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Use of *Gliricidia sepium, Leucaena leucocephala* and *Paraserianthes falcataria* leaves in concentrates to improve the appearance of young male goats Peranakan Etawa in East Java, Indonesia

E Marhaeniyanto[1],S. Susanti[1], B. Siswanto[1] andA.T. Murti[1]
1) Faculty of Agriculture, TribhuwanaTunggadewi University, Indonesia
Corresponding e-mail:ekohaen03@yahoo.com

Abstract: *Goat livestock productivity in Indonesia needs to be improved through improved feed quality. Various kinds of tree foliage including legumes have high crude protein content. The use of plant leaves as a protein supplement was expected to improve feed quality and production performance of goats. This research produced green concentrate (16% crude protein/CP) based on leaves of local tree foliage. Green concentrate formulation used a mixed leaf of Gliricidia maculata, Leucaena leucocephala, and Paraserianthes falcataria (1: 1: 1 ratio) as much as 10%, 20% and 30%. The control treatment uses commercial concentrate (SUSU PAP). Concentrate feed was given as much as 1% body weight (BW). The measured variables include: (a). Feed intake, (b). Digestibility, (c). Average Daily Gain (ADG), feed conversion, balance nitrogen (BN) and biological value (BV). The results showed that feed intake varied, but between treatments showed almost the same response except crude fiber intake (CFI). The use of mixed leaf meal up to 30% resulted in a significant increase in the CFI (23.87-24.41 g.kg^{-1}BW$^{0.75}$.day^{-1}) more than control feed (21.56 g .kg^{-1}BW$^{0.75}$.day^{-1}). The value of crude protein (CP), CF and Extract eter (EE) digestabillity showed better responses with increasing use of mixed leaf meal. The CP digestability value followed by the highest ADG was obtained for the use of 30% mixed leaf meal. It was concluded that the use of green concentrate with 30% mixed leaf meal as much as 1.0% BW can improve the appearance of goats with ADG of 118.31 ± 5.27^{ab} g.head^{-1}.day^{-1}.*

Keywords *-nutritional evaluation, goat, supplementation, tree foliage leaves,Indonesia*

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I. Introduction

Sixty percent of animal productivity is determined by feed quality. The productivity of goats in Indonesia is still low due to inadequate quantity and quality of feed provided. Feeding still relies on the provision of field grass and agricultural waste, so that the production of goat livestock is still low. Another factors that cause low livestock productivity is the availability of fluctuating feeds, in the dry season the availability of forage is limited, and more uses forage of agricultural waste. One alternative to improve the quality of feed is by utilizing plant leaves, because it has > 18% of crude protein content vitamins and minerals which are highly needed by goats.Utilization of plant leaves as a constituent of green concentrates, is expected to be cheaper feed costs and availability is guaranteed because it is a local potential.

Research on plant leaf supplementation to increase livestock productivity is reported to be limited.[1] Forages commonly available to goats under farm conditions on Lombok Island, Indonesia.[2] Utilizing *Sesbania grandiflora* leaves as goat fodder is proven to increase goat body weight. Giving *Gliricidia sepium* and *Leucaena leucocephala* leaves up to 1% in sheep is proven to increase nutrient consumption and sheep body weight gain [3]. Moringa leaf supplementation of 30% in concentrate has been studied in rabbits and sheep proven to increase body weight gain [4]. Although Moringa leaf supplementation is proven to be able to increase livestock productivity, the problem is the availability of Moringa leaves is limited [5]. Inventory of animal feed types has been carried out in five locations of Malang Raya goat breeders, it was found that the types of plants used as sources of goat fodder by most respondents were various tree crops, especially *Gliricidia sepium*, *Leucaena leucocephala*, *Calliandra calothyrsus*, *Paraserianthes falcataria*, *Artocarpus heterophyllus*. The results of weight gain ranged from 69 to 97.3 grams / head / day, DM intake ranged from 2.5 to 2.9% of body weight. The result of this body weight gain can still be increased again, because the dominant type of forage given is forage with high crude protein content [6]. The amount of feed given was not sufficient for production, causing a daily body weight gain of 65.9 ± 11.7 g / head / day [7]. In Latin America legume tree *Gliricidia sepium* and *Erythrina spp* are used as an effective supplement to improve the quality of feed fed with low quality hay compared to urea [8]. [9] suggests that tree plants contain tannin

compounds and can affect rumen function by decreasing ammonia levels and protein degradation and suppressing the degradation of fibrous feed. Drying with sunlight can reduce the anti-nutritive substances contained in *Albizzia chinensis*, *Calliandra calothyrsus*, *Gliricidia sepium*, *Leucaena leucocephala* and *Sesbania sesban*, so that the leaves of trees have great potential for commercial concentrate feed for large and small ruminants.

The problem faced by breeders is the availability of plant leaves as a source of forage for goats is not continuous throughout the year. Prodo Hamlet, Klampok village, Singosari sub-district, the region has great potential for the development of goats but still needs support from the aspect of providing quality feed and is available throughout the year. Availability of abundant plant leaves, namely *Gliricidia sepium*, *Leucaena leucocephala* and *Paraserianthes falcataria* leaves.To ensure the continuity of the availability of quality feed, it is necessary to continue research by utilizing the potential of potential plant leaves. Protein supplement from plant leaf flour is formulated together with existing local feed ingredients as ingredients for concentrate feed.

Based on the description that has been stated, it is necessary to conduct research to produce green concentrate based foliage on local plants to increase livestock productivity to support the establishment of goat development centers.

II. Methodology

The study was conducted in the Arjuna Sejahtera farmer group Prodo hamlet, Klampok village, Singosari Malang, East Java, Indonesia. Forage feed given to goat livestock varies in every breeder. The study to inventory the leaves of plants given to goats at the study site was conducted a survey of 91 breeders for 30 days. The leaves of plants that are most often used by breeders, namely *Gliricidia sepium*, *Leucaena leucocephala* and *Paraserianthes falcataria* leaves, are chosen as the constituent ingredients. Proximate analysis of leaf samples and concentrate feed was carried out according to [10]. In vivo experimental studies in individual cages were carried out to test green concentrate feed. Concentrate feed was prepared with 16% crude protein (CP) content. Green concentrate feed formulation using a mixture of *Gliricidia sepium*, *Leucaena leucocephala* and *Paraserianthes falcataria* leaves (1: 1: 1) as much as 10%, 20% and 30%. The study used a randomized block design, consisting of 4 treatments, 5 groups [11]. The treatments tested were:T_0=Basal feed + commercial concentrate (SUSU PAP) CP16%,T_1=Basal feed + 10% starch in plant leaves green concentrate CP 16%, T_2=Basal feed + 20% starch in plant leaves green concentrate CP 16%, T_3=Basal feed + 30% starch in plant leaves green concentrate CP 16%. Feed is given separately between basal feed and concentrate. Concentrate feed is 1% BW, while drinking water is given ad-libitum. Observed variables include: (a). Intake of DM, OM, CP and CF feed,(b).Digestion of DM, OM, CP and CF feed;(c).Daily gain, feed conversion, nitrogen balance and biological value.

Nutrient content of feed treatment

Table 1: Nutrient content of feed material during the study

Ingredients	Nutrientcontent offeed material				
	DM (%)	OM (%)	CP(%)	CF (%)	EE(%)
Gliricidia sepium. Jacq: *Leucaena leucocephala*: *Albaziafalcataria* (1:1:1)	86.11	92.53	24.32	22.15	3.55
Commercial concentrate	83.91	88.33	16.12	15.22	4.03
Copy pulp	91.17	90.83	11.18	21.74	2.50
Gound corn	89.10	94.00	10.8	3.10	4.70
Coconut cake	86.70	92.14	21.79	13.29	3.59
Rice bran	88.64	90.98	9.64	6.42	14.42
Soybean cake	86.00	92.00	41.30	5.30	4.90
Molasses	76.36	91.33	2.20	-	-
Mineral mixture	-	-	-	-	-

DM= dry matter. OM= organic matter. CP= crude protein. CF= crude fibber. EE=extract etter. Analysis results by Laboratory Animal Nutrition of Animal Husbandry Faculty, Brawijaya University Malang.

Composition and nutrient contentof concentrate treated during the study Table1.

Table 2: Nutrient content of treatment rations during the study

Ingredients	The composition of the ingredients of the treatment concentrate			
	T_0	T_1	T_2	T_3
Gliricidia sepium. Jacq: *Leucaena leucocephala*: *Albazia falcataria* (1:1:1)	0	10	20	30
Commercial concentrate	100			
Rice bran	N/A	20	18	16
Ground corn	N/A	18	17	15
Coconut cake	N/A	18	14	13
Soybean cake	N/A	17	14	10
Copy pulp	N/A	9	9	8
Molasses	N/A	7	7	7
Mineral mixture	N/A	1	1	1
Chemical composition*	T_0	T_1	T_2	T_3
Dry matter (%)	83.91	86.24	86.19	86.20
Organic matter (%)	88.33	88.69	89.19	89.13
Crude protein (%)	16.12	16.16	16.20	16.35
Crude fiber (%)	15.22	21.87	30.30	21.98
Extract etter (%)	4.03	4.78	4.18	4.07

* Analysis results by Laboratory Animal Nutrition of Animal Husbandry Faculty, Brawijaya University Malang.

The data were statistically analyzed by PASW STATISTICA 18 according to a randomized block design followed with a honesty significant difference test [11]. Standard errors were calculated from the residual mean square in the analysis of varians.

III. Results And Discussion

The chemical composition

Inventory of plant leaf types given to PE goats in Prodo sub-village, Klampok village was carried out for 30 days on 91 respondents of goat farmers. The results of forage types, the amount and percentage of feed utilization, as well as the nutrient content of plant leaves given to PE goats as shown in Table 1.

The results of observations of 17 types of plant leaves given to livestock, crude protein content ranged from 10.9 (*Swieteria mahagoni*) to CP 36.6% (*Moringa oleifera*. Lamm). The nutrient content of plant leaves can be a source of protein for livestock to stimulate animal growth if given in sufficient quantities.*Gliricidia sepium*, *Leucaena leucocephala* and *Paraserianthes falcataria* leaves are most often given to PE goats. The problem in farmers is that the amount of feed given is inadequate for production, namely the average intake of dry matter 526.07 ± 88.15 g / head / day, intake of crude protein 61.58 ± 16.21 g / head / day, daily gain 65.9 ± 11.7 g / head / day [12]. The use of *Gliricidia sepium*, *Leucaena leucocephala* and *Paraserianthes falcataria* leaf flour as constituent constituents is expected to be a protein source supplement to stimulate the growth of goats. It is expected that tree leaf plant supplementation will increase the supply of nitrogen and amino acids in both rumen microbes and livestock directly through absorption in the small intestine [13; 14].

Table 1: Forage types, amount and percentage of feed utilization summarized from 91 respondents and forage nutrient content given to PE goats

Species tree foliages	Utilization of feed by respondents		**DM**	**OM**	**CP**	**CF**	**EE**	**NFE**	**NDF**	**ADF**
	N	(%)	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**
Hibiscus rosa-sinensis. Linn	9	9.89	17.6	85.8	24.2	15.9	5.85	39.8	50.7	40.7
Eritrina lithosperma	5	5.49	22.8	88.9	29.0	25.4	3.25	31.2	50.7	33.4
Flemingia congesta	17	18.68	27.8	93.5	22.8	30.0	3.01	37.7	42.9	33.4
*Gliricidia sepium.*Jacq	60	65.9	21.1	90.7	26.9	21.0	3.97	38.9	38.3	25.8
Calliandra calothyrsus. Meissn	27	29,7	35.7	93.7	23.7	19.5	4.13	46.6	34.5	31.7

Sauropus androgynus L.Merr	5	5,49	18.4	87.1	31.8	17.1	6.12	32.0	16.4	12.1
Moringa oleifera. Lamm	3	3.29	18.4	87.1	36.6	10.8	5.79	24.1	16.1	12.7
Manihot utilissima	4	4,40	21.4	92.2	24.2	14.7	6.56	21.1	53.6	38.5
Leucaena leucocephala	55	60.43	28.9	93.2	24.0	23.1	3.02	53.4	38.9	30.3
Artrocarpus heterophyllus	11	12,1	37.1	88.8	27.9	22.9	2.97	52.0	32.6	32.4
Tithonia diversivolia	50	54.9	7.39	87.5	17.3	21.4	2.45	38.7	51.2	41.9
Ceiba petandra	4	4,40	35.0	89.5	18.5	19.9	5.69	45.4	54.4	28.9
Paraserianthes falcataria	54	59,3	31.,8	93.7	22.4	22.4	3.66	45.6	43.0	39.8
Sesbania grandiflora. Linn	8	8.79	18.3	90.8	23.3	23.5	4.45	36.8	39.7	25.9
Persea Americana	7	7.69	11.7	93.2	11.6	27.7	3.12	30.2	52.1	33.4
Swieteria mahagoni	6	6.59	37.1	88.8	10.9	22.9	2.97	38.7	51.2	41.9
Centrosema pubescens	1	1.10	19.9	92.6	18.6	34.3	2.06	38.7	45.9	37.4

DM = dry matter. OM = organic matter, CP = crude protein. CF = crude fiber. EE = extract etter. NFE= nitrogen free extract. NDF = neutral detergent fibre. ADF= acid detergent fibre.
**) 100% DM. analysis in the Laboratory of Animal Nutrition, Faculty of Animal Husbandry, Brawijaya University.*

Feed intake, feed digestibility and ingestion of feed intake.

Average feed intake, digestible and feed digestibility from the use of leaf flour from *Gliricidia sepium*.Jacq: *Leucaena leucocephala*: *Paraserianthes falcataria*(1:1:1) in concentrate as much as 1.0% BW(DM). The results showed that feed intake varied but between treatments showed no significant difference (P> 0.05) to DMD, OMD, CPI, and EEI, while CFI was significantly different (P <0.05).Feed intake is not different because the crude protein content of 16% concentrate feed is given in the same amount as much as 1% BW, and basal feed is given in the same amount which is around 2.5% BW.

The value of crude protein digestibility (CPD) at the highest T1 treatment, but not followed by a high daily gain, shows that the digested nutrients that have not been maximized are converted to livestock (meat) production. The results of CPD on T3 which produces the highest daily gain, this shows that T3 feed is not much degraded in the rumen, but the availability of N feed sources reaches the abomasum and intestine. Furthermore, feed can be digested and absorbed optimally by the landlady to meet basic living needs, production.These results are in line with research [15; 16] that the ability to decompose good protein sources derived from rumen microbes, by-pass feed by rumen microbial degradation, salivary urea, blood N-NH3, and endogenous N and rumen epithelium to be digested and then absorbed in the small intestine will maximally produce protein digestion high. Supplementation of 30% leaf flour in concentrate feed (PK 16%) can increase the weight gain of livestock.

The results of the analysis of nutrient intake digestibility in Table 3. produce the value of dry matter intake digestibility (DMID), organic matter intake digestibility (OMID), crude protein intake digestibility (CPID), crude fiber intake digestibility (CFID), extract etter intake digestibility (EEID) which was not significantly different (P> 0.05). Nutrient intake digestibility is a nutrient that can be utilized and absorbed by the animal's body. The higher the digestibility value of a feed ingredient in the digestive tract of livestock, the higher the nutrients that can be absorbed or absorbed by the livestock body.

Table 3: Average total intake (g/kgBW$^{0.75}$/day), digestibility (%), intake digestibility((g/kgBW$^{0.75}$/day) dry matter, organic matter, crude protein, and extract etter from supplementation *Gliricidia sepium*.Jacq: *Leucaena leucocephala*: *Paraserianthes falcataria*(1:1:1) in concentrate as much as 1.0% BW(DM)of young male goats Peranakan Etawa

Treatment	DMI	OMI	CPI	CFI	EEI
	---------- g/kgBW$^{0.75}$/day ----------				
T_0	71.39±5.64^a	63.53±5.27^a	12.12±0.65^a	21.56±1.61^a	1.86±0.09^a
T_1	66.37±8.77^a	59.28±7.99^a	11.48±1.15^a	21.50±2.66^a	1.94±0.18^a
T_2	69.58±2.58^a	62.26±2.38^a	11.87±0.47^a	24.41±0.95^b	1.86±0.08^a
T_3	74.06±5.85^a	66.33±5.23^a	12.52±0.92^a	23.87±1.80^b	1.93±0.15^a
Treatment	DMD(%)	OMD(%)	CPD (%)	CFD (%)	EED (%)
T_0	57.40±1.42^a	59.42±1.29^a	76.76±0.31^b	60.52±1.02^a	73.40±0.61^b
T_1	57.30±4.32^a	59.31±4.22^a	77.45±2.22^b	63.52±3.17^b	76.31±2.56^c
T_2	52.74±3.01^a	54.92±2.85^a	74.19±1.50^a	62.31±2.22^{ab}	70.74±1.76^a
T_3	53.44±1.53^a	55.50±1.67^a	73.82±0.27^a	59.25±1.06^a	69.67±0.36^a

Treatment	DMID	OMID	CPID	CFID	EEID
	---------- g/kgBW$^{0.75}$/day ----------				
T_0	39.08±3.21^a	35.95±2.97^a	8.98±0.43^a	12.62±1.18^a	1.32±0.05^a
T_1	37.70±5.42^a	34.80±4.99^a	8.92±0.63^a	13.30±1.44^a	1.50±0.11^a
T_2	36.12±3.12^a	33.61±2.82^a	8.75±0.38^a	14.48±0.21^a	1.32±0.06^a
T_3	38.35±3.34^a	35.68±3.20^a	8.86±0.43^a	13.99±1.67^a	1.29±0.06^a

DMI = dry matter intake, OMI= organic matter intake, CPI = crude protein intake, CFI= crude fiber intake and EEI = extract etter intake; DMD= dry matter digestibility, OMD= organic matter digestibility, CPD = crude protein digestibility, CFD = crude fiber digestibility, EED= extract etter digestibility. DMID = dry matter intake digestibility, OMID = organic matter intake digestibility, CPID = crude protein intake digestibility, CFID = crude fiber intake digestibility, EEID = extract etter intake digestibility. ^{ab}Means in the same column for each parameter with different superscripts are differences at (P<0.05) (P<0,01)

Nitrogen balance, biological value and body weight gain

The results of the study the average nitrogen balance and biological value of the implementation of this concentrate feed as much as1.0% BWpresented in Table4.

Table 4: Average balance nitrogen, biological value and daily gain from supplementation *Gliricidia sepium*.Jacq: *Leucaena leucocephala*: *Paraserianthes falcataria*(1:1:1) in concentrate as much as 1.0% BW(DM) of young male goats Peranakan Etawa

Treatment	N intake	N Faeces	N Urine	Balance Nitrogen	Biological value	ADG
	.....(g/kgBW$^{0.75}$).....				(%)	(g/head/day)
T_0	1.87±0.09^a	0.44±0.02^{ab}	0.38±0.16^a	1.05±0.11^a	73.57±9.79^a	106.42±5.31^b
T_1	1.84±0.10^a	0.41±0.04^a	0.45±0.10^a	0.97±0.08^a	67.98±5.36^a	75.85±31.66^a
T_2	1.89±0.08^a	0.49±0.04^{bc}	0.42±0.13^a	0.98±0.10^a	70.27±8.59^a	90.31±9.11^a
T_3	1.92±0.09^a	0.50±0.02^c	0.37±0.14^a	1.05±0.11^a	74.00±9.21^a	118.31±5.27^{ab}

^{ab} Means in the same column for each parameter with different superscripts are differences at (P<0.05)

Nitrogen retention is a reduction between N feed and the amount of fecal N and N urine excreted. The results of the analysis of variance showed that the treatments T0, T1, T2 and T3 showed no significant difference (P> 0.05) on nitrogen retention and biological values.T0 and T3 feed treatments tended to have higher nitrogen retention values and biological values than T1, T2, (P> 0.05). Biological value and nitrogen utilization are determinants of protein quality which states the proportion of feed protein consumed and absorbed can be used by livestock to synthesize microbial protein [17]

IV. Conclusion

The use of concentrate feed by supplementation of *Gliricidia sepium*.Jacq: *Leucaena leucocephala*: *Paraserianthes falcataria* leaves (1: 1: 1) as much as 30 percent given as much as 1.0% BW (DM) can improve the appearance of goats with weight gain 118.31 ± 5.27g / head / day.

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