

The Use of Rubber Leaves (*Hevea brasiliensis*) as Forage in Supporting the Development of Goats

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ABSTRACT

The nutritive potency of rubber leaves (*Hevea brasiliensis*) as forage/feed for goats was analysed in vivo. Twenty four male and female postweaned Etawah grade kids aged 4-6 months with body weights between 11 to 26 kg were allocated into three treatment groups (*i.e.* T0, T1 and T2) with eight repetition designed as Randomized Block Design. Treatment diet T0 consisted of 0% rubber leaves, 80% other forages and 20% rice bran. Treatment diet T1 consisted of 40% rubber leaves, 40% other forages and 20% rice bran, and Treatment diet T2 consisted of 60% rubber leaves, 20% other forages and 20% rice bran. The results showed that DM, DE and DP consumptions, ADG and FCR of the T0, T1 and T2 treatment groups were respectively: 1008, 1040 and 1199 g DM; 2.8, 2.9 and 4.0 Mcal/DE; 31.9, 42.9 and 59.8 g DP; 58.2, 85.7 and 76.1 g/head/day; 25.6, 15.9 and 18.0. It can be concluded that the use of rubber leaves and its branches with composition of 40 to 60% of goat diets can increase energy and protein consumptions, increase body weight gain, decrease FCR, and subsequently increase the production efficiency of the goats.

Key Words: Rubber Leaves, *Hevea brasiliensis*, Herbal Nutrition, Goat, Digestible Protein

INTRODUCTION

The exploration of rubber leaves (*Hevea brasiliensis*) as a source of animal feedstuff is a strategic issue in supporting the development of rural goat farming, especially those integrated into rural community rubber plantations. Rubber leaves and branches used as forage are harvested from the wild rubber trees growing under the main rubber trees. Analysis of rubber leaf potency as herbal nutrition (nutritive herbs) for goats had been previously carried out by quantitatively analysing the chemical composition of the feed, the content of total tannins and condensed tannins of fresh and 1d-withered leaves and branches (edible portion) of rubber trees taken from 7 types of rubber tree clones. The chemical composition of fresh rubber leaves were: 40.4% DM; 87.9% OM; 19.5% CP; 6.2% EE and 27.0% CF, and of withered rubber leaves were: 42.1% DM; 89.5% OM; 21.19% CP; 5.2% EE and 25.9% CF. Branches part of fresh rubber had a lower quality than the leaves part of fresh rubber. Withering of rubber leaves during the day can increase its quality (Wigati et al. 2014a). Average total tannins content in the fresh rubber leaves and branches (DM base) was 2.71%, and of the withered form was 2.37 %. Average content of condensed tannins in the fresh rubber leaves and branches was 2.05%, and of the withered form was 2.52%. Withering have lowered the content of total tannins, but relatively increased the content of condensed tannins. The contents of total tannins and condensed tannins in fresh or withered leaves and branches were indicated as nutritive levels. According to Makkar (2003), tannins within certain limits (2 to 4% DM basis) can improve the efficiency of microbial protein synthesis and degradation and can protect the protein in the rumen, thereby increasing the flow of essential amino acids to the small intestine and increase the absorption of amino acid into the blood which in turn will be able to increase the productivity of livestock. In ruminants, tannin, particularly condensed tannin has been reported to have an effect as a medicinal herb, which is as anti-parasitic

gastro-intestinal (natural anthelmintic) as reported by Paolini et al. (2003). The results of the previous research showed that rubber leaves and branches have good feeding value for goats, can be used in both fresh and withered form, and also indicated a potency as herbal medicine for goats (Wigati et al. 2014a). Further exploration of herbal nutrition potencies of rubber leaves and its branches by *in sacco* analysis in the previous research (Wigati et al. 2015) showed that rubber leaves and its branches (edible portion) have high protein contents, but relatively low energy contents. The average values of UDP and ME contents in fresh rubber leaves and branches were 40.88% and 8.07 MJ ME/Kg DM, and in 1d-withered form were 37.15% and 8.09 MJ ME/Kg DM. Moreover, the results of *in vitro* analysis of herbal potency of rubber leaves and its branches showed that the tannins contained in rubber leaves and its branches at a concentration of ≥ 2 g tannins (3.5% dry weight basis) has a strong anthelmintic effect against adult female *Haemonchus contortus* worms (Wigati et al. 2015). However, the nutritive and herbal effects of rubber leaves and its branches fed directly to goats have not been studied. Hence, the research was carried out to evaluate the nutritive effects of rubber leaves and its branches *in vivo* on energy and protein digestibilities and performance of postweaned Etawah Grade kids.

MATERIAL AND METHODS

The research was carried out in a rural community goat farming in a region of Jambi Province, Indonesia. The experiment used 24 male and female postweaned Etawah grade kids aged 4-6 months with body weights between 11 to 26 kg. The forages used as treatment diets were *edible portion* (parts of rubber tree which can be consumed by the animal) of fresh rubber leaves and its branches taken from the area of rubber plantation (Figure 1), and other forages used were grasses (*Otochloa nodosa*, *Axonopus compressus*) and browsed plants/weeds such as *cabe-cabe* (*Asystasia gangetica*), *anggrung putih* (*Trema orientalis*) and *Gusduran* (*Mikania micrantha*). Botanical parts of other forages used were leaves and branches of the plants. The concentrate used was rice bran. Feed chemical composition of the feed samples were determined by using proximate analysis procedure according to AOAC (2002).



Figure 1. Rubber trees (*Hevea brasiliensis*) and rubber leaves and its branches

Each of experimental animals was placed in an individual stable and was allocated into three treatment groups (*i.e.* T0, T1 and T2) given three treatment diets. The treatment diets used were T0, T1 and T2 which the composition were

T0 = 0% rubber leaves and its branches + 80% other forages + 20% rice bran

T1 = 40% rubber leaves and its branches + 40% other forages + 20% rice bran

T2 = 60% rubber leaves and its branches + 20% other forages + 20% rice bran

The feed chemical composition of the trial diets was presented in Table 1.

Table 1. Feed chemical composition of the treatment diets

Composition (%)	Treatment diets		
	T0	T1	T2
Dry matter (DM)	32.43	37.42	39.91
Organic matter (OM)	90.14	92.54	93.80
Crude protein (CP)	13.40	15.43	16.39
Extract ether (EE)	3.75	3.94	4.03
Crude fibre (CF)	17.77	18.58	19.00
Nitrogen free extract (NFE)	55.24	54.26	53.88
Total digestible nutrients (TDN)	76.10	77.40	87.60

T0 = 0% rubber leaves and its branches + 80% other forages + 20% rice bran; T1 = 40% rubber leaves and its branches + 40% other forages + 20% rice bran ;T2 = 60% rubber leaves and its branches + 20% other forages + 20% rice bran. Feed chemical composition of the trial diets was calculated by using feed chemical composition of each feedstuff used in the trial diets analysed in preliminary research

The feed quantities given to the goats were determined based on DM intake of Bligon goats, *i.e.* 3.5% of body weight, according to Wigati (2010). The feeding trial was carried out for 6 weeks with 2 weeks adaptation before feeding trial commenced. Treatment diets were given twice a day (in the morning and the afternoon), and were provided which enabled animals to choose freely (free choice). Drinking water was given in separated tin and was given *ad libitum*. The individual stable was equipped with a net for feces collection. The collections of the feeds, feed left overs and feces were carried out for 7 days in the end week of the feeding trial. Samples collected were oven-dried at a temperature of 55°C, grinded and analysed for feed/feces chemical composition using proximate analysis (AOAC 2002). Kids were weighed at 7 days interval.

Experimental Design. The kids were allocated into three treatment groups (T0, T1 and T2), and were designed in Randomized Block Design (RBD) based on sex and body weight. Each treatment group consisted of 8 goats as replication. Variables observed from feeding trials were dry matter (DM), digestible energy (DE) and digestible protein (DP) consumptions, ADG of the kids and feed conversion ratio (FCR).

Statistical Analysis. Data was analyzed by Analysis of variance (ANOVA) using General Linear Model (GLM) procedures. Any significant differences between treatments will be tested using the LSD-test (SPSS 16.0).

RESULTS AND DISCUSSION

Feed chemical composition of the feedstuffs used as treatment diets

From the preliminary research, it can be identified that forages or browse feeds other than rubber leaves that were most frequently and usually used by local farmer were rumpup paitan (*Axonopus compresus*), rumpup kawatan (*Otochloa nodosa*), and browse feed/weeds which were grown under the shade of rubber trees, such as cabe-cabea (*Asystasia gangetica*), anggrung putih (*Trema orientalis*) and Gusduran (*Mikania micrantha*). Feed Chemical Compositions of the feedstuffs used as treatment diets collected during feed collection were presented in Table 2.

The results of proximate analysis of the feedstuffs used in the research showed a decrease in quality from the middle to the end of the feeding trial. During the time (half end of feeding trial), it was also difficult to provide other forages other than rubber leaves. The

condition was due to a long dry season, and very bad air quality at that period due to forest fires.

Table 2. Feed chemical compositions of the feedstuffs used as treatment diets

Forages	DM	OM	CP	EE	CF	NFE
%.....					
<i>Hevea brasiliensis</i>	39.12	95.95	18.43	3.68	20.95	52.07
<i>Axonopus compresus</i>	38.30	93.00	9.05	0.76	21.80	61.38
<i>Otochloa nodosa</i>	36.05	92.16	11.58	3.34	22.42	54.84
<i>Asystasia gangetica</i>	22.55	87.26	16.29	3.62	17.41	49.94
<i>Trema orientalis</i>	31.96	89.29	14.14	4.69	15.30	55.16
<i>Mikania micrantha</i>	22.43	90.81	12.61	3.92	17.58	56.70
Rice bran	89.35	90.90	13.65	5.93	13.15	58.17

The consumption of dry matter in the diets

Table 3 presents dry matter (DM) consumption of the treatment diets and dry matter intake (DMI) in the kids with an average body weights of 21.7 kg in T0 group, 23.5 kg in T1 group and 21.2 kg in T2 group (Figure 2).

Table 3. The average values (\pm SEM) of dry matter (DM) consumptions and dry matter intakes (DMI) of the kids during the feeding trial

Variables	Treatment Diets		
	T0	T1	T2
DM consumption (g/head/day)	1008 ^a \pm 47.1	1040 ^{ab} \pm 73.2	1199 ^b \pm 63.3
DMI (% BW)	4.9 \pm 0.4	4.9 \pm 0.8	5.9 \pm 0.5

T0 = 0% rubber leaves and its branches + 80% other forages + 20% rice bran; T1 = 40% rubber leaves and its branches + 40% other forages + 20% rice bran; T2 = 60% rubber leaves and its branches + 20% other forages + 20% rice bran. Different superscripts in the same row showed significant differences ($P < 0.05$). SEM: Standard Error Means

The statistical analysis showed that DM consumption in T1 treatment group was not significantly different ($P > 0.05$) with those of T0 and T2 treatment groups ($P \geq 0.09$), but DM consumption in T2 treatment group was significantly different ($P < 0.05$) with that of T0 treatment group. Since rubber leaves forage has a higher DM and crude protein (CP) contents than other forages (Table 2), it was concluded that higher DM consumption in T2 was due to a higher rubber leaves content in T2 treatment diet.



Figure 2. The goat kid in each treatment group

DMI (% BW) was not significantly different ($P>0.05$) between treatment groups. Dry matter consumptions in all treatment groups were high according to the DMI values. DMI value in T2 treatment group was higher than that of Bligon kids fed with King grass as basal feed (Wigati 2010), *i.e.* 2.8 % of body weight, and was also higher than that of Bligon does fed Timor savannah grass supplemented with Urea *Gula Air* Multinutrient Block (Manu et al. 2015), *i.e.* 3.0% of body weight. The high DMI in kids fed with high proportion of rubber leaves was could also be due to high protein content of rubber leaves (Wigati et al. 2014; 2015). According to Aregheore (2003), total DMI increase with the increase of protein content in the diet, and Mohsen et al. (2011) also stated that a better nutrients digestibility will increase nutrient intakes. Wigati et al. (2015) has previously reported that rubber leaves and its branches had high crude protein contents (20.21% in average) and high protein digestibility by *in sacco* analysis (59.12% protein degradability and 40.88% undegraded dietary protein).

Digestible energy and digestible protein consumption

Digestible energy and digestible protein consumptions of the kids during the feeding trial is presented in Table 4.

Table 4. The average values (\pm SEM) of digestible energy (DE) and digestible protein (DP) consumptions of the kids during the feeding trial

Variables	Treatment diets		
	T0	T1	T2
DE consumption (Mcal/head/day)	2.8 ^a \pm 0.2	2.9 ^a \pm 0.4	4.0 ^b \pm 0.2
DP consumption (g/head/day)	31.9 ^A \pm 1.7	42.9 ^B \pm 2.5	59.8 ^C \pm 2.6

T0 = 0% rubber leaves and its branches + 80% other forages + 20% rice bran; T1 = 40% rubber leaves and its branches + 40% other forages + 20% rice bran; T2 = 60% rubber leaves and its branches + 20% other forages + 20% rice bran. Different lower case superscripts in the same row showed significant differences ($P<0.05$); Different upper case superscripts in the same row showed highly significant differences ($P<0.01$). SEM: standard error means

The results of statistical analysis showed that the digestible energy (DE) consumption in T1 treatment group was not significantly different ($P>0.05$) with that of T0 treatment group, but it was significantly different ($P<0.05$) with that of T2 treatment group. DE consumption in T2 was significantly higher ($P<0.05$) than that of T0 and T1. Meanwhile, the digestible protein (DP) consumptions were significantly different ($P<0.01$) between treatments. DP consumption in T0 treatment group was significantly lowest than those of treatment groups, and DP consumption in T1 treatment group was significantly lower than that of T2 treatment group.

According to NRC (1981), the DE for maintenance and 50 g average daily gain (ADG) in kids with body weights between 20 to 30 kg was 2.35-2.87 Mcal, and the DP 52 to 63 g. Meanwhile, according to Kearn (1982), the DE need was 1.61 to 1.83 Mcal, and the DP need was 38 to 43 g. The results of this experiment showed that DE consumptions in all treatment groups (T0, T1 and T2) have met the need of DE for maintenance and 50 g ADG according to NRC (1981) and Kearn (1982). The addition of rice bran concentrate as much as 20% of the total diets was suggested to have a contribution in meeting the energy needs in all treatment groups. Furthermore, in this experiment, most of rice bran offered to the animals was consumed, and rice bran has a high energy content, *i.e.* 10.15 MJ/kg DM as reported by Wigati et al. (2014b). The results of this experiment also showed that DP

consumption in T1 and T2 treatment groups have met the DP need for maintenance and 50 g ADG (NRC 1981; Kears 1982), but it has not met the DP need yet in T0 treatment group according to both NRC (1981) and Kears (1982). Hence, it can be concluded that the use of rubber leaves as a goat forage (feedstuff) can increase energy and protein consumptions in postweaning kids.

Body weight gain and feed conversion ratio (FCR)

Average daily body weight gain or average daily gain (ADG) is a factor that can significantly measure the growth of the animals. For most of the animals, feed conversion ratio (FCR) that has the most efficient production cost and highest ADG is a prime factor to determine the efficiency of animals production.

Goats naturally like foraging/browsing, if the quality of forages/browses is not good, thus the ADG will be low, and vice versa. The average daily body weight gain or average daily gain (ADG) and feed conversion ratio (FCR) of the kids fed with T0, T1 and T2 treatment diets were presented in Table 5.

Table 5. The average values (\pm SEM) of average daily gain (ADG) and feed conversion ratio (FCR) of the kids during the feeding trial

Variables	Treatment Diets		
	T0	T1	T2
ADG (g/head/day)	58.2 ^a \pm 7.3	85.7 ^b \pm 11.5	76.1 ^b \pm 12.3
FCR	25.6 ^a \pm 6.3	15.9 ^b \pm 3.4	18.0 ^b \pm 2.0

T0 = 0% rubber leaves and its branches + 80% other forages + 20% rice bran; T1 = 40% rubber leaves and its branches + 40% other forages + 20% rice bran; T2 = 60% rubber leaves and its branches + 20% other forages + 20% rice bran. Different superscripts in the same row showed significant differences ($P < 0.05$); SEM: standar error means

The results of the statistical analysis showed that ADG of the kids in T0 treatment group was significantly ($P < 0.05$) lower than those of T1 and T2 treatment groups, with no difference between the latter two groups. Based on DM, DE and DP consumption in all treatment groups, the lower ADG and FCR in T0 treatment group was attributed to significantly lower DP consumption when compared to T1 treatment group, and significant lower DE and DP when compared to T2 treatment group. However, an ADG of above 50g in the T0 treatment group (Table 5), was probably due to the use of 20% rice bran in the diet which increase its energy content.

Based on the results of the study, it can be concluded that the use of rubber leaves and its branches in the diets can increase body weight gain and decrease FCR, and consequently increase the production efficiency of the goats.

CONCLUSION

The use of rubber leaves and its branches with composition of 40% to 60% of goat diets can increase energy and protein consumptions, increase body weight gain, decrease FCR, and subsequently increase the production efficiency of the goats.

REFERENCES

- AOAC. 2002. Official Method of Analysis. 12 th Ed. Washington DC (USA): Association of Official Analytical Chemist. p. 129-146.
- Aregheore EM, Kumar A, Manuelli P. 2003. Dietary levels of energy and protein for optimal growth of crossbred Anglo-Nubian goats in Samoa. *Int J Agric Biol.* 5:428-431.
- Kearl LC. 1982. Nutrient Requirement of Ruminant in Developing Countries. Internasional Feedstuff Institute Utah Agricultural Experiment Station. Logan (USA): Utah State University.
- Makkar HPS. 2003. Effects and fate of tannins in ruminant animals, adaptation to tannins, and strategies to overcome detrimental effects of feeding tannin-rich feeds. *Small Rum Res.* 49:241-256.
- Manu AE, Henuk YL, Belli HLL, Kleden MM. 2015. Supplementation local feed urea *gula air* multinutrient block and different Level of sulphur for increasing lactation productivity doe also decreasing kid mortality Bligon goat grazed at Timor savannah. In: Proceedings of the 6th ISTAP, International Seminar on Tropical Animal Production: Integrated Approach in Developing Sustainable Tropical Animal Production. Yogyakarta, 20-22 October, 2015. Yogyakarta (Indonesia): Gadjah Mada University. p. 133-137.
- Mohsen MK, Gaafar HMA, Khalafalla MM, Shitta AA, Yousif AM. 2011. Effect of rumen protected choline supplementation on digestibility, rumen activity and milk yield in lactating Friesian cows. *Slovak J Anim Sci.* 81:238-242.
- NRC. 1981. Nutrient Requirements of Goats: Angora, dairy and meat goats in temperate and tropical countries. Washington DC (USA): National Academy Press.
- Paolini V, Bergeaud JP, Grisez C, Prevot F, Dorchies P, Hoste H. 2003. Effects of condensed tannins on goats experimentally infected with *Haemonchus contortus*. *Vet Parasitol.* 113:253-261.
- Wigati S. 2010. Integrasi tatalaksana pemberian pakan *cassava* dan reproduksi untuk meningkatkan kinerja kambing Bligon [Disertation]. [Yogyakarta (Indonesia)]: Universitas Gadjah Mada.
- Wigati S, Maksudi M, Latief A. 2014a. Analysis of rubber leaf (*Hevea brasiliensis*) potency as herbal nutrition for goats. In: Proceedings of the 16th AAAP Animal Science Congress Vol. II. Yogyakarta, 10-14 November, 2014. Yogyakarta (Indonesia): Gadjah Mada University. p. 497-500.
- Wigati S, Kustantinah, Wiyanto E, Ørskov ER. 2014b. In sacco degradability of six different tropical feedstuffs. In: Proceedings of the 16th AAAP Animal Science Congress Vol. II. Yogyakarta, 10-14 November, 2014. Yogyakarta (Indonesia): Gadjah Mada University. p. 376-379.
- Wigati S, Maksudi M, Latief A, Wiyanto E. 2015. Tannin anthelmintic doses, metabolizable energy and undegraded protein contents of rubber leaves (*Hevea brasiliensis*) as herbal nutrition for goats. In: Proceedings of the 6th ISTAP, International Seminar on Tropical Animal Production: Integrated Approach in Developing Sustainable Tropical Animal Production. Yogyakarta, 20-22 October, 2015. Yogyakarta (Indonesia): Gadjah Mada University. p. 151-155.

DISCUSSION

Question

Data initial BW varied, but variation of data consumption not so much, can you explain?

Answer

Data were analysed according to the design experiment