The evaluation of nutritive value and \textit{in vitro} digestibility of Mulato grass (\textit{Brachiaria hybrid} cv. Mulato) grown under mixed culture system with legume and horticulture plants on dry land

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Abstract. This research is conducted to study the nutrient contents and the \textit{in vitro} digestibility of Mulato grass (\textit{Brachiaria hybrid} cv. Mulato) grown under mixed culture system with legume-horticulture plants. The study used a completely randomized research design (CRD) consisted of four treatments and four replicates. Those treatments were (1) T$_0$ = monoculture Mulato grass, (2) T$_1$ = biculture Mulato grass with legume, (3) T$_2$ = biculture of Mulato grass with horticultural plants, and (4) T$_3$ = polyculture of Mulato grass with legume and horticultural plants. Data collected were subjected to analysis of variance (ANOVA). Results showed that treatment had significant ($P<0.05$) effects on Dry Matter (DM), Organic Matter (OM), and Crude Protein (CP) as well to the \textit{in vitro} digestibilities of DM and OM of Mulato grass. It was concluded that nutritive value and \textit{in vitro} digestibilities of DM and OM of Mulato grass were increased in a mixed culture system of Mulato grass with legume and horticulture plants.

1. Introduction

Improvements of feed supply and feeding management are main problems in cattle farming system, especially on the dry land region such as in East Nusa Tenggara (ENT) Province. The quantity and quality of forage are important factors in determining animal productivity. The fluctuation in forage production is not only influenced by seasons but also by low soil fertility. The availability of soil Nitrogen, for examples, affects on plant production and its biomass quality. Many ways have been developed to improve forage production and nutrients, one of them is through polyculture farming of grass, legume, and horticulture plants.

One of grass species that popular in local farmer in ENT is Mulato grass (\textit{Brachiaria hybrid} cv. Mulato). According to [1], dry matter (DM) yield of Mulato grass from three times of harvest in duration of four months was 12.04 ton/ha. Mulato grass can grow well during dry season but has low nutrient quality. Therefore, integrated culture of grass-legume could be the solution to improve quality of the grass. Legumes are able to fix N from the atmosphere, and this N compound will available for grass to grow in a legume-grass biculture system [2]. Moreover, legume has high nutrients content compared to grass, especially in crude protein content.
Introducing horticultural plants in the integrated legume-horticulture plants system is objected to minimize sunlight exposure on the soil. Thus, horticulture plant will retain soil moisture, reduce water requirement, and restrict N-soil loss. Moreover, this integrated legume-horticulture system may increase forages production and farmer income in the dry land [3]. Therefore, the aim of this study determine the effects of mixed culture of legume-horticulture plants on nutrients contents and in vitro digestibility of Mulato grass.

2. Material and methods

2.1. Material
The experiment was carried on the land owned by farmers at Oeletsala village, Taebenu sub-district, Kupang regency, ENT province. The materials used in this research were stem cuttings of Mulato grass, Clitoria ternatea legume, cucumber, Cayenne pepper, and Vigna unguiculata ssp. sesquipedalis.

2.2. Methods
The experimental used a completely randomized research design consisted of four treatments and four replications. The treatments were: (1) T₀ = monoculture of Mulato grass, (2) T₁ = biculture of Mulato grass with legume, (3) T₂ = biculture of Mulato grass with horticultural plants (cucumbers, cayenne pepper, Vigna unguiculata ssp. sesquipedalis), and (4) T₃ = polyculture of Mulato grass with legume and horticultural plants.

Observed variables are dry matter content (DM), organic matter content (OM) and crude protein content (CP). In vitro digestibility was carried out according to Tilley and Terry method and the calculation of in vitro digestibilities of DM and OM were according to a formula as described by [5].

2.3. Data analysis
Data were subjected to Analysis of Variance (ANOVA) based on Completely Randomized Design (CRD) to explore effect of treatments [6].

3. Results and discussion

3.1. Nutrients content of Mulato grass
Chemical compositions of Mulato grass in this research is shown in Table1 below. It is shown that the lowest DM, OM and CP contents of Mulato grass were found in treatment T₀, while the highest nutrients contents were found in treatment T₃. Legume introduction in mixed-culture apparently increased N fixation, while horticulture plants able to keep soil moisture. Thus, there were nutrient transfer, especially N compounds, to the grass that positively affecting DM, OM, and CP contents of the grass. According to [7], transfer of protein from legume to grass is occured through root’s grass by bacteria on legumes root. Mixed culture of grass-legume plants usually more productive then the monoculture, and the increase of crude protein content will occur if N fixation from atmosphere by rhizobium bacteria is effective [8].

| Parameters | Treatments | P-Value   |
|------------|------------|-----------|
|            | T₀± SD     | T₁± SD    | T₂± SD    | T₃± SD    |           |
| DM (%)     | 26.64±0.60 | 27.61±0.93| 27.90±0.40| 28.63±0.51| 0.01**    |
| OM (%)     | 75.18±1.22 | 75.30±0.79| 76.89±1.23| 77.64±0.60| 0.01**    |
| CP (%)     | 9.74±0.57  | 10.47±0.42| 11.07±0.61| 12.88±1.03| 0.00**    |

** *= highly significant different (P<0.01)
The differences in chemical contents of grass among treatments due to the plants have different abilities in N fixation from atmosphere and the lack of soil humus, in which the growth of grass in monoculture was relatively slow due to the heat stress. Through mixed culture of legume and horticultural plants, such as cucumber, the nutrients contents in grass biomass were increased. It has been reported that due to lack of N, plant growth was impeded that resulted in a dwarf plant, light yellowish leaves, and low yield quality [9].

This results were supported by [10] that protein content is an essential N compound in plant. Protein content of monoculture grass was lower compared to mixed culture with legume. In a low N soil condition, grass is highly responsive to N compounds supplied by legume that will increase the yield and crude protein content of grass [11]. CP content in grass was increased by the increasing of proportion of legume in a mixed culture legume-grass [12]. According to [13], legume cultivation in the pasture will provide better feeding value. However, mixed culture of grass and horticultural plants did not result in a significant increase of nutrients content because of limited N fixation by grass. But this plants combination could reduce water requirement due to less soil moisture evaporation as soil is covered by horticultural plants.

3.2. In vitro digestibility of Mulato grass

The in vitro digestibility of Mulato grass in this study was as presented in Table 2. It is shown that the lowest averages of DM and OM digestibilities were found in treatment T0 (monoculture Mulato grass), while the highest digestibilities were found in treatment T3 (polyculture of Mulato grass, legume, and horticultural plants). Different nutrition contents of grass grown under polyculture system, lead to different digestibility of DM and OM of Mulato grass.

| Parameters          | Treatments       | T0±SD | T1± SD | T2± SD | T3± SD | P-Value |
|---------------------|------------------|-------|--------|--------|--------|---------|
| DM Digestibility (%)|                  | 45.34±0.85 | 45.40±1.61 | 47.09±0.91 | 50.30±0.56 | 0.02*   |
| OM Digestibility (%)|                  | 47.09±1.00 | 48.18±0.87 | 48.66±1.87 | 51.54±2.56 | 0.02*   |

*Significantly different (P<0.05)

Statistical analysis showed that there was a significant difference (P<0.05) of DM and OM digestibilities among treatments. This result was in accordance with the contents of DM and OM found in this research. This differences were due to different applied mixed culture system. In the monoculture system, grass exposed by heat stress that led to higher CF (34.21%) as grass rapidly mature and increase its cell wall fraction. This will result in lower digestibility value of DM and OM. It has been reported by [14] that crude fiber content was affected by light intensity and temperature. High light intensity and temperature might increa plant respiration that allow a faster maturing process and lignification of cell wall plant. [15] found that defoliation of an older plant (60 days) will result in higher proportion of cellulose and hemicellulose, as parts of cell wall, that leads to the increases in crude fiber and DM contents. In contrast, the water soluble carbohydrate will be decreased.

Crude fiber content is also influenced by climate factor. Drought stress condition affects on crude fiber content, because the increase of cellulose and hemicellulose proportion existed in leaf and stem [9]. According to [16], crude fiber content is not only related to the age of plant, but also by mixed cultivation with legume. Association of grass and legume could affect the interference and mutual symbiosis [17] and resulted in different digestibility value of DM and OM as shown in this research.

4. Conclusion

Mulato grass grown under mixed culture system with legume and horticultural plants resulted in higher nutrition contents. This study also showed that mixed culture of Mulato grass with legume and horticultural plant might increase in vitro digestibilities of DM and OM of Mulato grass.
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