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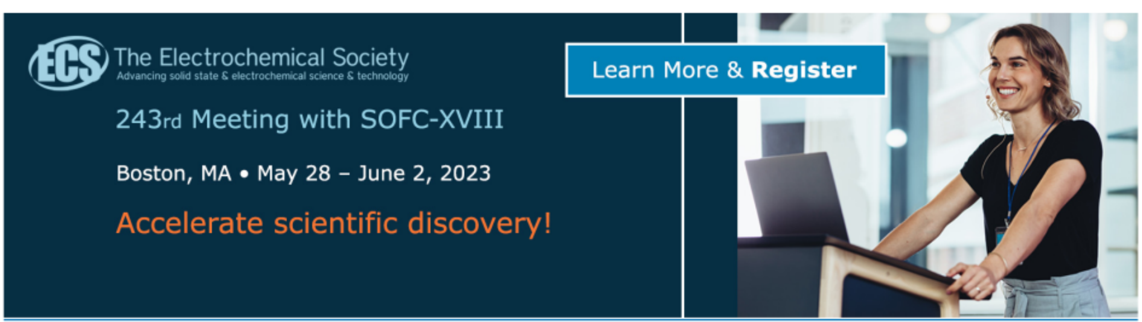

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Fungi Mycorrhizal Arbuscular for Reclamation of Coal Mining Using Land to Determine Characteristics of Rumen Fluids and Gas Production of Elephant Grass (*Pennisetum purpureum* of CV. Taiwan)

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Abstract. This study aims to determine the nutritional values of elephant grass to save critical land and provide forage quality animal feed which decreases due to conversion. This study employed the experimental method using a randomized block design with five types of treatments and four replications (groups). *Fungi Mycorrizal Arbuscula* (FMA) cv. *Glomus manihotis* will be inoculated at a dose of 10 grams/clump. The treatments comprise of A = 100% N, P, and K without FMA; B = 100% N, P, and K + FMA; C = 75% N, P, and K + FMA; D = 50% N, P, and K + FMA; E = 25% N, P, and K + FMA. The analysis results show that the treatments on the characteristics of rumen fluid, gas production, and metabolism energy (ME) are not significantly different (P > 0.05). The pH ranges from 6.86 (E) to 6.89 (B); the N-NH3 ranges from 11.20 (A) to 13.60 mg/100 ml (C); the VFA ranges from 93.3 (A) to 130.30 mM (E); gas production ranges from 34.40 (A) to 40.42 (ml/200 mg DM) (E). To conclude, adding 25% N, P, and K Fertilizer + FMA of *Glomus manihotis* 10 grams is the best process for the characteristics of rumen fluids and gas production.
Keywords: characteristics of rumen fluids; *fungi mycorrhizal arbuscular;* gas production; ME; N, P, and K

1. Introduction

The high activity of coal mining in several areas, such as the West Sumatra region, increasing regional income, and foreign exchange have damaged the environment [1]. Moreover, hundreds or even thousands of hectares of coal mining land have turned into unproductive land due to damaged physical structure and soil nutrient degradation that disables plants to grow [1]. One effort to restore critical land in coal mining is by utilizing Arbuscular Mycorrhizal Fungi (FMA) *glomus manihottis* [2]. In addition to FMA inoculation, N, P, and K fertilizers with doses of 100%, 75%, 50%, and 25% are recommended to apply. Whereas, FMA is inoculated with a dose of 10 grams/grass plant clump. The application of FMA on ex-coal mining land is expected to accelerate the growth of grass plants with their positive properties. Elephant grass is a superior type of grass that has a high productivity value, can form clumps with erect growth, and is easy to develop vegetatively [3]. Feed digestion in the rumen of ruminants is carried out fermentatively with the help of rumen microbes [4]. The increased microbial population will increase the concentration of enzymes, which in turn, are expected to increase feed digestibility and the supply of microbial protein for the needs of landlords. The FMA and fertilization on ex-coal mining land are expected to support the growth and development of grass production. This study has obtained the best reclamation method, level of FMA use, and fertilization for fattening cattle [5]. Moreover, this study provides an alternative solution to the difficult problem of forage feed, namely 3R (reuse, reduce, and recycle). To date, there have been limited studies on the reclamation of coal mined land. Therefore, the authors were interested in conducting research entitled *fungi mycorrhizal arbuscular* for reclamation

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of coal mining using land to determine characteristics of rumen fluids and gas production of elephant grass (*Pennisetum purpureum* of CV. Taiwan)

2. Methodology

a. Processing of coal mining land

This study employed the experimental method using a randomized block design with five types of treatment and four replications (groups) referring to the slope of the land. Then, the replications of forage will be analyzed at the laboratory by taking rumen fluid as an inoculum. The FMA was inoculated at a dose of 10 grams/clump. Meanwhile, the N, P, and K fertilizers were used at doses of 100%, 75%, 50%, and 25%. The dosages of N, P, and K fertilizers and FMA inoculations are as follows.
A = 100% of N, P, and K fertilizer without FMA
B = 100% N, P, and K + FMA + *Glomus manihotis*
C = 75% N, P, and K + FMA + *Glomus manihotis*
D = 50% N, P, and K + FMA + *Glomus manihotis*
E = 25% N, P, and K + FMA + *Glomus manihotis*
The randomized group design model is as follows.

$$Yij = \mu + \tau i + \beta j + \Sigma ijAb.$$

b. *In vitro* digestibility technique

This study employed the experimental method using the randomized block design (RBD) with five types of treatment and four replications (groups) that involved rumen fluid as an inoculum. This study tested the supplementation treatment to measure the pH, NH3-N, and VFA

c. Measurement of gas production and metabolic energy by *in vitro*

1. The metabolic content of forage samples was calculated based on the Menke and Steinngas [6] equations as follows.

ME (MJ/kg DM) = 2.2 + 0.136 (GP24¬¬) + 0.0057 (g/kg CP) + 0.00029 (g/kg CF) 2

3. Results and Discussion

3.1 Characteristics of rumen fluid

Acidity levels (pH) of rumen fluid and N-NH_3 concentration of rumen fluid and volatile fatty acid

The average scores of pH rumen fluid are presented in Table 1.

Table 1. Average scores of pH rumen fluid by *in-vitro* technique

Treatments	(pH) Rumen Fluid	N-NH_3	VFA
A	6.89	11.20	93.33
B	6.89	11.73	123.33
C	6.88	13.60	113.33
D	6.87	11.48	111.67
E	6.86	11.76	130.00
SE	0.02	0.17	8.40

Remarks: The treatments showed insignificantly different effects ($P < 0.05$).
SE: Standard errors

Table 1 shows that the average pH of the rumen fluid of each treatment ranges from 6.86 (E) to 6.89. (B). The statistical analysis has discovered that the treatment of using N, P, and K fertilizer doses and FMA on elephant grass of CV. Taiwan has significantly different effects ($P <0.05$) on the pH of rumen fluid. Sayuti opines [7] that one of the factors influencing pH is fermentation activity and products, namely VFA levels. Van Soest [8] also argues that the pH of the rumen fluid is influenced by the VFA production, the increased VFA will decrease the pH of the rumen fluid, and the increase in NH3 will increase the pH of the rumen fluid. Arora [9] states that the pH of the rumen fluid is more or less constant due to fermented products in the form of VFA and NH3. This statement agrees with the opinion of Arora (1989). Orskov [10] adds that a rumen pH of less than 6 (neutral) can inhibit the process of proteolysis and deamination because the growth of the bacterial rumen can be inhibited. The average concentration of N-NH3 rumen fluid from crude protein fermentation of Elephant grass CV.

Taiwan ranges from 11.20 (A) mg/100 ml (D) to 13.60 mg/100 ml (C). The statistical analysis has revealed that the treatment of using N, P, and K fertilizer doses and the FMA delivery on Elephant grass cv. Taiwan has a significantly different effect (P> 0.05) on the concentration of N-NH3 rumen fluid. This is due to the protein content of elephant grass of CV. Taiwan and its digestibility in the rumen are relatively identical. Moreover, the crude protein content in each treatment is not significantly different because the absorption of nutrients in treatments A, B, C, D, and E have sufficient growth and nutrient content of elephant grass CV. Taiwan is normal. This study has revealed that the highest concentration of NH3 was obtained in treatment Eof 16.42 mg/100 ml and rumen fluid with a treatment dose of 25% N, P, and K fertilizers added with 10 grams of FMA glomus manihotis because the protein content increases. Annison et al. [11] assert that increasing protein could increase NH3 production. The data signify that the range of NH3 production of rumen fluids in treatments A and B is not much different. Moreover, the data show that giving 100% doses of N, P, and K fertilizers with or without FMA does not significantly affect rumen fluid. In treatments C-D, NH3 levels decrease because the NH3 is used by rumen microbes during the fermentation process and the availability of energy or VFA is sufficient. This condition is supported by Hume [12], who states that the main factor affecting the use of NH3 in rumen fluid is the availability of crude fiber for rumen microorganisms. Crude fiber produced from Elephant grass cv. Taiwan functions as an energy source for rumen microbial growth and fermentation needs. With the high VFA, microbes can use the N-NH3 to form cell proteins. This condition agrees with Sutardi [13] who states that the use of NH3 needs to be accompanied by easily fermented energy sources. Meanwhile, Satter and Slyter [14] explain that the concentration of NH3 rumen fluid varies between 0-130 mg/100 ml while the minimum limit of ammonia that can support rumen microbial growth is 5 mg/100 ml. The need for NH3 for maximum rumen fermentation activity at the rough basal forage is 23 mg/100 ml of rumen fluid [15].

3.2 Volatile fatty acid production (VFA) of rumen fluid

The average total volatile fatty acid (VFA) production is shown in Table 1. The total production of VFA is relatively the same even though the dosages of N, P, and K fertilizers are different because the crude fiber content of treatments is equal. The low crude fiber of the cellulolytic enzyme easily distributes crude fiber in the rumen so that the total concentration of VFA increases. Harrison et al. [16] state that the high degradation of crude fiber in the rumen will result in a total VFA increase. Hartati [17] adds that the VFA production from rumen fluid is applied as a benchmark for the fermentability levels of the food ingredients. Furthermore, it is said that the higher the fermentability level of food, the higher the VFA production. VFA ruminants have a dual role employed as an energy source for livestock and as carbon skeletons to form microbial proteins [18This study has discovered that the average VFA could provide sufficient rumen microbial needs for optimal growth and development of rumen microbes. The total range of VFA needed for microbial growth and activity is 80-160 mM [19].

3.3 Gas Production

The average scores of gas production are presented in Table 2.

Table 2. The average scores of gas production and energy metabolism

Treatments	Average scores of gas production (ml/200 mg DM)	Energy metabolism (MJ/Kg DM)
A	35.20	8.04
B	36.36	8.18
C	36.76	8.01
D	36.99	8.19
E	40.42	8.46
SE	2.00	0.28

Remarks: The treatments have shown insignificantly different effects (P > 0.05).
SE: Standard errors

The difference in the fermentation gas production of each treatment is not significant (P > 0.05) because it has a relatively uniform digestion of fiber fractions [20]; this condition results in relatively identical gas production. Gas production and fermentation activity are closely related to the plant protein fraction and DMD [21]. Rumen microbes convert organic acids into VFA and NH3 accompanied by gas formation [22].

The production of VFA and NH3 from elephant grass fermentation of CV. Taiwan is inoculated by FMA of each treatment and significantly affects (P> 0.05) the production of *Pennisetum purpureum.* The production of VFA from rumen fluid can be used as a benchmark for the fermentability levels of food ingredients; the higher the level of fermentability of food, the higher the VFA would be produced [23].

The ability of FMA can absorb nutrients in the soil so that the reduced N, P, and K fertilizer doses result in relatively identical production and nutrient content in each treatment. Furthermore, Husin [24] states that plants with mycorrhiza can absorb more phosphorus, nitrogen, and potassium than those without mycorrhiza on the same substrate. Setiadi [25] also proves that FMA can reduce or save approximately 50% phosphorus needs, 40% nitrogen, and 25% potassium and increase fertilizer efficiency because FMA can extend and expand the root reach of nutrient absorption in the soil, especially the element of phosphorus. Consequently, the FMA affects the quality of forage.

4. Conclusion

This study concludes that the FMA inoculation could reduce the use of N, P, and K fertilizers up to 25% in elephant grass of CV. Taiwan planted in coal mining land. Moreover, the FMA inoculation does not affect the characteristics of rumen fluid (pH, NH3, and VFA), *in vitro* gas production, and energy metabolism.

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