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The Evaluation of Substituting Native Grass with Citronella Waste on the Digestibility of Dry Matter, Organic Matter, and Crude Protein in Ruminants Feeding

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Abstract

This study aims to determine the effect of substituting native grass with citronella waste on the digestibility of ruminants' dry matter, organic matter, and crude protein. A completely randomized design with 6 (six) treatments and 3 (three) replications is used in this research. The treatments were as follows: P1 = 50% native grass + 0% citronella waste + 50% concentrate; P2 = 40% native grass + 10% citronella waste + 50% concentrate; P3 = 30% native grass + 20% citronella waste + 50% concentrate; P4 = 20% native grass + 30% citronella waste + 50% concentrate; P5 = 10% native grass + 40% citronella waste + 50% concentrate; and P6 = 0% native grass + 50% citronella waste + 50% concentrate. The results showed that substituting native grass with citronella waste significantly affects ($P<0.01$) the digestibility of dry matter, organic matter, and crude protein. The highest digestibility values were observed in the treatment using 100% native grass, with dry matter digestibility at 52.67%, organic matter at 56.58%, and crude protein at 67.55%. The study concludes that while native grass cannot be entirely replaced by citronella waste, it can substitute up to 50% of the complete feed when native grass availability is limited.

Keywords: Native Grass, Citronella Waste, Concentrate

Introduction

Forage is the primary feed for ruminants, typically sourced from native grasses and superior grass varieties. However, increasing physical development for office and housing facilities has limited the availability of these grasslands in several areas. Therefore, it is necessary to find alternative forage sources to substitute native grass as a fibre source for ruminants. The alternative forage must be easy to obtain, cost-effective, have similar nutritional content, and be preferred by livestock. Numerous studies have explored the use of various agricultural, plantation, and industrial waste as animal feed tailored to the potential of the respective regions.

Lemongrass (*Cymbopogon nardus L.*) is a plant known for producing essential oils, including citronella and geraniol, with a distinctive aroma (Rastuti et al., 2019). The essential oil content in lemongrass plants ranges from 0.5% to 1.5%. The remainder comprises solid waste (raw material dregs) and used distillation water (Usmiati, 2014). Lemongrass plants are widely distributed throughout Indonesia, with West Java, Central Java, and Nanggroe Aceh Darussalam (NAD) being the primary producers of lemongrass oil, accounting for over 95% of Indonesia's total production (Directorate General of Plantations, 2013). Other regions producing lemongrass oil include West Sumatra, South Sumatra, West Kalimantan, and South Sulawesi. In West Sumatra, lemongrass cultivation has expanded in several cities and districts, with Solok City as a key centre. The total area of lemongrass cultivation in Solok City has reached 41 hectares, with a total production of 3.2 tons/ha/year (Indriyani, 2021).

Based on information from distiller farmers, the waste produced from the citronella distillation process constitutes 90% of the citronella composition. According to Sukamto and Dzujali (2011), citronella distillation waste has a nutritional content of 7% crude protein, 25.73% crude fibre, 2.30% crude fat, 3353 energy (kcal/GE/kg), 0.14% phosphorus, 7.91% ash, and 0.35% calcium. Given its nutritional content, citronella waste has the potential to be used as an alternative fibre source for ruminants (Nurhayu and Warda, 2018). Manurung et al. (2015) found that using citronella waste can increase milk production in dairy cows. Research by Findo et al. (2016) indicated that citronella can reduce methane, as observed in in vitro testing using buffalo rumen fluid. Nurhayu and Warda (2018) further noted that incorporating up to 40% citronella dregs in the feed can improve the performance of Balinese cows, with daily body weight gains reaching 0.20-0.24 kg/head/day. Using lemongrass waste as ruminant feed involves incorporating it into a ration formulation consisting of forage and concentrates to optimize nutrient intake for growth and production. Providing quality concentrates accelerates livestock growth, helping achieve the desired body weight relatively quickly. Concentrates are feed ingredients used alongside other feed components to enhance the

nutritional balance of the entire diet and are intended to be combined and mixed as a supplement or fortified feed (Hartadi et al., 1997)

The utilization of feed for ruminants can be assessed based on its digestibility level; the higher the digestibility, the greater the nutrient utilization in the livestock's digestive tract. This study evaluates the digestibility of feed, including dry matter digestibility, organic matter digestibility, and crude protein digestibility, in a complete feed that uses lemongrass as the primary forage source.

Materials and Methods

This research was conducted from April 29 to September 2, 2023, at the Animal Production and Nutrition Laboratory, Faculty of Agriculture, Universitas Mahaputra Muhammad Yamin Solok, and at the Biotechnology Laboratory, Faculty of Animal Husbandry, Andalas University, Padang. The research materials included native grass, citronella waste, and a concentrate of tofu dregs, rice bran, palm kernel cake, and minerals. Other chemicals were used for proximate analysis and in vitro digestibility measurements.

The tools used in this study include sickles, sacks, plastic, analytical scales, Erlenmeyer flasks, water bath shakers, fermenter tubes, centrifuges, pipettes, incubators, grinders (blenders), and masks. This study was conducted at the Biotechnology Laboratory of the Faculty of Animal Husbandry, Andalas University, using in vitro digestibility tests. The experimental design used was a completely randomized design with 6 types of treatments and 3 replications. Where the treatment is as follows:

P1 = Native grass 50% + citronella waste 0% + Concentrate 50%
P2 = Native grass 40% + citronella waste 10% + Concentrate 50%
P3 = Native grass 30% + citronella waste 20% + Concentrate 50%
P4 = Native grass 20% + citronella waste 30% + Concentrate 50%
P5 = Native grass 10% + citronella waste 40% + Concentrate 50%
P6 = Native grass 0% + citronella waste 50% + Concentrate 50%

The mathematical model of the design used is the design according to Steel and Torrie (1991). The parameters measured were the digestibility of dry matter, organic matter, and crude protein. The experiment was carried out in vitro using the method of Tilley and Terry (1963).

Results and Discussion

The average data on the digestibility of dry matter, organic matter, and crude protein of complete rations are shown in Table 1.

Table 1. Average Coefficient of Digestibility of Dry Matter, Organic Matter, and Crude Protein

Treatments	Dry Matter	Organic Matter	Crude Protein
P1	52,67[a]	56,58[a]	67,55[a]
P2	50,30[b]	53,65[b]	66,69[b]
P3	48,36[c]	50,51[c]	62,27[c]
P4	47,30[c]	49,57[c]	59,48[c]
P5	46,93[c]	50,07[c]	56,62[c]
P6	48,40[c]	50,41[c]	58,52[c]
SE	0,38	0,39	0,45

Description: Superscripts (a,b,c) indicate a highly significant effect (P<0.01).
SE: Standard Error.

Dry Matter Digestibility

Based on the results of the statistics analysis, substituting native grass with lemongrass waste has a highly significant effect (P <0.01) on the digestibility of dry matter (DM). The significant differences between treatments are attributed to each treatment's increasing crude fibre content.

Further tests using DNMRT indicated that the dry matter digestibility value for treatment P1 was significantly different from that of treatment P2, and P1 also differed significantly from treatments P3, P4, P5, and P6. This outcome can be attributed to the citronella dregs, a by-product of citronella oil distillation, which still contains residual phenolic substances such as tannins with antimicrobial properties. Aiyegoro and Okoh (2010) noted that various essential oils or plant extracts possess antimicrobial content. Tannins can inhibit enzymes produced by microbes and potentially cause microbial toxicity. Consequently, higher concentrations of citronella dregs in the ratio lead to a lower dry matter degradation coefficient. Cammack et al. (2018) Rumen microbes transform low-quality, fibrous plant material into usable energy for the host ruminant.

Organic Matter Digestibility

Based on the statistical analysis, the treatment has a highly significant effect (P <0.01) on the digestibility of organic matter. This is attributed to the chemical content in the feed ingredients. According to Jamarun and Zain (2013), the digestibility of organic matter is greatly influenced by the chemical composition of feed ingredients. Furthermore, McDonald P. et al. (2011). stated that differences in the digestibility of a ration are caused by antinutritional factors present in the feed ingredients.

Further tests using DNMRT revealed that the digestibility coefficient of organic matter in treatment P1, which used 100% field grass as the source of green fodder, was significantly higher than in treatments using citronella distillation by-products. The complete ration treatment containing 20% citronella waste (P2) showed a digestibility coefficient that was not significantly different from the treatment, with an increased citronella content of 50% in the complete ration.

Table 1 shows that the organic matter digestibility observed in this study aligns with the dry matter digestibility from the complete feed treatments. This finding supports Tillman et al. (1998), who noted that increasing dry matter digestibility can enhance organic matter digestibility. Furthermore, Fathul and Wajizah (2010) explained that since organic matter is a component of dry matter, an increase in dry matter will typically increase organic matter and vice versa. Consequently, this relationship extends to digestibility values, where an increase in dry matter digestibility is likely to correspond with an increase in organic matter digestibility. According to Munasik (2007), feed ingredients with similar nutrient content allow the digestibility of raw materials to reflect the digestibility of dry matter. Ismail (2011) also stated that organic matter digestibility is closely linked to dry matter digestibility, as dry matter comprises organic matter, with the main difference being the ash content.

Crude Protein Digestibility

The statistical analysis shows the research treatment of using citronella waste as a substitute for native grass in the complete feed had a highly significant effect (P <0.01) on crude protein digestibility. This is due to the protein content in the treatment ratio, which is relatively consistent. Research by Fadja et al. (2023) that used different citronella wastes up to 50% showed a non-significant effect.

Further tests using DNMRT showed that the crude protein digestibility coefficient of treatment P1 using 100% native grass as a source of fodder was significantly different from other treatments using citronella waste with different doses. The treatment using 20% citronella waste in complete feed as a substitute for native grass showed a crude protein digestibility coefficient that was not different from doses of 30%, 40%, and 50%. This is thought to be due to the tannin content in citronella waste, which is antimicrobial and affects the condition of rumen microbes. Stern et al. (2006) stated that protein digestibility in the rumen is a complex process that is influenced by various factors such as protein solubility and structure, rumen conditions, proteolytic microbial activity, microbial access to protein, and the length of time the protein is in the rumen.

Conclusion

The research results indicate that substituting native grass with citronella waste significantly affects (P < 0.01) the digestibility of dry matter, organic matter, and crude protein. The highest digestibility values were observed in the treatment using 100% native grass, with dry matter digestibility at 52.67%, organic matter at 56.58%, and crude protein at 67.55%. Although native grass cannot be replaced entirely by citronella waste, citronella can be used as a substitute for up to 50% of complete feed when native grass availability is limited. To optimize its nutritional benefits, citronella waste should undergo feed processing technology before being included in livestock feed rations.

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