Advances in Biological Sciences Research, volume 21
Proceedings of the 6th International Seminar of Animal Nutrition and Feed Science (ISANFS 2021)

Nutrient Content Digestibility of Butterfly Pea *(Clitoria ternatea)* with Different Nitrogen Source Fertilizers in the Third Harvest

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ABSTRACT
This study aimed to compare the use of gandasil balanced fertilizer with various levels towards the nutrient composition and dry matter digestibility (DMD) and organic matter digestibility (OMD) of butterfly pea (*Clitoria ternatea*) by in vitro method. This research used butterfly pea, fertilized at the third week and harvested at 7 weeks old. Materials for digestibility analysis include butterfly pea, sheep rumen liquor, HCl, pepsin, McDougall solution, and distilled water. The treatments consisted of P1 (butterfly pea with fertilizer) and P2 (butterfly pea with inorganic fertilizer). The dose of fertilizer application was based on the butterfly pea nitrogen requirement, which was 40 kg N/ha. The research design used was a completely randomized design one-way ANOVA, then the data obtained was followed by t-test data analysis. The use of organic and inorganic fertilizers on butterfly pea did not have a significant effect (P> 0.05) on the yield of nutrient content (dry matter, organic matter, crude protein, crude fiber, and crude lipid). The use of organic and inorganic fertilizers on DMD and OMD of butterfly pea also did not significantly affect (P> 0.05). This showed that organic liquid fertilizer has good potential to substitute for chemical liquid fertilizers. This is due to organic liquid fertilizers are more environmentally friendly and can reduce pollution.

Keywords: *Clitoria ternatea, Fertilizers, Nitrogen source, Nutrien content, In vitro digestibility*

1. INTRODUCTION

Forage is the primary source of feed for ruminants. Hence to increase the ruminants production, there must be an increase in the provision of adequate forage both in quantity and quality. There are several forage legumes, grass and forbs that are important in Indonesia, such as Puero (*Pueraria javanica*) [1], Sorghum and stylosanthes [2], *Chicoryum intybus* [3], *Brachiria* sp. [4], *Brachiaria brizantha* cv MG 5 [5], *Shorghum* BMR, *Pennisetum purpureum* [6], [7], *Pennisetum purpureum* cv Mott [8].

Legume is one of the dicot plant families that can fix nitrogen directly from the air. This makes legume plants have a high enough protein content which is good as animal feed. Moreover, legumes can also improve soil fertility [9]. One type of legume that has not been widely used as animal feed is the butterfly pea. *Clitoria ternatea* has potential as an animal feed because it has a high nutrient value with a crude protein content of 14% to 20% and has good palatability [10]. However, the biomass of butterfly pea is lower than the biomass of grasses. There are several ways to increase biomass, such as management of fertilization levels [4], [11]–[13], manage the level of defoliation [14], also manage the plant density [15]–[17].

Fertilization is an effort to increase the quantity and quality of plants. Inorganic fertilizers are often used as an alternative for farmers to increase plant growth quickly and be harmful if done in the long term. The continuous use of inorganic fertilizers can reduce land productivity [18]. It disrupts the physical, chemical, and biological balance of the soil so that it harms crop production and leaves residues that can damage the soil. Environmental damage because of excessive use of

inorganic fertilizers can be repaired by applying organic fertilizers. Organic fertilizers can improve the soil's physical, chemical, and biological properties due to

their carbon compounds [19]. Therefore, to achieve environmentally friendly agriculture, a study was conducted comparing the effectiveness of using organic fertilizers and inorganic fertilizers on nutrient content and digestibility of the butterfly pea.

2. MATERIALS AND METHOD

2.1 Research Design

This research used butterfly pea, *g*andasil D fertilizer, rabbit urine liquid organic fertilizer. There were four plants for one plot. Each treatment received 3 planting plots with a size of 1 x 1 m^2. The planting distance used in the study was 60 x 60 cm^2 and the distance between the plots was 50 x 50 cm^2. Fertilization was carried out at the third week after planting using liquid fertilizer, spraying directly on the leaves. The fertilizer dose was determined based on the plant's need for nitrogen, 40 kg N/ha. Butterfly pea plants were harvested at the age of 50 days after the second harvest. The plant was dried to reduce the water content using a 55ºC oven for 3 days, then mashed using Willey mill in a screen diameter of 1 mm.

2.2. Sample Analysis

The next stage evaluated the dry matter, organic matter, crude protein, crude fiber, crude fat, and in vitro digestibility (dry matter and organic matter) with the Tilley and Terry method on butterfly pea treated with organic inorganic fertilizers.

2.3 Data Analysis

The research design used was completely randomized one-way ANOVA with two treatments and 3 replications, namely A1 (butterfly pea with organic fertilizer) and A2 (butterfly pea with inorganic fertilizers). The data obtained were then analyzed with a t-test. Data analysis was performed with the help of Statistical Product and Service Solution (SPSS) version 16.0.

3. RESULT AND DISCUSSION

3.1 Nutrient Content of Butterfly Pea Plants

The results showed that the application of organic and inorganic fertilizers had a non-significant effect (P> 0.05) on the nutrient content (DM, OM, CP, CF, and CL) of the butterfly pea. The average nutrient content of butterfly pea with organic and inorganic fertilizers is presented in Table 1.

Nutrient (%)	Fertilizer	
	Organic	Inorganic
Dry matter (DM)	29.87± 3.72	29.73± 3.52
Organic matter (OM)	86.99± 0.76	86.78± 0.84
Crude protein (CP)	24.46± 1.43	24.78± 0.78
Crude fiber (CF)	21.81± 2.32	21.65± 2.61
Crude lipid (CL)	9.89± 0.46	9.92± 0.69

Table 1. Average nutrient content of butterfly pea by providing organic and inorganic fertilizers.

The DM produced from the butterfly pea given organic and inorganic fertilizers had a non-significant effect (P> 0.05). Plant DM consists of organic and inorganic materials other than water. Carbohydrates, proteins, lipids, and minerals are the constituents of DM derived from the plant's photosynthesis. The use of fertilizers directly on the leaves can increase the leaves' chlorophyll content which helps the plant photosynthesis process. Applying fertilizer to plants, especially directly on the leaves, let the nutrients in the fertilizer enter directly into the leaves through the stomata [20]. This can increase the capacity of photosynthesis so that the photosynthate produced is higher.

The OM produced from the butterfly pea with organic and inorganic fertilizers had a non-significant effect (P> 0.05). Organic matter is a part of plant DM. Therefore the content of OM is linearly related to DM. Organic matter is part of the DM, so if the DM increases, it will enhance the OM and vice versa [21].

The CP produced from the butterfly pea with organic and inorganic fertilizers had a non-significant effect (P> 0.05). The CP content can be affected by the addition of nitrogen to plants. Liquid fertilizers are easy to be absorbed by plants due to their simple component [22]. The application of fertilizer to plants affects the protein content of the forage.

The CF produced from the butterfly pea with organic and inorganic fertilizers had a non-significant effect (P> 0.05). The CF can increase with plant age. Fertilization can accelerate the generative phase of plants, where the CF content will also increase. Plants have the nature of continuous growth and do not stop, even though they have entered the generative phase where the CF content of the plant will also increase [23]. The addition of nitrogen to plants will accelerate vegetative growth to enter the generative growth phase.

The CL produced from the butterfly pea with organic and inorganic fertilizers had a non-significant effect (P> 0.05). The CL content can be affected by plant water content, where the higher the water content, the lower the lipid content. The CL content is related to the water

content of the plant, where the higher the water content will lower the CL content [24].

3.2 In Vitro Digestibility

The results showed that the application of organic and inorganic fertilizers had a non-significant effect (P> 0.05) on dry matter digestibility (DMD) and organic matter digestibility (OMD) of butterfly pea. The DMD and OMD of butterfly pea with organic and inorganic fertilizers are presented in Table 2.

The DMD produced from the butterfly pea with organic and inorganic fertilizers had a non-significant effect (P> 0.05). The protein and fiber content of feed ingredients influenced the DMD. Feed protein will affect the formation of NH_3 in the rumen by microbes [25]. Rumen microbes will use NH3 content in the rumen as the primary source for microbial protein synthesis. The higher the microbial population, the more enzymes will increase, thus, feed digestibility.

Table 2. Dry matter and organic matter digestibility of butterfly pea plants given with organic and inorganic fertilizers.

Digestibility (%)	Fertilizer	
	Organic	Inorganic
Dry matter digestibility (DMD)	84.51± 4.52	85.69± 3.26
Organic matter digestibility (OMD)	82.86± 6,20	83.12± 4.32

The OMD produced from the butterfly pea with organic and inorganic fertilizers had a non-significant effect (P< 0.05). The OMD is directly proportional to DMD. Dry matter digestibility can affect organic matter digestibility [26]. Decreasing DMD will result in decreased OMD or vice versa.

4. CONCLUSION

The results of nutrient content (DM, OM, CP, CF, and CL) between organic and inorganic fertilizers in butterfly pea were the same. The use of organic and inorganic fertilizers on DMD and OMD of the butterfly pea was also not different. This showed that organic liquid fertilizer has good potential to substitute for chemical liquid fertilizers. Organic liquid fertilizers are more environmentally friendly and can reduce pollution.

ACKNOWLEDGMENTS

The authors would like to thank Universitas Gadjah Mada for the grant under the scheme of Rekognisi Tugas Akhir (RTA) 2021.

REFERENCES

[1] I. K. Mudhita, N. Umami, S.P. Sasmito Budhi, I. Gede Suparta Budisatria, Wattimena., Effect of Bali cattle urine on legume cover crop puero *(Pueraria javanica)* productivity on an east Borneo oil palm plantation, *Pakistan J. Nutr.*, vol. 15, no. 5, pp. 406–411, 2016, DOI: 10.3923/pjn.2016.406.411.

[2] D. Astuti, B. Suhartanto, N. Umami, and A. Irawan, Effect of density between intercropped sorghum and stylosanthes on biomass production and quality under varying NPK fertilizer application rates, *J. Crop Sci. Biotechnol.*, vol. 23, no. 3, pp. 197–205, 2020, DOI: 10.1007/s12892-020-00014-z.

[3] N. Zaini, N. Umami, C. Hanim, A. Astuti, and B. Suwignyo, The Effect of Harvest Age on Different Regrowth on Chicory (*Cichorium intybus* L.) Forage Yield by Intercropped with *Pennisetum purpureum* cv. Mott, *Bull. Anim. Sci.*, vol. 45, no. May, pp. 103–108, 2021, DOI: 10.21059/buletinpeternak.v45i2.61334.

[4] N. Umami, B. Suhartanto, B. Suwignyo, N. Suseno, and F. Herminasari, Effects of season, species and botanical fraction on oxalate acid in *Brachiaria* spp. Grasses in Yogyakarta, Indonesia, *Pakistan J. Nutr.*, vol. 17, no. 6, pp. 300–305, 2018, DOI: 10.3923/pjn.2018.300.305.

[5] A. N. Respati, N. Umami, and C. Hanim, Growth and Production of *Brachiaria brizantha* cv. MG5 in Three Difference Regrowth Phase Treated by Gamma Radiation Dose, *Tropical Animal Science Journal*, 2018. https://journal.ipb.ac.id/index.php/tasj/article/view/21575/15894 (accessed Aug. 24, 2021).

[6] D. Ananta, Z. Bachruddin, and N. Umami, Growth and production of 2 cultivars *(Pennisetum purpureum* Schumach.) on regrowth phase, *IOP Conf. Ser. Earth Environ. Sci.*, vol. 387, no. 1, 2019, DOI: 10.1088/1755-1315/387/1/012033.

[7] N. Umami, D. Ananta, Z. Bachruddin, B. Suhartanto, and C. Hanim, Nutrient content, fiber fraction and ethanol production of three cultivars *(Pennisetum purpureum* Scumach.), DOI: 10.1051/e3sconf/202020003008.

[8] S. Widodo, B. Suhartanto, and N. Umami, Effect of shading and level of nitrogen fertilizer on nutrient quality of *Pennisetum purpureum* cv. Mott during wet season, *IOP Conf. Ser. Earth Environ. Sci.*, vol. 247, no. 1, 2019, DOI: 10.1088/1755-1315/247/1/012007.

[9] S. Susetyo, *Pasture Management*. Bogor, Indonesia, 1980.

[10] E. Sutedi, Potential of butterflypea (*Clitoria ternatea*) as a fodder crop, *Wartazoa*, vol. 23, no. 2, pp. 51–62, 2013.

[11] N. Umami, M. P. Dewi, B. Suhartanto, N. Suseno, and A. Agus, Effect of planting densities

and fertilization levels on the production and quality of Chicory (*Cichorium intybus*) in Yogyakarta, Indonesia Effect of planting densities and fertilization levels on the production and quality of Chicory (Cichorium intybus) , DOI: 10.1088/1755-1315/425/1/012073.

[12] R. Utomo, C. T. Noviandi, N. Umami, and A. Permadi, Effect of Composted Animal Manure as Fertilizer on Productivity of Azolla Pinnata Grown in Earthen Ponds, *OnLine J. Biol. Sci. Orig. Res. Pap.*, 2019, DOI: 10.3844/ojbsci.2019.232.236.

[13] A. M. Tilova, N. Umami, B. Suhartanto, A. Astuti, and N. Suseno, Effects of different level of nitrogen fertilizer on growth and production of *Cichorium intybus* at the eighth regrowth Effects of different level of nitrogen fertilizer on growth and production of *Cichorium intybus* at the eighth regrowth, *IOP Conf. Ser. Earth Environ. Sci*, vol. 788, p. 12163, 2021, doi: 10.1088/1755-1315/788/1/012163.

[14] H. O. Parjana *et al.*, Effects of different levels of defoliation on growth and production of *Cichorium intybus*, DOI: 10.1088/1755-1315/788/1/012166.

[15] N. Umami, S. Widodo, B. Suhartanto, B. Suwignyo, N. Suseno, and C. T. Noviandi, The effect of planting material on nutrient quality and production of *Brachiaria* spp. In Yogyakarta, Indonesia, *Pakistan J. Nutr.*, vol. 17, no. 12, pp. 671–676, 2018, DOI: 10.3923/pjn.2018.671.676.

[16] N. Umami, N. Isnaini, and B. Suhartanto, Content of Prussic Acid and Production of Sorghum Brown Midrib by Adding Urea Fertilizer and Extending Harvesting Time, *Anim. Prod.*, vol. 21, no. 2, p. 93, 2020, DOI: 10.20884/1.jap.2019.21.2.562.

[17] N. Umami, A. Abdiyansah, and A. Agus, Effects of different doses of NPK fertilization on growth and productivity of Cichorium intybus, *IOP Conf. Ser. Earth Environ. Sci.*, vol. 387, no. 1, 2019, DOI: 10.1088/1755-1315/387/1/012097.

[18] E. I. Munawar, *Pupuk organik : cair & padat, pembuatan, aplikasi*, Penebar Swadaya, Jakarta, Indonesia, 2006.

[19] W. Hartatik, Husnain, and L. R. Widowati, The Role of Organic Fertilizers in Increasing Soil and Plant Productivity, *J. L. Resour.*, vol. 9, no. 2, pp. 107–120, 2015.

[20] N. M. Witariadi and N. N. Candraasih, Productivity of legume plants (*Centrocema pubescens* and *Clitoria ternatea*) fertilized with fertilizer bio slurry, *Anim. Sci. Mag.*, vol. 20, no. 3, pp. 100–105, 2017.

[21] F. Fahul and S. Wajizah, Addition of Mn and Cu microminerals in the ration to the In Vitro Rumen Biofermentation Activity of Sheep, *JITV*, vol. 15, no. 1, pp. 9–15, 2010.

[22] S. Hadisuwito, *Making Liquid Compost*, Agromedia Pustaka, Jakarta, Indonesia, 2007.

[23] G. Wiguna, Phenotypic performance of several cucumber genotypes (Cucumis sativus L.)., *J. Agric. Sci.*, vol. 10, no. 2, pp. 45–55, 2014.

[24] F. Salisbury, B. Ross, and W. Cleon, *Plant Physiology Volume Three: Plant Biochemistry*, ITB Press, Bandung, Indonesia, 1995.

[25] U. H. Tanuwiria, B. Ayuningsih, and Mansyur, Fermentability and digestibility of complete ration of dairy cattle based on rice straw and amoniated sugarcane shoots (In Vitro)., *J. Anim. Sci.*, vol. 5, no. 4, pp. 64–69, 2005.

[26] A. D. Tillman, H. Hartadi, S. R. Prawirokusumo, and S. Lebdosoekojo, *Basic Animal Science*. UGM Press, Yogyakarta, Indonesia, 1989.