves of palm oil are produced from the trimming or cutting of old palm frond during the maintenance and fruit harvest. Production of palm midrib is 10.40 tons dry matter/ha/year (Sa'id, 1996). In 2013 the area of palm plantations in West Sumatra is 301,127 ha (BPS, 2014), it is estimated that the production of palm midrib is as much as 3,131,720.8 tons dry matter/year.

Although palm leaf is available in large quantities and has great potential to be used as forage, but its utilization as feed is still very limited. This is partly due to the low biological quality of palm leaves. The results of palm leaf nutrient content analysis showed: dry matter: 54.12%; organic matter: 89.86%; crude protein: 8.51%; crude fiber: 28.48%; NDF: 59.11%; ADF: 42.87%; cellulose: 24.69%; hemicellulose: 16.24% and lignin: 14.21%. The high lignin content causes low digestibility and palatability (Widjaja and Utomo, 2001). Efforts to optimize feed utilization of waste had focused on processing techniques, physical, chemical, biological, or combinations thereof. Treatment itself has given small response on the increase of digestibility. Therefore, efforts to increase the digestibility of fibrous feeds should also be combined with efforts to optimize bioprocess in the rumen through the increase of rumen microbial population (Warly *et al*., 1998).

Rumen microbial population highly depends on nutrient availability of precursors such as carbohydrates, energy, nitrogen, amino acids and vitamins for microbial protein synthesis. Cellulolytic rumen bacteria require branched-chain fatty acids (Branched-Chain Fatty Acids = BCFA), which is the result of decarboxylation and deamination of Branched Chain Amino Acids (BCAAs). A low quality feeding waste contains low quality of BCAA so that the supplementation of BCAAs in the ration is necessary. Cheap and accessible natural source of BCAAs is cassava leaves. The content of BCAAs in cassava leaf, namely: Isoleucine: 4.4%; Leucine: 8.75% and Valine: 8.43% (Muller and Nah, 1975).

The specific aims of this study were: to study the effect of mineral supplementation of sulfur and phosphorus, as well as cassava leaves in diets based on processed palm leaves on the rumen bioprocess optimization and performance of beef cattle.

MATERIALS AND METHODS

The research was conducted in Farmers Group Cerdas at Block A Sitiung II, Jorong Koto Hilalang II, NagariSungai Langkok, District Tiumang, Dharmasraya. Analysis of processed palm leaves, feed and feces was

Corresponding Author: Suyitman, Faculty of Animal Husbandry, Andalas University, Campus Limau Manis, Padang, West Sumatra, Indonesia

conducted at the Faculty of Animal Husbandry Ruminant Nutrition Laboratory, University of Andalas Padang. The research materials were 20 bulls Simmental aged around 1-2 years weight about 350 kg. Cows were divided into 4 groups based on body weight and randomly allocated to 5 different treatment rations. Ration consisted of forage and concentrate with a ratio of 60:40%. Concentrate formed by fine bran concentrate, pulp, palm oil sludge, premix and probiotics. Forage consisted of grass pitch control and processed palm leaves with mineral supplementation S and P as well as cassava (best result of previous experiments). The equipment used was a cage, cages equipment, digital scales capacity of 1,500 kg, laboratory equipment and other. Randomized block design was used with 5 treatments and 4 rations of beef cattle groups as replication. Cow grouping was based on body weight at the beginning of the study, each replication consisted of 1 beef cattle. The treatments tested were 5 different ration consisted of:

A = Grass field+concentrate (60%: 40%) as a control
B = Leaves of palm oil processed in phase I+concentrate (60:40%)
C = B+supplementation of mineral S and P
D = B+cassava leaf flour
E = C+cassava leaf flour

Design model used was according to Steel and Torrie (1991), as follow:

$$Y_{ij} = \mu + P_i\, K_j + \epsilon_{ij}$$

Differences between treatments were tested by Duncan's Multiple Range Test (DMRT). The parameters measured were: feed intake (kg/head/day), digestibility of nutrients (%), weight gain (kg/head/day), feed efficiency (%).

RESULTS AND DISCUSSION

Observation in this study indicates that refined palm leaf feeding on cattle production is not a problem because it is normally consumed by all cows in this study.

Feed intake: Consumption is a measure of the palatability of feed ingredients, whether the feed ingredients are quite palatable or not, it can be seen from the level of feed intake. Dry matter intake during the study is presented in Table 1.

The results of this study showed that the treatment has no significant effect (p>0.05) on dry matter intake. Dry matter intake in this study was around 10.54-11.25 kg/head/day. Although dry matter intake was not significantly different, but the consumption of dry matter with cassava leaf meal supplementation (ration D) tended to be higher, i.e., 11.25 kg/head/day. This situation illustrates that the supplementation of S and P mineral and cassava leaf meal can increase feed intake because it is palatable and easy to digest.

Table 1: Average dry matter intake during the study

	Treatment					
Dry matter intake	A	B	C	D	E	SE
Kg/head/day	10.54	10.59	10.80	10.81	11.25	1.05
Weight (%)	3.01	3.03	3.04	3.05	3.12	0.09

Description: SE: Standard error, A: Control (grass), B: Ammoniation palm leaves, C: B+S and P mineral supplementation, D: B+cassava leaf meal, E: C+cassava leaf meal

Table 2: Digestibility of nutrients research ration (% DM)

	Treatment					
Nutrient content	A	B	C	D	E	S.E.
Dry matter	61.59[a]	51.51[c]	55.98[bc]	59.05[a]	60.89[a]	1.45
Organic matter	64.57[a]	54.69[c]	58.56[b]	59.62[ab]	61.95[a]	1.39
Crude protein	71.60[a]	49.43[c]	56.65[b]	58.90[b]	70.94[a]	0.1258
Crude fiber	55.27[a]	48.60[b]	51.22[ab]	53.47[a]	54.83[a]	0.2486
NDF	53.07[a]	42.60[d]	45.22[c]	48.47[b]	51.83[a]	0.2486
ADF	39.61[a]	22.44[d]	27.76[c]	34.06[b]	38.72[a]	0.1354
Selulosa	52.31[a]	43.31[c]	46.67[bc]	48.65[b]	52.04[a]	0.0973
Hemiselulosa	78.46[a]	75.16[a]	75.46[a]	76.41[a]	77.11[a]	0.1664

Description: The different superscript in the same row indicate significantly different (p<0.05)

Table 3: Average daily gain (ADG) and feed efficiency

	Treatment					
Parameters	A	B	C	D	E	S.E.
ADG (kg/head/day)	0.79[ab]	0.63[b]	0.65[b]	0.69[b]	0.88[a]	0.06
Feed efficiency (%)	7.49[ab]	5.95[b]	6.02[b]	6.38[b]	7.82[a]	1.54

Description: The different superscript in the same row indicate significantly different (p<0.05)

In this study, the treatment did not seem to affect the palatability of the ration indicated by the relatively the same in consumption of dry material. The situation is due to the similar composition and content of nutrients in the diet. It is in line with the opinion Blaxter (1969) that the consumption of dry matter was influenced by several factors such as palatability, the amount of feed available, the quality or chemical composition of the feed. Sutardi (1980) also stated that the size of the dry matter intake was influenced by several factors, among others, the quality or composition of food in the ration.

Other factors affecting the level of feed intake is physical form, particle size of the feed and feeding frequency. In this study, forage given was previously cut so that the physical shape and size of the particles were similar. The frequency of rationing was done three times: morning concentrates and forage afternoon and evening. Thus the experimental animals had the same time to consume the feed given. This is in accordance with the opinion of Sayuti (1989) that the habit of eating in cattle affected by hunger, time available, physical form of food and feeding frequency. The same opinion was also stated by Van Soest (1982) that the nutrient content of the feed, particle size of the feed and the amount of calories were factors affecting feed intake.

Cattle used in this study were at the age of 1-2 years which is the period of growth with a body weight of 350-400 kg. It means the capacity of the digestive tract and the needs of the food substances were also similar. According to Sutardi (1982) feed consumption was basically depended on the cattle age and livestock condition and production. Davies (1982) added that the level of feed intake was influenced by breeds, body weight, age, rate of production, over weight bodies, protein, feed calorie, blood and rumen metabolism, physiological condition and value of feed digestibility.

Dry matter intake in this study ranged from: 10.54 to 11.25 kg/head/day or 3.00 to 3.12% of body weight (BW). This result is consistent with the results of Batubara (2002) who obtain dry matter intake in beef cattle fed with rations palm leaves was 3.02% of its body weight (BW).

Feed digestibility: Ruminant feed digestibility is closely related to the amount and activity of microbes in the rumen. The results of the digestibility of nutrients during the study are shown in Table 2.

The quality of ration is determined by the digestibility of nutrients from the ration, which illustrates the percentage of substance ingested and the percentage of substance discharged through feces. Substances contained in the food ration are not fully available for the body of livestock some of them will be released again through feces. In Table 2, it appears that the value of digestibility of nutrients of ammoniation palm leaves (treatment B) was significantly lower than other treatments. It describes the low activity of and the number of microbes in the rumen due to insufficient availability of nutrients for microbial growth. Feed digestibility in ruminants is largely determined by the population of microbial bacteria in the rumen. Although in the treatment ammonia was produced quite high; however, it had not been able to increase the growth of bacteria in the rumen. This suggests that in order to grow, the bacteria are not only required nitrogen but it should be followed by the availability of other nutrients such as energy, minerals and amino acids.

S and P mineral supplementation (diet C) was able to increase the digestibility of nutrients, but the increase was only slightly and could not match the digestibility of grass (ration A). This was due to the S and P supplementation that led to the improvement of rumen condition, thus improving the quality of rumen microbes. Mineral S and P are an essential component for the synthesis of amino acids and microbial protein synthesis (Hungate, 1966; Komisarczuk and Durrand, 1991).

Digestibility of dry matter in the ration C was increased by 8.71% compared to ration B, while the fiber fraction digestibility of NDF, ADF and cellulose were increased 8.93, 20.10 and 5.44%, respectively; hemicellulose digestibility, on the other hand, did not increase. Supplementation of S and P minerals gave positive effect on the digestibility of fiber fraction, especially the ADF. This is in accordance with the opinion of Komisarczuk and Durrand (1991) that S is important for fiber digestion in the rumen; sufficient supply of S could optimize the digestibility of cellulose through cellulolytic bacteria specific stimulation and the activity of ciliate protozoa and anaerobic rumen fungi.

Phosphorous is needed by rumen microorganisms for cellulose digestion, but it is not easy to prove that P can stimulate the production of VFA (Church, 1979). Phosphorous is specifically required for digestibility of cell wall's major elements, especially for cellulolysis requiring higher P compared to hemicellulolysis and amylolysis. In most *in-vivo* studies P deficiency showed negatively affect on the digestibility of fiber fraction and organic matter (Komisarczuk and Durrand, 1991).

S and P mineral supplementation in ration C caused the content of S and P in the ration to be as much as 0.57 and 0.62% of dry matter. This amount is much higher than the standard mineral needs, which is 0.14 to 0.26% for the S and from 0.16 to 0.38% for P (NRC, 1985). Meanwhile, according to McDowell (1982) S requirements for small ruminants reared intensively is 0.4% of the total ration dry matter. Although the number is higher than the standard requirement but the bioavailability of these minerals in the ration is low. This is evident from the increase in the digestibility of nutrients in diets C that lower than treatment D and E. In addition, the type of mineral and mineral supplementation shape also affects the outcome of this research.

Supplementation of cassava leaf flour in ration D was significantly increased the digestibility of nutrients. The increased in dry matter digestibility of NDF, ADF and cellulose in ration D was 10.13, 15.83, 51.19 and 43.21%, respectively. Hemicellulose digestibility, however, was decreased by 10.58%. Cassava leaf flour is a source of branched chain amino acids. Branched amino acids are source of carbon skeletons needed to stimulate growth of cellulolytic. Without the carbon skeleton, urea or ammonia nitrogen is not normally used for rumen microbial protein synthesis. The increased population of and activity of cellulolytic bacteria was also reflected in an increase in ration digestibility of ADF and cellulose. The same was reported by Mir *et al*. (1986). It proves that cellulolytic bacteria are very responsive to the addition of branched carbon skeleton.

In this study, it can be seen that rumen microbes are more responsive to the addition of branched-chain amino acids than to the addition of mineral S and P. It is reflected by the increase in the digestibility of nutrients that higher in ration D than that of ration C. This is due to the availability of nutrients for a balanced microbial growth, because without supplementation of mineral S and P the level of minerals in the ration D was 0.32% for S and 0.45 for P and this number was higher than the mineral requirements recommended by NRC (1985).

Mineral supplementation along with cassava leaf meal in the ration E caused an increased in digestibility of the ration thus it was equal to the ration A (grass). The increase in dry matter digestibility of NDF, ADF and cellulose in this treatment were, respectively, 14.63, 22.81, 81.05 and 19.72%. This was due to the increase in population of microbes and its activity in the rumen due to the availability of sufficient and balanced nutrients. The study proved that particular nutrient supplementation should be adjusted to the availability of other nutrients. Increased digestibility can best be achieved in a ration that contains all the nutrients needed by the rumen microbes. In this case the nitrogen comes from ammonia on ammoniation palm leaves, mineral S and P from mineral supplementation and branched carbon skeleton derived from branched-chain amino acids contained in the cassava leaf meal. In this study it appears that the supplementation of mineral S and P and flour cassava leaves gave positive effect on digestibility especially ADF.

When linked with the consumption of the ration dry matter (Table 1) apparently the increase in the digestibility of the ration was not followed by an increase in feed intake. This is due to the rate of flow of digesta in the lower digestive tract. Although ruminant stomach has a large capacity but the amount consumed is still limited by the speed of digestion and the remaining food removed from the digestive tract. Raw foods containing high crude fiber is difficult to digest thus the flow rate is low (Tillman *et al*., 1998).

Dry matter digestibility in this study ranged from 51.51-61.59%. This figure is lower than the dry matter digestibility obtained by Batubara (2002) where palm leaves were given to cattle which was 69%. ADF digestibility values range from 22.66-41.02%. This figure is similar to the results of Zain (1999) by giving ammoniation palm fiber and supplemented with hydroxy analogue methionine and branched chain amino acids in defaunation sheep i.e., 10.98-51.09%. A study by Akbr (2006) using fermented palm bunches on dry matter digestibility of sheep obtained 60.12-70.97% and ADF digestibility 36.44-56.47%.

Average daily gain and feed efficiency: The addition of body weight is a reflection of the quality of the feed. Data of body weight gain and feed efficiency in this study are presented in Table 3.

In this study ammoniation palm leaves (ration B) gave similar figure of body weight gain to that of diet C (mineral supplementation) and D (supplemented cassava leaf meal). The highest body weight gain was obtained in ration E (S and P mineral supplementation and cassava leaves) which was 0.88 kg/head/day and the lowest was in ration B (refined palm leaves) of 0.63 kg/head/day. The high body weight gain in ration E was due to high consumption and ration digestibility as shown in Table 1 and 2. Whereas, the low weight gain in ration C was due to the low consumption of the ration dry matter so that the availability of nutrients for cattle was low. Body weight gain in this study is higher than that of obtained by Batubara (2002) that gave palm leaves on the beef cattle: 0.76 kg/head/day.

Feed efficiency is the value obtained from the resulting body weight gain per unit of feed dry matter consumed. The greater the value the more efficient is the ration in resulting body weight gain. As shown in Table 3 the treatment gave significantly different effect ($p<0.05$) on feed efficiency. The value of feed efficiency in rations A, B, C and D was not significantly different, but the efficiency of B ration was lower than other treatments. The low efficiency of feed rations at B due to lower body weight gain produced. Ration efficiency values were best obtained on treatment E, which was 7.82% and followed sequentially by treatment A, D, C and B. The difference in feed efficiency in this study was due to the differences in body weight gain and feed dry matter intake. In accordance with the opinion of Sutardi (1980) that the magnitude of feed efficiency will depend on the amount of dry matter intake that able to give weight gain. Therefore, it can be assumed that the higher the body weight gain resulting from a diet, the more efficient the ration to be used.

Feed efficiency values obtained in this study ranged from 5.95 to 7.82%, this value is higher than that of obtained by Batubara (2002) where palm leaves were given to cattle, which was 13.6%. The results of this study are also higher than the efficiency of the ration of the goats fed with rations of cut palm leaves and palm oil processing wastes, amounting to 12.71-16.11% (Batubara *et al*., 2003). Study by Akbr (2006) who gave the fermentation of palm empty fruit bunches resulted efficiency values ranged from 6.34 to 13.41%.

Conclusion: The results showed that ammoniation palm leaves supplemented with mineral S and P and cassava leaf meal was able to replace 100% grass in beef cattle feed and gave better performance than control ration (grass) in terms of body weight gain.

ACKNOWLEDGEMENTS

The authors are grateful to the Directorate General of Higher Education (DGHE) for funding this project under the scheme of Master Plan for the Acceleration and Expansion of Indonesia's Economic (MP3EI).

Acknowledgements submitted to the Directorate of Research and Community Service, the Directorate General of Higher Education, Ministry of Education and Culture which has funded this research through DIPAof the University of Andalas.

REFERENCES

Akbr, S.A., 2006. Effect of fermented empty palm fruit bunches, defaunasi and by pass protein on performance of sheep. Dissertation Postgraduate Program Andalas University. Padang.

Batubara, L.P., 2002. The biological potential of palm leaves as basal feed in rations of beef cattle. Proceedings of the National Seminar on Animal Husbandry and Veterinary Technology. Center for Animal Husbandry, Bogor, pp: 135-138.

Batubara, L.P., S.P. Ginting, K. Simanjuntak, J. Sianipar and A. Tarigan, 2003. Utilization of waste and by-products of oil palm plantations as goat ration cut. Proceedings of the National Seminar on Animal Husbandry and Veterinary Technology. Center for Animal Husbandry, Bogor, pp: 106-109.

Blaxter, K.L., 1969. The Energy Metabolism in the Rumen. Methuen and Co. Ltd., London.

Central Bureau of Statistics (BPS), 2014. West Sumatra in Figures 2013, Central Bureau of Statistics of West Sumatra Province, Padang.

Church, D.C., 1979. Digestive Physiology and Nutrition of Ruminant. Vol. 1. Digestive Physiology. 2nd Ed. Jhon Wiley and Sons, New York.

Davies, H.L., 1982. Nutrition and Growth Manual. Publihed by Australian Universities International Development Program, Melbourne.

Hungate, R.E., 1966. The Rumen and It's Microbes. Department of Bacteriology and Agriculture Experiment Station University of California. Davis California Academy Press, London.

Komisarczuk, S. and M. Durrand, 1991. Effect of mineral on microbial metabolism. In. Rumen Microbial Metabolism and Ruminant Digestion. J.P. Jouany (Ed) INRA publ. Versailes, France.

Mc Dowell, L.R., 1982. Mineral in Animal and Human Nutrition. Academic Press, Inc. London.

Mir, P.S., Z. Mir and J.A. Robertson, 1986. Effect of branched chain amino acids or fatty acids supplementations on *in vitro* digestibility of barley straw or alfalfa hay. Can. J. Anim. Sci., 66-151.

Muller, Z. and K.C. Nah, 1975. Cassava as total substitute for cereals in livestock and poultry rations. Proc. of Tropical Products Institute Conference, 1-5 April, 85-89.

NRC, 1985. The Nutrient Requirements of Ruminant Livestock. National Academy of Science, Washington, D.C.

Sa'id, E.G., 1996. Handling and Utilization of Oil Palm Waste. Poster Agriwidya, Ungaran.

Sayuti, N., 1989. Ruminology. Faculty of Animal Husbandry andalas University, Padang.

Steel, R.G.D. and J.H. Torrie, 1991 Principles and Procedures of Statistics, A Biometric Approach. 2nd edition B. Sumantri. PT. Scholastic Press, Jakarta.

Sutardi, T., 1980. Resistance of protein food ingredients against degradation by rumen microbes and beneficial for the improvement of livestock production. Proceedings of the Seminar on Research and Supporting Ranch. LPP, Bogor.

Sutardi, T., N.A. Sigit and T. Toharmat, 1982. Standardization of food protein quality parameters based ruminant metabolism by rumen microbes. Faculty of Animal Science, Bogor Agricultural University In collaboration with the Director of Development and Community Services Department of Education. Jakarta.

Tillman, A.D., H. Hartadi, S. Reksohadiprodjo, S. Prawirokusumo and S. Lebdosoekojo, 1998. Animal Feed Science Basis. Gadjah Mada University. Yogyakarta.

Van Soest, P.J., 1982. Nutritional Ecology of Ruminants. O and B Books. Inc. Virginia.

Warly, L., A. Kamaruddin, Hermon, W.S.N. Rusmana and Elihasridas, 1998. Utilization of agro-industrial by-products as a food ingredient ruminants (evaluation *in vivo*). Competitive Grant Research Report V/2 College of Fiscal Year 1997/1998. Faculty of Animal Husbandry, Andalas University, Padang.

Widjaja, E. and B.N. Utomo, 2001. Utilization of oil palm solid waste as a feed supplement ruminants in Central Kalimantan. Proceedings of the National Seminar on Animal Husbandry and Veterinary Technology. Center for Animal Husbandry, Bogor, pp: 262-268.

Zain, M., 1999. Substitution lawn with palm fiber in the diet of sheep growth: the effect of ammoniation, defaunasi and supplementation of methionine hydroxy analogue and branched amino acids. Dissertation Postgraduate Program Bogor Agricultural University, Bogor.