Open access
Vol. 21 No. 3: 208-211, Desember 2023
e-ISSN: 2622-3279, p-ISSN: 2657-0068
DOI: http://dx.doi.org/10.29244/jintp.21.3. 208-211

JINTP
Jurnal Ilmu Nutrisi dan Teknologi Pakan
http://journal.ipb.ac.id/index.php/jurnalintp

Adequacy of micromineral content (Fe, Zn, Cu) of Napier grass *(Pennisetum purpureum)* as beef cattle feed in Merapi volcanic slopes of Magelang Regency, Indonesia

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ABSTRACT

A study was conducted to assess the micromineral content of *Pennisetum purpureum*, commonly known as Napier grass, in the Magelang Regency of Central Java, Indonesia. Three different topographical areas, namely flat, undulated, and sloping, were considered for the study. Samples of Napier grass were collected from each area, with a total of 20 samples taken from each area. The samples were then subjected to various processing techniques, including fresh weight measurement, chopping, sun-drying, oven-drying, and milling. The mineral content of the samples was determined using an atomic absorption spectrophotometer (AAS). The results revealed that the mineral content of Zn and Cu in Napier grass varied significantly across the three topographical areas ($p<0.05$), with average values of 40.34 and 11.56 ppm, 33.44 and 10.75 ppm, and 40.38 and 13.43 ppm for flat, undulated, and sloping areas, respectively. The Fe content, on the other hand, was found to be not significantly different across the areas, with an average of 377.90 ppm. These findings suggest that the use of Napier grass as a basal feed for beef cattle, with a dry matter requirement of 7.56 kg day^{-1} and a proportion of Napier grass of 7.13 kg DM day^{-1}, would provide sufficient micro minerals, including Fe, Cu, and Zn, for the cattle in the three topographical areas.

Key words: mineral, napier grass, topography

ABSTRAK

Penelitian bertujuan untuk mengetahui kandungan mikromineral *Pennisetum purpureum* (Rumput gajah) di Kabupaten Magelang, Jawa Tengah, Indonesia. Sampel yang digunakan dalam penelitian ini adalah rumput gajah yang diambil dari tiga wilayah dengan topografi berbeda yaitu datar, bergelombang, dan miring. Sebanyak 20 sampel diambil dari masing-masing daerah. Sampel ditimbang segar, dipotong, dijemur, kemudian dikeringkan matahari kemudian dioven hingga mencapai berat stabil, selanjutnya digiling. Sampel yang diperoleh kemudian diukur kandungan mineralnya menggunakan *Atomic Absorption Spectrophotomete* (AAS). Hasil penelitian menunjukkan bahwa kandungan mineral Zn dan Cu pada rumput gajah yang diambil dari tiga topografi yang berbeda di wilayah Kabupaten Magelang berbeda nyata ($p<0,05$) yaitu: 40,34 dan 11,56 ppm, 33,44 dan 10,75 ppm, serta 40,38 dan 13,43 ppm masing-masing untuk wilayah topografi datar, bergelombang, dan miring. Kandungan Fe teridentifikasi tidak berbeda nyata, rata-rata 377,90 ppm. Dapat disimpulkan bahwa penggunaan rumput gajah sebagai pakan basal sapi potong yang dilakukan oleh sebagian besar peternak di wilayah tersebut, dengan asumsi kebutuhan bahan kering sebesar 7,56 kg hari^{-1} atau dengan proporsi rumput gajah sebesar 7,13 kg BK/hari. Mineral mikro Fe, Cu, dan Zn untuk sapi potong diketiga topografi tersebut mencukupi.

Kata kunci: mineral, rumput gajah, topografi

INTRODUCTION

Microminerals are elements needed in beef cattle feed to express their growth potential properly, so their availability must be considered. Napier grass is the main feed ingredient for beef cattle, usually cultivated in the Magelang Regency, Indonesia. Magelang Regency is a district surrounded by Mount Merapi (2,910 masl), Mount Merbabu (3,145 masl), Mount Sumbing (3,371 masl), Mount Sindoro (3,136 masl), Mount Andong (1,726 masl), and Menoreh Mountains (1,022 masl). Mount Merapi is a very active volcano which erupts and emits volcanic ash. Merapi volcanic ash is indeed rich in micro-minerals needed by livestock (Aini *et al.* 2019), but most areas of Magelang Regency have steep slopes and high rainfall, which can cause these minerals to be leached and not available in the forage plants that grow on it. The mineral content in forage plants varies greatly even within the same species, which is determined by the mineral content in the soil (Zhang *et al.* 2021), this condition is often not considered in feed management, so the risk of low productivity of beef cattle cultivated in the area becomes a bet.

Beef cattle need microminerals in their feed; if these needs are not met, livestock productivity will not be maximized. Patel *et al.* (2019) found that adequate microminerals in the feed can improve the productivity and quality of meat produced by beef cattle. Iron (Fe) is the fourth most common element in the Earth's crust and an essential micromineral for all animal species (Wysocka *et al.* 2020). Hilal *et al.* (2016) stated that in animal development and health, copper (Cu) and Zink (Zn) have a multitude of biological and physiological functions. These minerals support immune system function, tissue growth, and antioxidant defense. Mcdonald *et al*. (1988) recommended the amount of micro minerals Fe, Zn, and Cu needed by livestock of 20-80, 10-50, and 1-5 mg kg^{-1}, respectively.

The preparation of ruminant rations by farmers in Magelang Regency still uses a standard benchmark that has yet to consider the possibility of differences in the availability of microminerals in the forage used. Most cattle breeders in the volcanic area of Mount Merapi compose their rations by combining Napier grass, commercial concentrates, and mineral supplements. Information regarding Napier grass's micro-mineral content, widely used as a crude feed source in beef cattle rations at different topography in the volcanic area of Mount Merapi, Magelang Regency, has yet to be available. This can cause the provision of mineral supplements in the ration to be ineffective. Based on these conditions, a study was conducted to examine the content of micro minerals (Cu, Fe, and Zn) in Napier grass plants taken from various fields with different topography on the volcanic slopes of Mount Merapi. The research results are expected to be used as a basis for formulating mineral supplements in beef cattle rations on the volcanic slopes of Mount Merapi.

METHODS

Time and Place of Research

This research was conducted using a survey from June 2021 to June 2022 in the Magelang Regency area. Samplings of Napier grass (*Penisetum purpureum*) were taken from three types of topography, namely: flat (Borobudur subdistrict 235 masl, Mungkid district 320 masl, and Mertoyudan district 347 masl), wavy topography (Bandongan district 431 masl, Tegalrejo district) elevation of 478 masl, and Windusari sub-district 525 masl), and sloping topography (Kaliangkrik sub-district 823 masl, Pakis district 841 masl, and Ngablak district 1,378 masl) (Central Bureau of Statistics, 2014). Sample preparation and analysis of mineral content were carried out at the Laboratory of the Faculty of Agriculture, University of Tidar.

Sample Collection and Preparation

Napier grass samples were taken using purposive sampling, considering the largest cattle population and soil topography type. Napier grass samples were taken from three different topography at 20 location points for each topography, for a total of 60 points (Table 1). Each sample unit was taken as much as 1 kg of fresh material.

The samples that have been obtained are then chopped to the same size, then dried in the sun until the water content is reduced to 60%. After that, the sample was put into a paper container, then baked in an oven at 65°C for 72 hours or until the sample reached a stable weight. After the sample weight is stable, grind it into flour using a blender. After that, the sample is filtered to obtain the same particle size to be ready to be tested for mineral content.

Analysis of Mineral Content and Statistics

Analysis of mineral content was carried out following the AOAC (2005) and ACIAR (1990) methods. The sample for which the mineral content will be measured is prepared by drying it in an oven until it becomes 100% dry matter using the AOAC (2005) method. A destruction process is carried out following the ACIAR (1990) method to obtain a solution for the extract in aquabidest. The mineral content of Fe, Zn, and Cu in the sample extract was then

Table 1 Sampling locations of Napier grass in different topography

Sampling location		Number of location points
Flat topography	Mertoyudan	7
	Mungkid	6
	Borobudur	7
Wavy topography	Bandongan	6
	Windusari	7
	Tegalrejo	7
Sloping topography	Pakis	9
	Ngablak	4
	Kaliangkrik	7
Total		60

measured using an Atomic Absorption Spectrophotometer (AAS). Data on micromineral content from samples between collection locations were then compared with the Duncan Multiple Range test.

RESULTS AND DISCUSSION

The results of this study indicate that the content of Fe, Zn, and Cu in Napier grass taken from land with flat, wavy, and sloping topography in Magelang Regency has a different pattern (Table 2), also presented are the soil minerals. The Fe content in Napier grass taken from the three types of land topography was not significantly different. The average value of Fe content in Napier grass from the three types of land was 378.40 mg kg^{-1}. Zn content in Napier grass from 3 types of land topography was found to be different ($p<0.05$). The highest Zn content was found in Napier grass taken from land with flat topography, followed successively by grass taken from land with wavy and sloping topography. Slightly different findings were noted for the Cu content of Napier grass taken from land with flat and undulating topography but were not significantly different. The average value was significantly lower ($p<0.05$) than the Cu content of Napier grass taken from land with sloping topography. The micromineral content from the Napier grass linearly with the soil micromineral content.

Although the micro-mineral content of Napier grass taken from the three types of land topography has a different pattern, all quantities of the content are above the requirements for ruminant feed: Fe = 50 mg kg^{-1} (Khan *et al.* 2005; McDowell 1985), Zn = 12-20 mg kg^{-1} (ARC 1980), and Cu = 8-14 mg kg^{-1} (Khan *et al.* 2006 ;NRC 2000). The findings from this study illustrate that although the micro-mineral content of Fe, Zn, and Cu has a different pattern between types of minerals. Between types of topography of the land from which the grass was taken, all of them still meet the requirements as ruminant animal feed.

Research reports on the Fe content in Napier grass vary greatly depending on the country or region of origin of the grass samples, the age of the grass, and the season when the samples were taken. Mirzaei (2012) reported a Fe content of 472 mg kg^{-1} in Napier grass taken from the Punjab Region (Pakistan) in winter and summer. Fujihara *et al*. (2015) reported that Napier grass taken from Nueva Ecija, Philippines, produced 504 mg kg^{-1} of Fe during the wet season. Onyango *et al.* (2019) reported that the Fe content of Napier grass taken from Lower Nyando Basin, Western Kenya, was 1.59-1.80 mg kg^{-1}. Davis *et al*. (2017) reported a Fe content of 11.94-176.88 mg kg^{-1} from Kerala, India, taken in all seasons (summer, monsoon, and post-monsoon). The Fe content in Napier grass as a result of this study (378.40 mg kg^{-1}) was confirmed by a number of the research reports above. However, some reports appear to be higher, and some are lower. It is possible that the deviation of the Fe content in Napier grass from that reported by other researchers occurred due to differences in plant age and land conditions (Asmare *et al*., 2018).

The Zn content recommended for ruminant forage of 35-50 mg kg^{-1} (McDowell, 1985) can be met if the cattle are fed Napier grass basalt. In this study, Napier grass taken from flat, wavy, or sloping topography had Zn content of 40.34, 33.44, and 40.38 mg kg^{-1}, respectively. Many researchers previously reported varying data on Zn content in Napier grass. However, the Zn content in Napier grass as a result of this study is still in the range that is not too far from the results of studies on Napier grass in various countries, such as Pakistan of 45.00 mg kg^{-1} (Mirzaei 2012), Nueva Ecija, Philippines of 2.74 mg kg^{-1} (Fujihara *et al*. 2015), Kerala, India of 4.82-47.22 mg kg^{-1} (Davis *et al*. 2017), Utar Pradesh, India of 49.32 mg kg^{-1} (Indira & Samuel 2014). The variation in the Zn content of Napier grass from the results of this study with the results of studies reported from various countries may be due to the influence of differences in land conditions, plant age, and season when plant samples were taken.

The amount and type of minerals consumed determine mineral status in livestock. Excessive consumption can cause poisoning; conversely, too low consumption of minerals can lead to deficiency. The micro-mineral requirements of Fe, Zn, and Cu in beef cattle are 378.00, 226.80, and 75.60 mg day^{-1} (NRC 2000). Napier grass is used as basal feed for beef cattle, as practiced by most breeders in areas affected by the volcanic eruption of Mount Merapi. It can be assumed that the dry matter requirement for feed is 7.56 kg day^{-1} or with a proportion of Napier grass of 7.13 kg DM day^{-1}. Napier grass that grows in flat, wavy, and sloping areas contributes to meeting the needs of (1) micro minerals Zn respectively, namely, 287.61; 238.44, and 237.87 mg

Table 2 Fe, Zn, and Cu mineral content in Soil and Napier Grass from Magelang Regency and Weeds in different topography (mg kg^{-1})

Micro minerals (mg kg^{-1})	Flat			Wavy			Slope		
	Soil	Napier grass	Weeds*	Soil	Napier grass	Weeds*	Soil	Napier grass	Weeds*
Fe^{ns}	66.01	363.12	605.61	72.48	366.14	804.00	59.63	404.42	431.88
Zn	121.29	40.34^{b}	34.49	128.75	33.44^{a}	36.16	120.99	40.38^{b}	23.13
Cu	49.14^{b}	11.73^{b}	16.03	41.75^{a}	10.75^{a}	14.50	51.37^{c}	13.43^{c}	8.98

*Berutu *et al.* (2016), ^{abc}Different superscripts on the same line show significant differences, ^{ns}Non-significantly different

day^{-1}, (2) micro minerals Cu as much as 83.61, 76.62, and 95.72 mg day^{-1}, and (3) Fe micro minerals an average of 2,694.36 mg day^{-1}. Based on the facts above, providing basal feed in Napier grass, as much as 7.13 kg DM day^{-1}, can meet the needs of micro minerals Fe, Zn, and Cu in beef cattle, assuming a body weight of 350 kg. Adding mineral feed supplements to cattle rations in flat, undulating, and sloping areas in Magelang Regency is unnecessary.

CONCLUSION

Based on the study's results, it can be concluded that the mineral content of Zn and Cu in Napier grass growing in flat areas is higher than that of wavy and sloping areas. In contrast, the mineral content of Fe in the three topographic areas is not different or the same. If Napier grass is used as a basal diet for beef cattle, then the needs of the three types of micro minerals can be fulfilled from the Napier grass consumed.

RECOMENDATION

It is recommended for beef cattle breeders in areas affected by the volcanic activity of Mount Merapi to use Napier grass as a basal diet not to add Fe, Zn, or Cu mineral supplements.

ACKNOWLEDGMENT

We thank LPPM-PMP Tidar University, which has funded this research through Universitas Tidar DIPA funds at 2020.

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