IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)
e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 3, Issue 6 (Jul. - Aug. 2013), PP 23-27
www.iosrjournals.org

Blood profile and daily gain of fat-tailed growing rams receiving tree foliages to substitute other ingredients in the concentrate diets

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Abstract : *This research was aimed to investigate the blood profile and daily gain of fat-tailed growing rams by substituting dried leaves of Moringa oleifera (MOL) and Samanea saman (SSL) to other ingredients in the concentrate feed. 16 growing rams aged between 6 and 8 months (PI_0), average body weight (BW) was 13.83±1.73 kg, were placed randomly in an individual cage. The treatments were $P_{14}L_0$=14% of CP concentrate feed without leaves supplement, $P_{14}L_{M-S}$=14% of CP concentrate feed with MOL (30%),SSL (10%), $P_{18}L_0$=18% of CP feed concentrates without leaves, $P_{18}L_{M-S}$=18% of CP feed concentrates with MOL (30%), SSL (10%). The rams were fed a basal diet of maize stover plus the concentrate at 2.5 % and 1.% of body weight on dry matter basis, respectively. Drinking water was available ad libitum. Blood sample was taken from the jugular vein and analysed for blood metabolites profile. The results showed that substituting ingredients with MOL and SSL had no significant effect on feed dry matter digestibility as well as on the blood profile. Nevertheless, the total feed intake and daily weight gain increased significantly ($P<0.05$) as compared to the control diet by 6.5 % and 12.5 %, respectively. The blood profiles of rams i.e.: hemoglobin (8.3 to 9.38 g/dl), leukocyte (47.90 to 68.71/mm^3), erythrocytes (4.95 to 5.85 x 10^6/mm^3), blood glucose (53.63 to 56.50 mg/dl), blood urea (19.75 to 24.28 mg/dl), albumin (1.95 to 2.28 g/dl), and globulin (2.73 to 4.10 g/dl) were considered within the normal range suggesting that substituting MOL and SSL did not impair the general health of the rams.*

Keywords - *supplementation, tree foliages, and blood profile.*

I. INTRODUCTION

Efforts to improve the productivity of ruminants are generally done through the manipulation of the fermentation process in the rumen. The main result of fermentation process in the rumen are volatile fatty acids (VFA), microbial cells, CO_2, and CH_4. Addition of antibiotics, growth hormones, and chemicals to stimulate growth in ruminants can leave residues in livestock products which are potentially harmful to public health, so their use have been banned in several countries [1]. In this regard, some researchers have done many studies utilizing tropical tree foliages such as *Calliandra calothyrsus* and *Flemingia macropphylla* as an alternative protein source as well as secondary compounds to manipulate fermentation of feed in the rumen and simultaneously supress the production of methane gas. [2],[3],[4],[5].

In Indonesia there are many tree foliages as the source of supplemental protein, minerals and vitamins for ruminants but their usage is still underutilized [6]. There is ample evidence to show that supplementation with tree foliages at certain levels will be beneficial to the animals, but if the dose exceeds the threshold limit, it will result in interference [7],[8].

In the previous studies under in vitro conditions (Marhaeniyanto, unpublished) addition of either aceton or ethanol-extracted leaves of 15 species of Indonesian tree foliages showed a signifcant supression of CH4 production suggesting that the secondary compounds of these tree foliages can be used as a rumen manipulator. Furthermore, when the dried leaves of *MOL* and *SSL* were mixed at ratio (30% of MOL: 10% of SSL) in the concentrate diet the production of CH_4 decreased by 34 % that may imply to the significant reduction in the emitted methane gas to the air (Marhaeniyanto,unpublished).

As plant secondary compounds influence the general health of animals particularly if given in excess of the limit threshold and there is paucity in information on the deleterious effect of some Indonesian tree foliages given to ruminants it is pertinent to elucidate such effect reflected in the blood profile of animals.

II. Methodology

The materials used for this study consisted of 16 growing rams aged between 6 and 8 months (PI_0), average body weight (BW) was 13.83±1.73 kg, were placed randomly in an individual cage. The treatments were:

$P_{14}L_0$ = 14% of CP concentrate feed without leaves supplement,
$P_{14}L_{M\text{-}S}$= 14% of CP concentrate feed with *MOL* (30%), *SSL* (10%),
$P_{18}L_0$ = 18% of CP feed concentrates without leaves,
$P_{18}L_{M\text{-}S}$= 18% of CP feed concentrates with *MOL* (30%), *SSL* (10%).
Since the maize stover had a high crude fiber (26.32%), a supplementary energy sources i.e. wheat pollard, rice bran, and corn bran were added to balance nutrient content in the concentrate feed.

In the period of adaptation, the rams were drenched with a commercial anthelmintic drug prior to data collection. The rams were fed a basal diet containing maize stover plus concentrate at 2.5 % and 1.0 % of body weight on dry matter basis, respectively. Drinking water was available ad libitum.

The variables measured were (a) nutrient content and feed nutrition, (b) average daily gain and feed conversion, (c) blood profiles of rams i.e.: blood hemoglobin, leukocyte , erythrocytes , blood glucose , blood urea , albumin and globulin. The blood samples were aspirated via a jugular vein at 3 hours post feeding and it was done 3 times at three weeks interval. The blood were transferred immediately to the laboratory for furthes analysis using ABX Micros 60 Hematology Specification Analyzer. The data were statistically analyzed according to a randomized block design followed with a honesty significant difference test.

III. Results And Discussion

3.1. Nutrient content of animal feed, nutrition, average daily gain and feed conversion

Table 1**.** Nutrient content of rations used throughout the study

Ingredients	Concentrate feed CP 14%		Concentrate feed CP 18%	
	without leaves	with leaves*	without leaves	with leaves*
	$P_{14}L_0$	**$P_{14}L_{M\text{-}S}$**	**$P_{18}L_0$**	**$P_{18}L_{M\text{-}S}$**
Moringa oleifera leaves	0	30*	0	30*
Samanea saman leaves	0	10*	0	10*
Wheat pollard	15	0	8	5
Rice bran	25	25	7	10
Corn bran	11	25	7	10
Coconut cake	27	0	35	16
Soyabean cake	10	0	22	7
Coffee pulp	8	0	15	6
Molasses	3	9	5	5
Mineral mixture	1	1	1	1
Chemical composition**				
Dry matter (%)	88.41	85.64	85.72	85.56
Organic matter (%)	87.82	86.59	88.17	86.55
Crude protein (%)	14.03	13.90	17.96	18.06
Crude fiber (%)	17.91	15.69	16.47	16.43

* concentrate feed contained MOL (30%), SSL (10%) in addition of other ingredients to make 100 %
**Analysis results by Laboratory Animal Nutrition of Animal Husbandry Faculty, Brawijaya University Malang.

As shown in Table 1. there is minor differences between intended and analysed CP content of the experimental diet. Table 2. shows feed intake and digestibility differences as affected by dietary regimes. Substituting other ingredients of concentrate rations with *MOL* and *SSL* tended to reduce the feed intake regardless of the CP content. In contrast, feed digestibility was not statistically influenced by addition of MOL and SSL that may associated with the inconsistent changes in the daily weight gain of the animals and feed conversion ratio. [9] reported a significant increase in feed intake of dairy creole cows fed a basal diet consisting of *Brachiaria brizantha* and mollases when *MOL* was added to the diet. In this study, the feed intake and feed digestibility were reduced in the presence of *MOL* and *SSL* that may be linked to the binding properties of tannin from *MOL* and *SSL* to the grain protein of the concentrate feed. But as the daily weight gain improved in the presence of *MOL* and *SSL*, It thus is likely that the second stage of enzymatic digestibility taken place at post rumen digestive tracts may play an important role to break down the binding and release available nutrients to be absorbed and utilized for growth

Table 2. Average total intake (g/kgBW$^{0.75}$/day), digestibility (%), daily gain (g/head/day) and feed conversion from fed a basal diet of maize stover plus the concentrate at 2.5 % and 1.% of body weight on dry matter basis in growing ram

Parameter	Fed a basal diet of maize stover plus concentrate feed CP 14%		Fed a basal diet of maize stover plus concentrate feed CP 18%	
	without leaves	with leaves*	without leaves	with leaves*
Dry matter intake (g/kgBW$^{0.75}$/day)	71.7±8.65^{b}	59.2±10.42^{a}	66.4±3.85^{ab}	68.6±4.04^{b}
Organic matter intake (g/kgBW$^{0.75}$/day)	64.9±7.95^{b}	53.6±9.28^{a}	60.0±3.42^{ab}	61.9±3.51^{b}
Crude protein intake (g/kgBW$^{0.75}$/day)	7.03±0.70^{b}	5.75±0.91^{a}	7.11±0.55^{b}	7.56±0.21^{b}
Crude fiber intake (g/kgBW$^{0.75}$/day)	21.9±2.61^{b}	18.3±2.53^{a}	20.3±0.97^{ab}	20.9±1.04^{b}
Dry matter digestibility (%)	66.9±5.00^{a}	68.6±4.33^{a}	72.5±3.43^{a}	68.1±4.57^{a}
Organic matter digestibility (%)	68.9±4.85^{a}	70.4±4.39^{a}	73.8±3.44^{a}	69.3±4.22^{a}
Crude protein digestibility (%)	64.3±3.57^{a}	65.7±6.20^{a}	71.0±4.16^{a}	68.5±4.74^{a}
Crude fiber digestibility (%)	63.6±7.66^{a}	75.4±4.43^{a}	66.1±3.34^{a}	77.1±4.16^{a}
Average daily gain (g/head/day)	75.1±19.01^{b}	54.3±20.7^{a}	76.6±9.08^{b}	87.7±18.3^{b}
Feed conversion	7.51±1.32^{a}	9.00±1.96^{a}	6.74±0.66^{a}	6.28±1.20^{a}

^{ab} *Means in the same row for each parameter with different superscripts are differences at (P<0.05)*
^{a} *Means in the same row for each parameter with same superscripts are not differences at (P>0.05)*

Calculating the DM and CP intake on the basis g/kgBW^{0,75} it was found that substituting other ingredients in the concentrate *with MOL* (30%) and *SSL* (10%) had exceeded the nutrient requirement for maintenance. As reported by [10] the maintenance requirement for DM and CP intakes are 50 g/kgBW$^{0.75}$ and 4.15 gCP/kgBW$^{0.75}$, respectively. In this experiment as the feed digestibility was higher than 65 % [11] which is considered as the intended minimum digestibility of feed, it is therefore expected that any excess of feed consumption by the rams would be converted into meat production.

Daily gain is one indicator of the production performance substantiated by the nutritive value of feed ration consumed. This study demontarted that increasing CP level from 14 to 18 had significantly improved ADG (Table 2), but the difference between $P_{18}L_0$ and $P_{18}L_{M-S}$ was not significantly different in spite of treatment $P_{18}L_{M-S}$ showed a high response of ADG *i.e*. 87.68±18.27 g/head/day. The results of ADG obtained in $P_{18}L_{M-S}$ correlates with the highest feed intake and digestibility as compared with the other dietary regimes (Table 2). This ADG is similar to the research results of the use of *MOL* and *Leucaena leucocephala* leaves as much as 1% of body weight with rice straw basal feed *i.e*. 76.00±0.10 g/head/day [12], however it is still lower than the report of [13] where mollases urea block containing *MOL* supplementation as much as 1% of body weight (BW) on growing goats resulted in ADG up to 107.54±10.27 g/head/day.The feed conversion in this study is considered still within the normal range in rams i.e. 6.38 to 8.02 [14]

3.2. Blood Profile

Tabel 3. Blood profile indices in growing rams as affected by the difference in the dietary regimes

Parameter	Fed a basal diet of maize stover plus concentrate feed CP 14%		Fed a basal diet of maize stover plus concentrate feed CP 18%		level in the normal ram blood
	without leaves	with leaves*	without leaves	with leaves*	
Haemoglobin g/dl	8.30±1.67^{a}	9.38±0.99^{a}	8.83±0.77^{a}	8.46±1.61^{a}	8-14[15], [16]
Leukocytes /mm^3	68.7±7.53^{a}	59.8±24.14^{a}	47.9±7.66^{a}	62.0±10.86^{a}	4-12[16]
Eritrocytes 10^6/mm^3	5.32±1.05^{a}	5.38±1.66^{a}	5.85±0.49^{a}	5.95±0.57^{a}	5-15[15], [16]
Glucose mg/dl	56.5±6.61^{a}	53.6±6.07^{a}	55.1±2.46^{a}	55.88±2.87^{a}	30-60[16] [17]
Ureum mg/dl	21.04±0.87^{a}	19.7±3.53^{a}	24.3±2.73^{a}	24.16±2.46^{a}	6-36 [16] [17]
Total protein g/dl	5.80±0.32^{a}	5.60±0.37^{a}	5.00±1.35^{a}	6.38±0.57^{a}	5,5-8,10[17],[18]
Albumin g/dl	1.95±0.53^{a}	2.03±0.68^{a}	2.28±0.87^{a}	2.28±0.31^{a}	2,7-4,55[18]
Globulin g/dl	3.85±0.66^{a}	3.58±0.39^{a}	2.73±0.57^{a}	4.10±0.55^{a}	n.a
Ratio A:G	0.53±0.22^{a}	0.58±0.23^{a}	0.82±0.25^{a}	0.56±0.11^{a}	0,5-1,6[18]

^{a} *Means in the same row for each parameter with same superscripts are not differences at (P>0.05)*
n.a = not available
Analisis by Faal laboratory, Medical medicine Faculty of Brawijaya University.

The effects of dietary regimes under investigation on the blood profile showed no significant difference (P>0.05) (Table 3). Except that for leucocyte, all blood parameters were within the normal range.

Leukocyte is the body's defense systems unit. Leukocyte is formed partly in the bone marrow (granulocytes and monocytes, and some lymphocytes), and partly in the lymphoid tissue (lymphocytes and plasma cells) further to be transported in the blood to various parts of the body needed. Increased value of leucocyte is generally associated with the response of internal body against microbial infection. The higher value of blood leucocyte found in this study that ranged from 47.90 to 68.71/mm^3 (Table 3) pose a further explanation since there was no deleterious effect observed in the animals such as severe infection.

Erythrocyte is a blood cell that has a function to bind oxygen and circulate throughout the body tissue. Erythrocyte levels of growing rams showed values ranging from 4.95 x10^6/mm^3 to 5.85 x10^6/mm^3 (Table 3).

The highest erythrocyte level was in treatment $P_{18}L_{M-S}$ ($5.95\pm0.57x10^6/mm^3$) but still within the normal range of values reported by [15] i.e. from 5 to 15 X $10^6/mm^3$. The tendency of lower values of erythrocyte in treatment $P_{18}L_{M-S}$ may reflect the presence of anti-nutrient factor presumably in the form of saponin that has been known to cause lysis of erythrocyte. This condition may induce hypoxia if the amount of saponin in excess of the tolerance of animal's body. Nevertheless, the values of erythrocyte in this study are still within the acceptable range, so no pathological symptom appeared.

The glucose levels did not show significant difference (P>0.05) among treatments ranging from 53.63±6.07 mg/dl to 56.50±6.61 mg/dl. According to [16] the normal sugar levels in rams ranges from 55.0 to 131 mg/dl. Thus, the blood glucose growing of rams during the study was still in the normal range. Glucose is needed the body for the function of nerve, muscle, fat tissue, fetal growth, and milk production. In ruminants, it is known as glucose level guard system in the blood through the process of glycolysis, glycogenesis, and gluconeogenesis, so that the blood glucose concentration remained relatively constant [19]. If the feed carbohydrate is insufficient, the need of glucose of the body will be met through the process of gluconeogenesis i.e. the formation of glucose or glycogen from non-carbohydrate sources, the main substrates are glycogenic amino acids, lactate, glycerol, and propionate, also, from the process of glycogenolysis or glycogen breakdown. The highest amount of glucose is in the blood and extra cellular fluid [14]. The estimate of body's energy can be seen from the content of blood glucose.

Blood urea levels in rams during the study showed no significant difference (P>0.05) among treatments, with values ranging from 19.75 to 24.28 mg/dl. The highest blood urea mean was found in treatment $P_{18}L_{M-S}$ (24.16±2.46 mg/dl) and $P_{18}L_0$ (24.28±2.73 mg/dl), while the lowest value was found in treatment $P_{14}L_{M-S}$ (19.75±3.53 mg/dl). The blood urea levels in rams are normally ranging from 10.0 to 36.0 mg/dl [11],[19]. Accordingly, blood urea level was within normal limit but increasing CP content from 14 % to 18 % regardless of substitution with MOL and SSL, blood urea levels increased suggesting that more soluble nitrogen was feremented in the rumen to satisfy the microbial requirement for growth. This finding is in accordance with the opinion of [20] that the increase of urea concentration in blood plasma is proportional to the availability of protein ration.

The total protein ranged from 5.00 to 6.38 g/dl; albumin level ranged from 1.95 to 2.28 g/dl; globulin level ranged from 2.73 to 4.10 g/dl, and ratio of A/G ranged from 0.53 to 0.82. According to [16], the total protein content in rams ranges from 5.70 to 9.10 g/dl and albumin level ranges from 2.70 to 4.55 g/dl and ratio of A/G ranges from 0.70 to 1.60. This condition is still in the normal range despite it is in the lower threshold. Albumin and blood globulin are synthesized in the liver. Albumin is the smallest plasma protein molecule, because albumin is small, it is more involved in the osmotic pressure. Proposes that albumin is the major protein in plasma with molecular weight of 69 kDa and compiles around 60% of the total plasma protein. Immune system found in albumin is needed by the body to maintain the integrity to the dangers that can be posed in a variety of environmental materials [21].

IV. CONCLUSION

Substituting dried leaves of *Moringa oleifera* (30%) and *Samanea saman* (10%) to other ingredients in the concentrate feed (18% of crude protein) given as much as 1.0% BW to the basal diet of maize stover resulted in average daily gain of 87.68±18.27 g/head/day, and normal range of blood profile of growing rams.

Acknowledgements

This study was funded by a doctoral research scholarship provided by Directorate General of Higher Education, Ministry of Education and Culture the Republic of Indonesia and partly supported by Tribhuwana Tunggadewi University fund. Many thanks are due to official staff of Animal Nutrition Laboratory, Faculty of Animal Husbandry, and Physiology Laboratory of Medical Faculty, Brawijaya University for their valuable assistance and supports.

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