Roles of tree and shrub legume leaves as protein sources for cattle raised by small farmers in Bangkalan Regency

Mashudi Mashudi¹, Poespitasari Hazanah Ndaru¹, Wike Andre Septian¹, Kusmartono Kusmartono¹*, and Aprilia Dwi Kartika¹

¹Faculty of Animal Science, Universitas Brawijaya, Malang 65145, Indonesia

Abstract. Inclusion of tree or shrub legume leaves in the ration of beef cattle improved quality and the main indicators are the increase in crude protein content and digestibility. The present study was done from March to September 2023 involving 30 farmers in Bangkalan regency who raised madura cattle and the information gathered were type and number of feeds offered daily. Tree and shrub legume leaves such as *Gliricidia*, *Moringa*, *Indigofera*, and jackfruit are the most common protein sources used to supplement field grass or straws. Samples of forage were taken and the following rations were formulated to simulate cattle feed: A (grass only); B (60% grass + 40% gliricidia); C (60% grass + 40% moringa); D (60% grass + 40% Indigofera); E (60% grass + 40% jackfruit) leaves. Parameters measured using an in vitro gas production technique showed that supplementation with tree and shrub legume leaves on field grass basal diet improved dry matter digestibility (DMD) and organic matter (OMD) values and this was closely related to improvements of rumen NH₃ concentration which also contributed to efficiency of microbial protein synthesis (ESPM) value improvement. It can be concluded that tree and shrub legume leaves have shown important roles in improving the quality of field grass based diet for Madura cattle.

1 Introduction

Poor nutrition due to imbalance of energy and protein content of ration can be a major cause of low beef cattle productivity in Bangkalan regency, especially in the seasonally dry areas where there is a severe shortage of feed during the dry season [1]. Concentrate or supplemental feeds are sometimes used by farmers to improve overall animal efficiency, and [2] reported that by supplementing 0.5 kg rice bran in comparison to 2.5 kg concentrate containing 40% rice bran, 19% tofu waste, 31% maize bran and 10% soybean hulls increased dry matter intake (56.1 vs 89.3 g/kg0.75/d) in Madura cows fed on field grass based-diet. However, the high price of those concentrate as energy and protein supplements (e.g., coconut cake meal, palm kernel cake, brand pollard, rice brand) limits their widespread use.

* Corresponding author: kusmartono Ansi@ub.ac.id
One of possible ways to improve protein content of the ration is by giving tree or shrub legume leaves as it has been reported that feeding leguminous fodder that is high in protein can improve protein content leading to improvements of rumen fermentation parameters and digestibility of low quality fibrous feeds, and hence improved animal production [4]. Tree or shrub legumes may help to increase beef cattle productivity in Bangkalan regency by providing a high protein supplement. When fed to supplement low quality roughages such as field grass or rice straw, farmers would have another reason to grow and use leguminous trees in their agricultural systems. This paper aimed to explain roles of tree/shrub legume foliage as protein supplements on gas production, rumen fermentation parameters and microbial protein synthesis in the ration that contained low quality roughage as a basal diet.

2 Materials and Methods

2.1 Experimental design

This study was conducted in Bangkalan regency from March to September 2023 as part of in vivo study involving 30 farmers who were raising Madura bulls for fattening purposes. Chemical analysis of feeds identified was done in the Animal Nutrition laboratory, Faculty of Animal Science, Brawijaya University, Malang. Materials used for formulating ration were local feeds namely field grass, *Gliricidia*, *Moringa*, *Indigofera*, and jackfruit leaves collected from beef cattle farmers in Bangkalan regency. The rations were then formulated in such a way to mimic the beef cattle ration under small farmer’s condition and the use of tree/shrub legume leaves were used to improve the protein contents of the ration. Rumen liquids were taken from the slaughterhouse in the morning at three different times as replication and it was done due the absence of rumen fistulated animals.

2.2 Methods

Feed samples included field grass, gliricidia, moringa, indigofera and jackfruit leaves were taken weekly, and sub-samples were brought to the laboratory for proximate analysis [5]. Based on the chemical analysis data, the ration was then formulated as the following treatments: A = field grass (control); B = field grass + gliricidia leaves; C = field grass + moringa leaves; D = field grass + indigofera leaves; E = field grass + jackfruit leaves. The ratio between field grass and the tree/shrub leaves was 60:40 on a dry matter basis. Parameters measured were in vitro gas production (IVGP) following the procedure of [6], dry matter digestibility (DMD) and organic matter digestibility (OMD). Observation of gas production was carried out at 2, 4, 6, 8, 12, 16, 24, 36, 48, and 72 hour and the calculation of gas production was executed using the Neway (Excel) program [7] using the following equation of [8]:

\[ p = b (1 - e^{-ct}) \]

where \( p \) = the volume of gas produced at time \( t \), \( b \) = fraction of potential degraded or gas production potential, \( c \) = rate of gas production. Rumen ammonia concentration was measured according to [9], whilst efficiency of microbial protein synthesis (EMPS) was measured as guided by [10].

2.3 Data analysis

Data obtained were subjected to statistical analyses using a Randomised Block Design (RBD) according to [11] whereas times of rumen liquid taking were used as a block. Statistical analyses were performed on all data by following the general linear procedure in PROC GLM from SAS. The data obtained were analysed for variance at the 5% significance level. If the
Data shows a significant difference as an effect of the treatment, then continue with Duncan's new multiple range test (DMRT).

3 Results and discussion

3.1 Chemical composition of forages used in this study

Data on chemical composition of field grass and tree and shrub legume leaves collected from cattle farmers in Bangkalan regency is presented in Table 1.

Table 1. Type of feeds commonly used by farmers in Bangkalan regency

<table>
<thead>
<tr>
<th>No</th>
<th>Feeds</th>
<th>Nutrient contents (% DM)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>DM</td>
</tr>
<tr>
<td>1</td>
<td>Field grass</td>
<td>25.3</td>
</tr>
<tr>
<td>2</td>
<td>Rice bran</td>
<td>89.2</td>
</tr>
<tr>
<td>3</td>
<td>Glyricidia</td>
<td>22.5</td>
</tr>
<tr>
<td>4</td>
<td>Moringa leaves</td>
<td>24.2</td>
</tr>
<tr>
<td>5</td>
<td>Indigofera</td>
<td>26.3</td>
</tr>
<tr>
<td>6</td>
<td>Jackfruit leaves</td>
<td>35.4</td>
</tr>
</tbody>
</table>

CF – crude fibre; CP – crude protein; DM – dry matter; EE – ether extract; NFE – nitrogen free extract

During the execution of the study, it was found that field grass being a majority of the feed used as a sole diet by the farmers and as seen in Table 1 crude protein (CP) content of field grass was 9.2%, which was a little bit higher than CP content of rice bran (8.4%). A small number of farmers occasionally provide those two feeds for their cattle as rice bran is considered an expensive stuff in Bangkalan regency (IDR 4,000-4,200). Crude protein contents of gliricidia, moringa, indigofera and jackfruit leaves were in the range of values reported elsewhere by [1, 4, 12].

3.2 IVGP, DMD, OMD, rumen NH3 and EMPS

Data on IVGP, DMD, OMD, rumen NH3 concentration and EMPS is presented in Table 2. Statistical analysis showed that feed treatments significantly affected IVGP, DMD, OMD, rumen NH3 concentration EMPS (P<0.05). The highest IVGP values were recorded in treatment C (132.6 ml/500 mg DM) followed by treatments E, D, B and A (121.8, 119.4, 112.9 and 99.6 ml/500 mg DM, respectively). Similar trends were also observed in DMD, and OMD values, in which the DMD and MD values increased by the presence of tree or shrub legume leaves in the ration. This evidence clearly shows that increasing CP content of the ration due to the supplementation of tree or shrub legume leaves has allowed rumen microbes to grow and do the digestion process better.

Table 2. IVGP, NH3 and EMPS

<table>
<thead>
<tr>
<th>Parameters observed</th>
<th>A (SEM)</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>IVGP (ml/500 mg DM)</td>
<td>99.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>112.9&lt;sup&gt;b&lt;/sup&gt;</td>
<td>132.6&lt;sup&gt;d&lt;/sup&gt;</td>
<td>119.4&lt;sup&gt;b&lt;/sup&gt;</td>
<td>121.8&lt;sup&gt;c&lt;/sup&gt;</td>
<td>4.34</td>
</tr>
</tbody>
</table>
DMD – dry matter digestibility; ESPM – efficiency of microbial protein synthesis; IVGP – in vitro gas production OMD – organic matter digestibility; Different superscripts in the same row showed significant difference (P<0.05).

Ammonia concentration required by microbes in the rumen were at the normal level for all treatments ranging from 79.8 mg N-NH3/l (in rice bran supplementation) to 113.8 mg N-NH3/l (in moringa leaves supplementation). ESPM values also went on the same trend as NH3 concentration value in which by supplementing moringa leaves (treatment C) on field grass produced the highest ESPM value (32.4 g N/kg DOMR) followed by treatments E, D, B and A (30.2, 28.5, 24.6 and 19.4 mg N/kg DOMR respectively). [13] stated that the protein in Moringa has good rumen bypass properties and in the study of [14] showed that by feeding dairy cows 2 kg or 3 kg DM of Moringa leaves increased milk yield (4.9 and 5.1 kg/day) compared to cows fed only Brachiaria brizantha hay; this improvement was related to an increase in feed intake and in the digestibility of nutrients (dry matter, organic matter, crude protein, and dietary fibre) in Moringa leaves.

4 Conclusion

In summary, tree or shrub legume leaves have potential roles in improving quality of ration based on field grass. The adequate concentration of NH3 in the rumen and improvement on ESPM values when tree or shrub legume leaves are supplemented has become an important finding of this study.

The authors wish to thank the Ministry of Education, culture, research and technology for funding this study through “Matching Fund scheme”

References

4. R. A. Leng. (Food and Agriculture Organization of the United Nations, Rome, 1997)
5. AOAC. (Oxford University Press, England 2019)
7. X. Chen. (Unit. Rowett Research Institute, Backburn, Aberdeen 1994)