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5 Complete Dried Ration for Ruminant Based on *Pennisetum purpureum* cv. Mott Enriched Phyto-Protein of Tree Legumes Leaf

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Abstract. Indonesia is a country with a big human population in the world, still import red meat, since the price of this commodity is higher than those import. The problem is supply of forages is insufficient due to limitation of space for forage production. Especially during the dry season the forages almost disappear and farmers face on shortage supply of forage followed decrease beef production. This research aimed to study the effects of enriched protein of tree legume leaf on complete dry ration based on tropical grass. The treatments were: T-1 = P.purpureum (control); T-2 = PP + GS+Cr; T-3 = PP + LL + Cr; T-4 = PP + IZ + Cr. Treatments were arranged on Completely Randomized Design, with 5 replications. Twenty male goats with average body weight \pm 15 Kg has been used. The results of this research showed that treatment T-3 with *I. zolingeriana* (IZ) as a source of phyto-protein in complete rations has the best results on all variables measured. It could be concluded that leaves of this tree legumes prospective to support the application of technology complete ration based on local resources to resolve the problem of shortages of feeds supply to ruminant in the tropic region.

Keywords: dry ration, ruminant, pennisetum, enriched, legume.

1. Introduction

Indonesia is the 5th biggest human population in the world, still import red meat to meet the national demand of this commodity in the country, since the price of this product is higher than those import. One of the main constraints in increasing livestock productivity in the tropical region is the scarcity of good quality feed through the year, particularly during the long dry season. Poor quality feed of tropical grasses given by the farmer leads to low daily gain of cattle. The problem is supply of forages is insufficient due to limitation of space for forage production and depend on the seasons especially in dry period. Tropical grasses as the main source of feed is never sufficient to meet nutrient requirement at least 8% of crude protein [1]. On the other hand, there are some tropical



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forages such as tree legumes i.e., *Gliricidia sepium*, *Leucaena leucocephala*, and *Indigofera zollingeriana* grown abundantly and available along the year, where those tree legumes produces leaf could be improved the quality of low-quality grasses. The later is a new species being evaluated in a country with good agronomic traits such as rapid re-growth in the defoliation interval of 60 days with a production of 50 tons/ha/year [2], well adaptive to low soil fertility and high seed production [3], with crude protein content 23.40%. Used fresh leaf of this species for local goats increased daily weight gain and efficiency up to 45% and 30% respectively [4]. This study was carried out to evaluate the contribution of these leaf tree legumes to enrich the complete ration based on tropical grass of *Pennisetum purpureum* cv. Mott and improve in term of coefficient digestibility, average daily gain and feed conversion.

2. Material and Methods

This research was conducted at Asessment Institute of Agriculture Technology (AIAT) at Pandu village, North Minahasa regency of the province of North Sulawesi. Located on the geographical position of Lat. 1° 30' N, and 124° 54' E and 67 meters above sea level. The study lasted 7 months from January to late August 2019. The experiment was conducted at the Laboratory of Forage Science Faculty of Animal Science, University of Sam Ratulangi Manado. The plant material used, consists of tree legumes leaves of *G. sepium*, *L. leucocephala* and *I. zollingeriana* in this study were taken from the field experimental station in collaboration with Regional Board of Agricultural Assessment Technology in North Sulawesi Province, located on the geographical position of Lat. 1° 30' N, and 124° 54' E and 67 meters above sea level. The study lasted 7 months from January to late August 2019. All plants have been trimming to get homogeny re-growth where *P. purpureum* cv. Mott was harvest at the age of 45 days re-growth and all tree legumes were harvest at the age of 60 days re-growth. *P. purpureum* cv. Mott was defoliated at first node from the soil surface (approximately 10 cm above ground). Sample of *P. purpureum* has taken five plants in two places in each plot so there were 10 plants as samples in each plot. All tree legumes were defoliated at 1 meter from the soil surface. Fresh samples were then dried at 60 °C or about 48 h to determine the dry weight. Complete rations in this research were dried chopped *P. purpureum* (PP), dried ground leaf of tree legume of *G. sepium* (GS), *L. leucocephala* (LL) and *I. zollingeriana* (IZ), and concentrate (Cr) consists of rice bran, ground yellow corn, tapioca powder, salt, and mineral mix. The treatments were: T-0 = *P. purpureum* (PP) as control feed; T-1 = PP + GS + Cr; T-2 = PP + LL + Cr; T-3 = PP + IZ + Cr. All ingredients in each treatment were mixed homogeny, formed a block of 10 cm x 20 cm x 5 cm and dried under sunlight. Treatments were arranged on Completely Randomized Design, with 5 replications. Twenty male goats with average body weight ± 15 Kg has been used. Variables measured were quality of complete rations, feed intake and nutrient digestible coefficient. Total digestible collection methods have been applied to determine the apparent digestible coefficient (ADC) of dry matter, crude protein, crude fiber, ether extract, and nitrogen-free extract. This trial has been done in two periods of time, where 7 days preliminary periods as adaptation to the new ration, and 5 days as feces and intake data collecting. Total ration offered and refused was measured each day during collecting periods, and drinking water for animals was available freely. For control ecto and endoparasite animal has received injection of doramicine prescribe by veterinarian. Sample of test rations has been taken two days at the end of preliminary periods and five days during collecting. Sample of feces was first dried under sunlight and then oven drying at 60 °C for 48 hours. The samples were analyzed for dry matter, crude protein, crude fiber, and ash according to the standard procedure of the Association of Official Analytical Chemists. Data were then statistically analyzed by using analysis of variance (ANOVA) employing MINITAB (Version 16). Honestly, Significance Difference (HSD) was applied to determine the difference among treatments. Differences were considered at $P < 0.05$.

3. Results and Discussions

3.1 Local concentrate

Complete ration based on tropical grass *P.purpureum* cv. Mott for ruminant which is poor as feed needs to be improved the quality with some sources of energy and protein as local concentrate. The ingredient of local concentrate consists of rice bran 45%, ground yellow corn 35%, coconut meal 12.50%, Tapioca 5.00% and mineral-mix 2.00%. complete ration was formulated as T-0, T-1, T-2, and T-3 with different sources leaf protein of *L. autocephaly*, *G. sepium* and *I. zollingerianain* same levels by 40%, and local concentrate by 20 % (Table 1).

Table 1. Formulation of the experimental complete feed (% DM)

Ingredients (%)	Treatments			
	T-0	T-1	T-2	T-3
<i>Pennisetum purpureum</i> cv. Mott	100	40	40	40
<i>Leucaena lucocephala</i>	-	40	-	-
<i>Gliricidia sepium</i>	-	-	40	-
<i>Indigofera zollingeriana</i>	-	-	-	40
Local concentrate	-	20	20	20
Total	100	100	100	100

T-0, control feed 100% *P. purpureum* (Pp)cv. Mott ; T-1 40% of PP + 40% LL + 20% Cr; T-2 40% of PP + 40% of GS + 20% Cr; T-3 40% of PP + 40% of IZ + 20% Cr.

Feed materials have been ground pass a 1 mm sieve size and mixed homogenously with nutrient contents as presented in Table 2 below.

Table 2 showed CP content of treatment T-3 lightly higher than those treatment T-1 and T-2, and more than double compared to treatment T-0 was probably due to the high CP content 29.2% of the plant [5]. High CP content of this *Indigofera*.had been also reported by some authors and generally ranged from 23-27% DM [4] and [6]. Further, the impact of this quality using pure pellet of *I. zollingeriana* leaves increase goat milk production, feed efficiency, and nutrient efficiency by approximately 26%, 15-23%, and 5-9%, respectively [7].

Table 2. Nutrient contents of experimental complete rations (%DM)

Treatments	CP	CF	NFE	EE	Ash
T-0	7.56	33.9	41.1	1.71	14.8
T-1	16.5	11.7	52.9	8.88	11.6
T-2	15.9	10.5	50.7	7.95	10.9
T-3	18.5	10.1	49.3	8.99	12.7

Note: T-0 control feed; T-1 complete ration with source protein *Leucaena* ; T-2 complete ration with source protein *Gliricidia*and T-3 complete ration with source protein *Indigofera*.

3.2 Feed intake and coefficient digestibility

The effects of treatments on feed intake and apparent digestibility coefficient of nutrients is presented in Table 3. The digestibility of dry matter is the primary determinant, besides organic matter, of the quality feed and forage. Nutrient digestibility is determined by the composition of fiber in the diet. Treatment T-0 as control contained high level of fiber and low crude protein content (Table 2) lead to the low ADC of DM at 66.26% significant (P<0.05) lower compared to the treatments T-1 (69.91%), T-2 (69.80%), and the highest value of ADC of dry matter was at the T-3 (74.49%). The better utilization of *I. zollingerianain* complete ration has also been supported by the report of *in vitro* digestible trial that *in vitro* dry matter digestibility (IVDMD) of this leaf tree legume was ranged between 65.5-71.5%[8]. High ADC of crude protein by using *I. zollingeriana* is due to the CP content 18.5% was higher compared to other legumes and control treatment (Table 2). Further, this high ADC of crude protein it seems that secondary compound present in this tree legume such as tannins and saponins influence the digestibility by protecting protein and other nutrients from microbial degradation in the rumen [9]. Contrary low coefficient digestibility of CF (65.55%)

probably due to the high content of CF concomitantly low CP content (7.56%) of treatment of T-0, which is not meet the minimum level required in ruminant diets.

Table 3. Feed intake and coefficient digestibility of complete ration

Treatment	Variable	Components		
		DM	CP	CF
T-0 (Pp)	Feed intake (Gr/h/d)	552,76	51,67	138,30
	FecalOut put (Gr/h/d)	186,47	19,60	47,64
	Apparent Digestible Coefficient (ADC) (%)	66,26 ^c	62,74 ^c	65,55 ^b
	Nutrients digested intake (Gr/h/d)	375,87 ^c	32,03 ^c	89,70
T-1 (Ll)	Feed intake (Gr/h/d)	565,34	56,23	136,65
	FecalOut put (Gr/h/d)	170,23	17,68	44,12
	Apparent Digestible Coefficient (ADC) (%)	69,91 ^b	68,56 ^b	67,71^a
	Nutrients digested intake (Gr/h/d)	395,50 ^b	38,23 ^b	91,55
T-2 (Gs)	Feed intake (Gr/h/d)	561,78	55,49	131,03
	FecalOut put (Gr/h/d)	169,65	18,04	45,12
	Apparent Digestible Coefficient (ADC) (%)	69,80 ^b	67,45 ^b	65,56 ^b
	Nutrients digested intake (Gr/h/d)	387,63 ^b	37,17 ^b	85,17
T-3 (Iz)	Feed intake (Gr/h/d)	571,14	65,33	129,01
	FecalOut put (Gr/h/d)	171,21	18,01	45,32
	Apparent Digestible Coefficient (ADC) (%)	74,49^a	72,43^a	68,87^a
	Nutrients digested intake (Gr/h/d)	496,64 ^a	47,04 ^a	87,73

Treatment means with common letters in the same column in each treatment and variable are not significantly different (P<0.05).

3.3 Average daily gain and feed conversion

The effects of treatments of complete ration on the feed intake, average daily gain and feed conversion presented in Table 4. Complete rations containing tree legume leaf of *I. zollingeriana* showed the better results of all variables measured. Dry matter intake 571.14 Gr/h/d, ADG 150.60 Gr/h/d and FC value by 3.79 were significant higher (P<0.05) compared to other treatments. Higher ADG of treatment T-3 was determined by higher nutrient digested intake 496.64 Gr/h/d of DM and 47.04 Gr/h/d of CP (Table 3), as stated by previous research [10] and [11].

Table 4. The effects of complete rations on feed intake, average daily gain, and feed conversions.

Variable	Treatments			
	T-0 (Pp)	T-1 (Ll)	T-2 (Gs)	T-3 (Iz)
Dry matter intake (Gr/h/d)	552,76 ^c	565,34 ^b	561,78 ^b	571,14 ^a
Average daily gain (ADG) (Gr/h/d)	110,25 ^c	130,38 ^b	135,50 ^{ab}	150,60 ^a
Feed conversion (FC)	5,01 ^c	4,33 ^b	4,14 ^b	3,79 ^a

Treatment means with common letters in the same rows are not significantly different (P<0.05).

4. Conclusion

It could be concluded that leaves of this tree legume are prospective to support the application of technology complete ration based on local resources to resolve the problem of shortages of feeds supply to ruminant in the tropic region.

Acknowledgments

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