PERFORMANCE OF GOAT FED ON BASAL FEED AND *Indigofera zollingeriana*

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Abstract. This study aimed to measure the potential and basal feed introduction (corn stover, gliricidia leaves, *Panicum maximum*) with the addition of *Indigofera zollingeriana*, which is expected to increase the goat performance. Fifteen goats aged 9-12 months, with an initial weight of ±20 kg were randomly assigned in completely randomized design (CRD) to one of three treatments and five replications. The treatment were P1 = 60% basal feed + 40% *Indigofera zollingeriana*, P2 = 70% basal feed + 30% *Indigofera zollingeriana*, P3= 80% basal feed + 20% *Indigofera zollingeriana*. We assessed the study outcomes as follows: daily weight gain (DWG), dry matter intake (DMI), feed efficiency and physiological responses. Data was statistically analyzed with Analysis of Variance (ANOVA) and Duncan's multiple range test. ANOVA test showed that the treatments significantly affected ($p<0.05$) the DMI, DWG, feed efficiency and respiratory rate. Based on multiple range tests, treatment P1 was significantly different ($p<0.05$) than treatment P2 and P3. Mean DMI ranged from 265.8 to 380.32 g/head/day, mean DWG ranged from 33.28 to 65.62 g/head/day, mean feed efficiency ranged from 0.12 to 0.17%, mean respiratory rate ranged from 22 to 32 rate per minute. Statistical analysis showed that the treatment did not significantly ($p>0.05$) affect rectal temperature and heart rate. Mean rectal temperature and heart rate were 38.2-39.8ºC and 80-90 beats per minute, respectively. In conclusion, the administration of 60% basal feed (20% corn straw, 20% gamal leaves and 20% *Panicum maximum*) and 40% *Indigofera zollingeriana* could improve the goat's performance.

Keywords: goat performance, basal feed, *Indigofera zollingeriana*, daily weight gain, dry matter intake, feeding efficiency, physiological response

1 Introduction

Providing a good quality and quantity of forage is essential to increase goat production. To complete the nutritional elements, forage consisting of grass and legumes is needed. Forage is the main source to increase goat production. Nutritional value consumed by livestock is expected to be a protein source in increasing ruminant livestock productivity [1].

Preston [2] reported that corn stover contains 29% acid detergent fiber (ADF), 48% neutral detergent fiber (NDF), 9% crude protein, 7% ash, 0.5% calcium and 0.25%

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phosphorus. Meanwhile, the results of corn stover proximate analysis by Amuda et. Al [3] reported ADF content of 58.5%, 69.3% NDF, 8.4% crude protein and 7.1% ash.
Gliricidia leaves are ellipitical (oval) shaped leaves with sharp tip and blunt base. They are arranged in opposite directions, like lamtoro or turi leaves. In the dry season, its butterfly-shaped flowers bloom on the tip of the stem [4]. As forage, these leaves should be administered together with grass. As a forage, gliricidia leaves have advantages due to its high content of essential amino acids, protein, vitamins, and minerals, though they are barely utilized by farmers [5].

Bengal grass (*Panicum maximum*) is one of the animal feed plants that has valuable nutrients. Fanindi and Sutendi [6] reported that Bengal grass (*Panicum maximum*) has nutritional value as follows: 8.80% of dry matter; 5.98% of crude protein; 2.24% of crude fat; 36.38% of crude fiber, 9.98% of ash, 1.09% calcium, 0.41% phosphorus respectively with a total energy of 4034 kcal. One of the feed ingredients that contains high protein is *Indigofera zollingeriana*, a leguminose that is suitable to grow in Indonesia due to its tolerance to dry seasons, easy waterlogged and resistance to salinity. It had a total dry matter production of 21 ton/ha/year and 5 toh/ha/year [7].

Indigofera zollingeriana is a leguminous plant that has not been widely explored, and is rich in protein, calcium and phosporus. It has nutritional values as follows: 23.20% of crude protein, 90.68% of organic matter, 36.72% of neutral detergent fiber, 0.83% of phosphorus and 1.23% of calcium. Compared to other legumes, *Indigofera zollingeriana* has better forage quality [8]. Forage is an important factor in livestock business; thus, the proper forage rations are essential. An animal's ability to consume feed depends on the forage quality, environmental temperature, body size and the physiological condition of the animal. Therefore, it is necessary to conduct a study that measures the effective feeding management and goat physiological response to achieve production efficiency.

Indigofera sp. also contains anti-nutrition factor (ANF) like alkaloids, flavonoid, saponin and tannin [9]. ANF that is dangerous for livestock found *Indigofera sp* is indospicine (L-6-amindino-2-aminohexanoic acid), an analogue of arginin. These ANF contained in Indigofera – if they are consumed excessively – have a negative impact on livestock [10].

This study aimed to measure the potential and basal feed introduction (corn stover, gamal leaves, *Panicum maximum*) with the addition of *Indigofera zollingeriana*, which is expected to increase the goat performance.

2 Materials and Methods

Fifteen goats aged 9-12 months were recruited in this study. We used corn stover, gliricidia leaves, and *Panicum maximum* as basal feed with a ratio of 1:1:1. Participants were randomly assigned to one of three treatments and five replications:
P1= 60% basal feed + 40% *Indigofera zollingeriana*
P2= 70% basal feed + 30% *Indigofera zollingeriana*
P3= 80% basal feed + 20% *Indigofera zollingeriana*

The forage was administered twice a day in the morning at 08.00 WIB and in the afternoon at 17.00 WIB, and water was administered ad libitum.
We assessed the study outcomes as followed:

1. Daily weight gain (DWG)
   DWG was calculated with following formulation:

$$\text{DWG} = \frac{final\ weight - initial\ weight}{days\ on\ test}$$

2. Dry matter intake (DMI)
   DMI was obtained by calculating the difference between the given feed and the remaining feed, then multiplying this with the result of DM analysis, calculated in g/head/day.
3. Feed efficiency
   Feed efficiency was calculated by dividing the daily weight gain with feed consumption.
4. Physiological responses were also recorded, with variables as follows:
   a. Respiratory rate was measured by obserbing the inhalation or expansion of the chest wall for one minute using a stopwatch.
   b. Heart rate was measured using a stethoscope placed on the left side of the thorax near the heart in a standing position, then the pulse or korotkoff sound was counted for one minute.
   c. Rectal temperature was measured using a digital body temperature, inserted to the goat's rectum.

The data was analyzed using analysis of variance (ANOVA) test and Duncan Multiple Range Test.

3 Results and discussion

Table 1. Mean DMI, DWG, feed efficiency and physiological response

Treatments	DMI (g/head/ day)	DWG (g/head/day)	Feed efficiency (%)	Rectal temp (^{0}C)	Heart rate (beat per minute)	Respiratory rate (breaths per minute)
P1	380.32^a	65.62^a	0.17	39.80	90.	32^a
P2	291.38^b	43.30^b	0.14	39.40	82.	24^b
P3	265.80^b	33.28^b	0.12	38.20	80	22^b

Numbers followed by different superscripts in the same row indicate non significant effect ($p>0.05$)

ANOVA test showed that the treatment significantly affected ($p<0.05$) the DMI. Mean DMI ranged from 265.80 to 380.32 g/head/day. This is higher than what Wicaksana et al [11] reported in their study with 207 g/head/day. In terms of DMI, P1 treatment was significantly different ($p <0.05$) than treatment P2 and P3. This probably related to feed palatability. Tarigan dan Ginting [12] reported that the ratio between legumes and grass in feed rations affected the intake, digestibility, and body weight gain of goats.

In analysis, we found that DWG was significantly affected ($p<0.05$) by the treatment and mean DWG ranged from 33.28 to 65.62 g/day. Post hoc analysis showed that P1 tretment was significantly different from treatment P2 and P3.

ANOVA test showed that the treatment significantly affected ($p<0.05$) the feed efficiency. Post hoc analysis showed that P1 treatment was significantly ($p<0.05$) higher than P2 and P3. Mean feed efficiency ranged from 0.12 to 0.17%. In this study, the reported feed efficiency is higher than what Tarigan and Ginting [12] reported (0.08-0.12%). Sagala [13] in his study stated that feed efficiency is significantly affected by some external factors eg. ability of livestock to digest feed ingredients, growth and body function and the type of feed. High feed efficiency indicates good livestock performance. Thus, higher feed efficiency showed that the goat consumed less feed but resulted in increased weight gain.

ANOVA test showed that the treatments did not significantly affect ($p>0.05$) rectal temperature. The rectal temperature ranged from 38.20 to 39.80ºC. The rectal temperature of goats participating in this study was within normal range. Aye [14] stated that the normal

range of rectal temperature in goats and sheep is 32.6-39.6ºC. According to Nurmi [15], goats are livestock with good adaptation abilities, and able to survive in harsh and hot climatic conditions. A normal range rectal temperature indicates that the livestock is in healthy and normal conditions [16].

In analysis, we found that the heart rate was not significantly ($p>0.05$) affected by the treatment. The heart rate of goats ranged from 80 to 90 beats per minute in this study. The normal range of goats' heart rate is 70-80 beats per minute [17]. An increased heart rate aims to regulate blood pressure and help circulate the heat from internal body organs to the body surface [18].

In contrast to previous physiological responses, treatment significantly affected ($p<0.05$) respiratory rate. Post hoc analysis showed that P1 treatment was significantly different from treatment P2 and P3. Mean respiratory rate in this study ranged from 22 to 32 breaths per minute and still within normal range. The normal respiratory rate in goats ranged from 26 to 54 breaths per minute [19]. Wuryanto et al. [20] reported that feed consumption greatly affects the respiratory rate of livestock, thus increasing their body metabolism. Administration of legumes in large quantities also likely increased the livestock respiratory rate.

4 Conclusion

We conclude that the administration of 60% basal feed (20% corn straw, 20% gamal leaves and 20% *Panicum maximum*) and 40% *Indigofera zollingeriana* could improve the goat's performance.

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