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Evaluation of the Chemical Quality of Based Rations Guinea Grass (*Panicum maximum*) through Combination of Different Swamp Forages

Evaluasi Kualitas Kimia Ransum Berbasis Rumput Benggala (Panicum maximum) melalui Kombinasi Jenis Hijauan Rawa Berbeda

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ABSTRAK

Hijauan rawa berpotensi sebagai pakan alternative untuk ternak ruminansia. Penelitian ini bertujuan untuk mengevaluasi kualitas kimia ransum berbasis rumput Benggala (*Panicum maximum*) yang dikombinasi dengan jenis hijauan rawa Penelitian ini dilaksanakan selama 3 bulan di Laboratorium Nutrisi Makanan Ternak Program Studi Peternakan Fakultas Pertanian Universitas Sriwijaya. Rancangan yang digunakan dalam penelitian ini adalah Rancangan Acak Lengkap (RAL) yang terdiri dari 4 perlakuan dan 4 ulangan. Perlakuan terdiri dari R0 (70% Rumput Benggala + 30% Konsentrat), R1 (40% Rumput Benggala + 30% Kemon Air + 30% Konsentrat), R2 (40% Rumput Benggala + 30% Kiambang + 30% Konsentrat), R3 (40% Rumput Benggala + 30% Purun Tikus + 30% Konsentrat). Variabel yang diamati yaitu kadar bahan kering (BK), bahan organik (BO),protein kasar (PK), serat kasar (SK), lemak kasar (LK), tannin dan saponin. Hasil penelitian menunjukkan bahwa perlakuan berpengaruh nyata ($P < 0.05$) terhadap kadar BK, BO, PK, SK, Tanin dan Saponin, sedangkan kadar lemak kasar tidak berpengaruh nyata ($P > 0.05$). Selanjutnya kandungan BK (82,45%), BO (76,96%) dan PK (16,35%) tertinggi diperoleh pada R1, SK (26,48%) pada R0. Konsentrasi tanin terbaik (1,09%) diperoleh pada R3 dan saponin (2,16%) pada R1. Kesimpulan dari penelitian ini menunjukkan bahwa kombinasi dari 40% rumput Benggala + 30% kemon air + 30% konsentrat dapat meningkatkan kualitas kimia ransum.

Kata kunci: kualitas kimia, rumput benggala, hijauan rawa

ABSTRACT

Swamp forage has the potential as an alternative feed for ruminants. This study aimed to evaluate the chemical quality of Guinea grass (*Panicum maximum*) based rations through a combination of different types of swamp forage. This research was conducted for

3 months at the Animal Feed Nutrition Laboratory, Faculty of Agriculture, Sriwijaya University. The design used in this study was a completely randomized design (CRD) consisting of 4 treatments and 4 replications. The treatments consisted of R0 (70% Guinea grass + 30% Concentrate), R1 (40% Guinea grass + 30% water mimosa + 30% Concentrate), R2 (40% Guinea grass + 30% giant molesta + 30% Concentrate), R3 (40% Guinea grass + 30% water chestnut + 30% Concentrate). The variables observed were dry matter (DM), organic matter (OM), crude protein (CP), crude fiber (CF), extract ether (EE), tannin and saponins. The results showed that the treatment had a significant effect (P < 0.05) on the content of DM, OM, CP, CF, Tannins and Saponins, while the extract ether content had no significant effect (P > 0.05). Furthermore, highest DM (82.45%), OM (76.96%) and CP (16.35% were obtained in R1, CF (22.34%) in R0. Tannin best concentration (1.09%) in R3 and saponins (2.16%) in R1. The conclusion of this study showed that the combination of 40% Guinea grass + 30% water mimosa + 30% concentrate could improve the chemical quality of the ration.

Keywords: chemical quality, guinea grass, swamp forage

INTRODUCTION

The productivity of ruminants (cows, buffaloes, sheep and goats) is influenced by the availability of forage, both quality, quantity and continuity. In general, ruminant businesses are maintained traditionally, the amount of feed provided is not sufficient for the livestock needs, this is because the forage provided only comes from natural grazing which has low quality and fluctuates available. Rao et al. (2015) reported that the application of a sustainable cattle production system in the tropics with local forage supplements could improve the nutritional characteristics of the ration that could support fermentation activity in the rumen, reduce methane gas emissions, and increase livestock productivity. Utilization of alternative feed derived from swamp land as a source of local forage is a solution to meet the needs of forage for ruminants. Swamp forages such as water mimosa, water chestnut and giant molesta have the potential to increase the value of ration availability because of their high productivity and good nutritional value. Ali et al. (2013) stated that the nutritional content of swamp forage consisted of crude protein ranging from 8.12-28.03%, crude fiber 11.29-34.08%, extract ether 1.34-3.24% and N-free extract 41,38-59.16%, based on this, swamp forage has the potential as an alternative feed ingredient for ruminant rations.

The combination of swamp forage in the basic ration of ruminants could increase the nutritional quality and the value of the availability of the ration, as the results of research by Riswandi et al. (2017) stated that supplementation of water mimosa legumes and tree legumes could increase the digestibility of dry matter and improve rumen fermentation characteristics. Furthermore, Rostini et al. (2014) reported that the combination of swamp forage, consisting of 60% grass and 40% swamp legumes as basic feed for goats could increase consumption and performance of goats. So far, there has been no research that discusses the combination of swamp forage types in the form of water mimosa, water chestnut and giant molesta in ruminant rations. The aimed of the study was to evaluate the chemical quality of ruminant feed based on Guinea grass through a combination of different types of swamp forage.

MATERIALS AND METHODS

Tools and Materials

The tools used in this research were chopper machine, feed scales, analytical balance, measuring cup (1000 ml), oven, desiccator, crucible, furnace, centrifuge, destruction flask and spectrophotometer.

The materials used in this study were guinea grass, water mimosa, water chestnuts, giant molesta, concentrates and materials for proximate analysis, tannins and saponins.

Chemical Analysis of Research Ration Feed Ingredients

The forage consisting of guinea grass, water mimosa, water chestnuts, giant molesta, was washed with running water, the roots were cut and the leaves were used as research samples. The four ingredients were dried in an oven at 60 º C for three days and then ground until smooth and filtered with a 0.5 mm sieve size, then the feed ingredients were divided into two parts. The first part was used for the analysis of tannin and saponin content. A total of 10 milliliters of methanol solvent was put into a test tube containing 0.5 g of plant material (guinea grass, water mimosa, water chestnuts, giant molesta).

The tubes were then stored for 20 minutes at room temperature. Each sample was then centrifuged (Thermo Scientific IEC Centra CL2 Centrifuge, Fisher Scientific Pte Ltd., Singapore) at 3000 g and 4 C for 10 min. This procedure was repeated twice, and the supernatants were combined and further measured for tannin and saponin concentrations (Cieslak et al., 2014; Jayanegara et al., 2015).

Measurement of nutrient levels based on proximate analysis using mashed feed ingredients (second part) consisting of guinea grass, water mimosa, water chestnuts, giant molesta, then mixed with concentrate consisting of rice bran, ground corn, tofu by-product, ultra minerals, salt and urea.

The composition of the concentrate (Table 1). Mixing the feed ingredients according to the treatment, the ingredients were mixed from a few to a lot to make it homogeneous. Laboratory analysis of dry samples was used to determine the content of dry matter (DM), organic matter (OM), crude protein (CP), crude fiber (CF) and ether extract (EE) according to the AOAC (2010) procedure.

Data Analysis

The design used in this study was a completely randomized design (CRD) consisting of 4 treatments and 4 replications. The treatments consisted of R0 (70% Guinea grass + 30% Concentrate), R1 (40% Guinea grass + 30% water mimosa + 30% Concentrate), R2 (40% Guinea grass + 30% giant molesta + 30% Concentrate), R3 (40% Guinea grass + 30% water chestnut + 30% Concentrate).

The data obtained were analyzed for variance according to the design used and if there was a difference between the treatments and the Duncan Multi Range Test (DMRT) was further tested, the data were processed using the SPSS program.

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Table 1. Composition of concentrates used in the ration

Feed Ingredients	Amount (kg)
Rice Bran	80
Ground Corn	8
Tofu By-Product	10
Ultra Mineral	0.5
Salt	0.75
Urea	0.75
Total	100

RESULTS

Ration Nutrient Composition (dry matter, organic matter, crude protein, crude fiber, extract ether). The average nutrient value of the treatment ration was showed in Table 2. The results of the analysis of variance showed that the treatment had a significant effect ($P < 0.05$) on the dry matter (DM) and organic matter (OM) content (Table 2). The results showed that the content of DM and OM between R0, R1 and R3 was significantly different, while between R0 and R2 was not significantly different, the lowest value was found in R0 80.38% and 76.37%, the highest DM and OM content was found in R1 i.e. by 82.44% and 76.96%, respectively.

The results of the analysis of variance showed that the treatment had a significant effect ($P < 0.05$) on the CP content (Table 2). Further test results showed that the CP content between R0, R1 and R2 was significantly different, while between R0 and R3 was not significantly different. The lowest CP content was found in the R3 treatment of 11.61%, the highest content was found in the R1 treatment of 16.35%.

The results of the analysis of variance showed that the treatment had a significant effect ($P < 0.05$) on the CF content (Table 2). Further test results showed that the CF content between R0, R1 and R2 was significantly different, while between R0 and R3 was not significantly different. The lowest CF content was found in treatment R1 of 18.89%, the highest content was found in treatment R0 of 22.34%.

The results of the analysis of variance showed that the treatment had no significant effect ($P > 0.05$) on EE content (Table 2). The results showed that the extract ether content of the ration obtained ranged from 3.84 to 4.04%, this was due to the EE content of each substituted feed ingredient being almost the same. The content of tannins and saponins in the ration. The average value of tannins and saponins in the treatment ration was showed in Table 3.

Table 2. Effect of treatment in the ration on the content of DM, OM, CP, CF and EE. (% dry matter)

Treatment	DM (%)	OM (%)	CP (%)	CF (%)	EE (%)
R0	80.38 ± 0.49^a	76.37 ± 0.26^a	11.85 ± 0.11^a	22.34 ± 0.40^c	3.84 ± 0.26
R1	82.44 ± 0.43^c	76.96 ± 0.21^c	16.35 ± 0.55^c	18.89 ± 0.41^a	4.04 ± 0.25
R2	80.75 ± 0.94^a	76.46 ± 0.15^a	14.64 ± 0.49^b	19.65 ± 0.53^b	4.03 ± 0.14
R3	81.70 ± 0.67^b	76.64 ± 0.17^b	11.61 ± 0.30^a	21.94 ± 0.43^c	3.90 ± 0.29

Note: Different superscripts in the same column show significantly different ($P < 0.05$). R0 (70% Guinea grass + 30% Concentrate), R1 (40% Guinea grass + 30% water mimosa + 30% Concentrate), R2 (40% Guinea grass + 30% giant molesta + 30% Concentrate), R3 (40% Guinea grass + 30% water chestnut + 30% Concentrate).

Table 3. The average value of tannins and saponins in the treatment ration (% dry matter)

Treatment	Tannin(%)	Saponins (%)
R0	0.12 ± 0.04^a	0.72 ± 0.22^a
R1	0.87 ± 0.05^b	2.16 ± 0.01^d
R2	0.95 ± 0.04^c	1.89 ± 0.06^c
R3	1.09 ± 0.09^d	1.54 ± 0.04^b

Note: Different superscripts in the same column show significantly different ($P < 0.05$). R0 (70% Guinea grass + 30% Concentrate), R1 (40% Guinea grass + 30% water mimosa + 30% Concentrate), R2 (40% Guinea grass + 30% giant molesta + 30% Concentrate), R3 (40% Guinea grass + 30% water chestnut + 30% Concentrate).

DISCUSSION

The quality of ruminant rations is influenced by the nutritional content of the feed ingredients that make up the ration, the nutritional composition of the feed ingredients varies depending on several things, namely the species of plant, the age of the plant, the climate and soil nutrients (Jayanegara, 2012). The results showed that the content of DM and OM varied between treatments, the highest content was at R1, this was due to the high content of DM and OM in water mimosa so that it contributed to the increase in the content of DM and OM in the ration. DM content is in line with OM, DM content in this study is higher than OM this is influenced by the content of inorganic matter (ash) in feed ingredients. The addition of water mimosa (R1) is the treatment with the highest DM and OM content, this indicates that water mimosa has potential as a source of quality feed for ruminants. The high nutritional content of water mimosa consisted of 28.02% CP, 2.028 % EE, 17.25% CF and 44.86 % N-free extract (Ali et al.. 2013).

The high content of CP in R1 is due to the contribution of CP from water mimosa so that it has an impact on increasing CP rations. The protein content contained in the ration is a combination of various types of feed ingredients that make up the ration, in this case it is seen that the CP content of water mimosa can reach 20.56–28.20% (Ali et al., 2013; Muhakka et al., 2020), the CP content of the material is relatively high so that it has an impact on the treatment of R1 which has a higher protein ration content. The CP content of all treatments was above the minimum requirement for protein rations for ruminants of 7.5% (NRC, 2016). Fiber feed sources such as grass in the tropics have low quality (low digestibility) so they need to be supplemented with energy and protein sources. The low digestibility value is caused by the high fiber content in grass. Nutrient supplementation, both energy and protein together, is intended to optimize the growth of rumen microbes so that fibrous feed can be utilized by livestock properly (Lazzarini et al., 2016). Furthermore, David (2020) explained that the ideal conditions for the formation of microbial protein are if the fermented carbohydrate source is available simultaneously with the protein source, thus the balance of energy and protein content is a requirement for the preparation of rations for ruminants.

The provision of swamp forage in general reduced the CF content of the ration compared to controls, this was due to the low fiber content of the substituted swamp forage. The CF content of the treatment with the addition of water mimosa has the lowest CF content, this is due to the low CF content of water mimosa (15.03%) (Muhakka et al., 2020).

Crude fiber is a part of feed nutrition that cannot be hydrolyzed. The fiber digestibility of a feed ingredient greatly affects the digestibility of the feed, both in terms of the amount and the chemical composition of the fiber (Jayanegara, 2012). Fiber can not be used as a whole by ruminants, about 20–70% of the fiber consumed is found in the feces. The low digestibility of CF is the result of a high proportion of lignin in the tropics, with forage feeding without additional concentrates will cause a high rate of movement of nutrients, so that enzyme work is not optimal and results in a number of nutrients that cannot be degraded and absorbed by the animal's body. High CF content in complete feeds will reduce the digestibility coefficient in the feed ingredients, because CF contains parts that are difficult to digest. Fiber has an important role in the supply of energy by the livestock itself, CF has a positive correlation with consumption levels (David, 2020).

The results showed that the EE content of the ration obtained ranged from 3.84–4.04%, this was caused by the contribution of EE content from swamp forage ranging from 2–4% (Ali et al., 2013; Muhakka et al., 2020), the value of EE content substituted from swamp forage is almost the same. EE content in feed ingredients is an important study carried out in the strategy of feeding ruminants, because ruminants that are in the high production phase require large amounts of energy. Haryanto (2012) reported that the unsaturated fatty acids contained in fat have the potential as an energy source without inhibiting rumen microbial fermentation which results in a decrease in fiber degradability, provided that the livestock is in a feed condition that provides sufficient energy (positive energy balance.

The addition of swamp forage in general increased the tannin and saponin content of the ration, this was due to the high content of tannins and saponins from swamp forage which were substituted into the diet compared to Guinea grass. The tannin and saponin content of forage feed ingredients obtained in this study were Guinea grass (0.15% & 1.03%), water mimosa (2.63% & 5.81%), giant molesta (3.04% & 4.78%) and water chestnut (3.10% & 3.68%).

The content of active substances in phytogenic feeds (tannins and saponins) varies greatly depending on the part of the plant used (seeds, leaves, roots or bark), season, and geographic origin. Processing techniques (steam distillation, extraction with non-aqueous solvents) modify the active substance and related compounds in the end product of phytogenic feed additives (Periyanayagam et al., 2014). Reported that the chemical composition of phytogenic feeds varies depending on the ingredients used, the location of the material taken, climatic conditions, harvest age and storage techniques. Several other factors that influence the activity of plant phytogenic active components are plant parts used, physical properties, plant genetic variation, plant age, dosage used, extraction method, harvest time, and compatibility with other materials (Karaskova et al., 2015).

Tannins are a complex group of water-soluble polyphenolic compounds found in a wide variety of plant species commonly consumed by ruminants.

Tannins are reported as a heterogeneous group of high molecular phenolic compounds with the ability to form complexes with proteins. It has been proven that tannins may be used to prevent protein degradation and form by-pass proteins in the rumen based on their properties, such as: increasing the supply and utilization of protein in the small intestine so as to improve the performance of ruminants (Jayanegara et al., 2015). Furthermore, Brogna et al. (2013) reported that the addition of tannins extracted from Quebracho to sheep's diet at a dose of 80 g/kg functioned as parasite control did not have a detrimental effect on lamb meat quality but increased ribose, fructose, glucose and sorbitol concentrations in the meat.

Saponins are naturally occurring surface active glycosides produced mainly by plants and the name derives from their ability to form a stable soap-like foam in aqueous solution (Das et al., 2012). Liu et al. (2019) reported that saponins form complexes with proteins thereby reducing protein digestibility. This phenomenon can help the utilization of protein nutrition in ruminants by preventing rumen degradation by microbes. In addition, many studies have reported a significant effect of saponins in reducing the population of rumen protozoa (Albores-Moreno et al., 2017), which consequently increases nitrogen utilization and directly leads to improved performance of ruminants. Naturally, saponin compounds have also been observed to have a substantial effect on rumen microbial populations by selectively increasing or inhibiting the growth of several bacterial species (Wanapat et al., 2013). Patra et al. (2012), reported that saponin supplementation changed the rumen bacterial community by selectively and significantly increasing the population of *Ruminococcus flavefaciens*, *Prevotella* and *F. succinogenes*, thereby, increasing feed digestibility.

CONCLUSSION

The conclusion of this study is that the combination of 40% Guinea grass + 30% water mimosa + 30% concentrate can improve the chemical quality of the ration.

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