The Physical of Biscuit Complete Ration Based on Hymenacne Acutigluma Supplemented with Different Legumes

by Sofie Sandi

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Abstract. The aim of this research was to study the effects of supplementation different legumes on the physical quality of biscuit complete ration based on hymenacne acutigluma. This study was conducted in Animal Feed and Nutrition Laboratory of Agriculture Faculty, Sriwijaya University. This study was done in 2 months. A completely randomized design with four treatments and four replicates was used in this study. Each treatments were P0= 70% kumpai grass + 30% concentrate + 0% legume, P1= 55% kumpai grass + 7.5% lamtoro leaves + 7.5% water mimmosa + 30% concentrate, P2= 55% kumpai grass + 7.5% acacia leaves + 30% concentrate , and P3= 55% kumpai grass + 5% lamtoro leaves + 5% acacia leaves + 5 % water mimmosa + 30% concentrate. Variables measured were water content, density, average collision endurance, specific gravity and water absorption. The result indicated that The adding of different legumes in the ration significantly (P<0.05) affected the specific gravity and water absorption, but no significant effect on density, average collision endurance. Duncan Multirange Range Test showed that treatment of control (P0) had the highest of water absorption (264.56%). The highest content of water gravity was obtained in the treatment of adding lamtoro, acacia and water mimmosa (P3), namely 0.9 g/ml water gravity. The conclusion of this study is the addition of different legumes in kumpai grass-based diets can improve the physical quality of the complete ration biscuit. The addition of lamtoro leaves, water mimosa and acacia at the level of 5%, gave the best result in specific gravity and water absorption.

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1 Introduction

The productivity of ruminants is mostly determined by the quality and quantity of feed consumed. Feed quality includes the content of various nutrients, such as energy, protein, minerals, vitamins, and anti-nutritive substances, including tannin, lignin, and other secondary compounds. The interaction between the components of nutrients and anti-nutritive substances required attention in an effort to formulate an efficient feed and meet the needs of livestock so that high production can be achieved [1].

Problems that occur in the supply of feed for ruminants requirement is the amount of forage over time decreases along with the shift in land use, such as for housing, roads, industries, as well as food crops and plantations. In addition, the availability of forage is also influenced by season, where production will be plentiful in the rainy season and less during the dry season [1]. This requires the use of non-conventional feed resources. Utilization of alternative feed in the future needs to be improved through optimization of the utilization of swamp forage, and various types of trees legume as high quality feed. Utilization of fibrous feed for ruminants need to be supplemented by feed energy and protein. This is due to the high fiber content which can reduce digestibility and feed quality. Nutrient supplementation both energy and protein together aim to optimize microbial growth so that the use of fibrous feed is more optimal [2, 3].

Technology of complete feed in the form of biscuits is one alternative to overcome the lack of forage, especially during the dry season. Development of technology for cattle feed formulation is known as a complete feed (CF). CF for ruminants is a mixture of concentrates and forage [4]. Complete feed is very suitable to be applied in Indonesia. This is because most of the farm is managed by a the farmer who did not master the preparation of feed [5]. Supplementation with legume aims to improve the physical and nutritional quality of complete feed. Legume is a functional forages that contain a lot of protein, minerals, and low in crude fiber, so it can affect the quality and physical characteristics of biscuits produced.

Utilization of biscuits as a complete feed is the latest technological innovation in terms of feed processing to modify the form of feed that has existed before the wafer feed. This technology aims to prepare a complete feed as well as to streamline the storage and transportation of feed [6]. The quality of feed during the handling process will decrease when it exceeds a certain time limit. Therefore, the physical quality tests on feed is very important to do. The physical properties of the feed is a nature so that by knowing the physical properties of the feed, it can determine the maximum limit for the storage of food in the warehouse industry. It is useful to ensure the feed to be distributed to the farmers still have a good nutritional quality [7,8]. The purpose of this research is to study the effect of different legumes on the physical quality of the complete ration biscuits made from kumpai tembaga grass.

2 Materials and Methods

Place and Timehis study was conducted in the Cage Experiment, and the Laboratory of Animal Nutrition and Feed, Faculty of Agriculture, University of Sriwijaya for 2 months.

2.1 Tools and materials

The tools used in this study includes a tool shaping biscuits, feed scales, spades, sickles, tarpaulins, plastic bags, tools for analysis of dry matter in the feed. The materials used include kumpai grass, hymenacne acutigluma, acacia, and lamtoro. Constituents of the concentrate consists of bran, corn, coconut cake, cassava flour, milled corn, tofu pulp, ultra minerals, urea, and salt. Rations are prepared with crude protein content of 12-14% and TDN content of 67%.

2.2 Experimental variables and analytical procedurs

This study consisted of two stages, including biscuit manufacture and testing of physical and nutritional quality. Forages (kumpai tembaga grass, *Hymenacne acutigluma*, leucaena and acacia) were chopped with a size of 3-4 cm. Forage and tofu were dried for 2-3 days until the moisture content was reduced. After that, mixed with bran, soybean meal, molasses and salt, then stirred until homogeneous. The mixture was then steamed for 15 minutes to be easily formed. After steaming, the mixture was inserted into the printing press (mall) for compaction. Once solidified, it was removed and then put in the oven 60ºC for 24 hours. After drying, the physical quality of the biscuits was tested.

Rations were prepared with a ratio of forage and concentrate 70%: 30%. From 55% forage was replaced with swamp grass that has been treated, namely swamp grass fermented with probiotic 8% inoculum and molasses, swamp grass (kumpai) supplemented with different types of legumes according to treatment. The composition of the feed material for preparation of concentrates is presented in Table 1 dan 2.

The study used a completely randomized design (CRD), which consists of 4 treatments and 4 replications. The treatments were as follows:

P0 = 70% fermented kumpai grass + 30% concentrate + 0% legume (control)

P1 = 55% fermented kumpai grass + 7.5% leucaena + 7.5% *Hymenacne acutigluma* + 30% concentrate

P2 = 55% fermented kumpai grass + 7.5% acacia leaves + 7.5% *Hymenacne acutigluma* + 30% concentrate

P3 = 55% fermented kumpai grass + 5% leucaena + 5% *Hymenacne acutigluma* + 5% acacia leaves + 30% concentrate

Table 1. Composition of the feed material for concentrates

Feed Materials	Compotition (%)
Bran	43
molases	20
Coconut cake	12
Cassava flour	12
Milled corn	9
Tofu pulp	2
Ultra minerals	1
Urea	1
Salt	
Total	100

Table 2. Feed Compotiiton

Feed Materials	Compotition (%)			
	A0	A1	A2	A3
Fermented swamp grass	65	50	50	50
Hymenacneacutigluma		7.5	7.5	5
Acacia		7.5		5
Leucaena		-	7.5	5
Bran	12.9	12.9	12.9	12.9
Molasses	5	5	5	5
Coconut cake	6	6	6	6
Cassava flour	3.6	3.6	3.6	3.6
Milled corn	3.6	3.6	3.6	3.6
Tofu pulp	2.7	2.7	2.7	2.7
Ultra minerals	0.6	0.6	0.6	0.6
Urea	0.3	0.3	0.3	0.3
Salt	0.3	0.3	0.3	0.3
Total	100	100	100	100
Crude Fiber	25.82	24.36	24.88	24.63
Crude Protein	11.53	13.63	13.49	13.42
TDN	61.73	60.93	60.85	61.33

2.3 Physical Quality Test

Density. Measurements of the density of the biscuits is by weighing the weight (g), measuring the radius (cm), and the thickness of the biscuits (cm) [8]. Biscuits density value is calculated using the formula:

$$K = \frac{W}{(\pi . r^2 . T)} \quad (1)$$

Description:
K = density (g / cm3)
W = weight of the test sample (g)
r = radius of the sample (cm)
π = 3.14
T = sample thickness (cm)

Pile corner. Measurement angle stacks were as follows [9] by dropping the sample onto a flat surface from a certain height. Diameter was measured on the same side in all the observations using a ruler, while the height measurements carried out from a flat surface to the top of the feed in all the observations using a ruler. The magnitude of the corner pile was measured by the formula:

$$tg\,\alpha = \frac{t}{0.5d} = \frac{2t}{d} \qquad (2)$$

Description :
α = angle pile of feed material expressed in units of degrees (º)
d = diameter of the base
t = height

Gravity. Measurement of specific gravity by using the legal principle of Archimedes [9] as follows: Samples with a weight of 2 grams was put in a 100 ml measuring cup containing 50 ml of distilled water, and then observed changes in water volume. Changes in volume of distilled water showed the actual material volume. Density expressed in grams / ml3, which is calculated using the formula:

$$\text{Gravity} = \frac{\text{Weight of feed (g)}}{\text{Changes in destilate water volume(ml}^3\text{)}} \qquad (3)$$

Water Absorption. Water absorption was obtained from measurements before and after the weight of biscuits soaked in water for 5 minutes and drained for ± 10 minutes [8]. Percentage of water absorption was calculated by the formula:

$$\boldsymbol{DSA}(\%) = \frac{\boldsymbol{BB-BA}}{\boldsymbol{BA}}\boldsymbol{x100}\%$$

(4)

Description :
DSA = wafer water absorption (%)
BA = initial weight (g)
BB = final weight (g)

2.4 Data Analysis

Data were analyzed by analysis of variance (ANOVA) and the differences between treatments were tested further by Duncan [10].

3 Results and Discussions

3.1 Characteristics of Biscuits

Feed biscuits made in this study is a product of the processing of feed consisting of a mixture of forages with or without other feed ingredients such as concentrate material, adhesive (molasses) through the compaction process with a pressure of 200-300 kg / cm2 and heating at a temperature of 150 ° C for 5 -10 minutes [6]. Formula biscuit feed used in this study is a legume Kemon water, acacia leaves, leaf lamtoro, grass kumpai copper concentrates and molasses. Each material has the characteristics and different physical properties that affect the physical quality of the feed biscuits. Physical form biscuits diet in this study showed physical shape compact and solid.

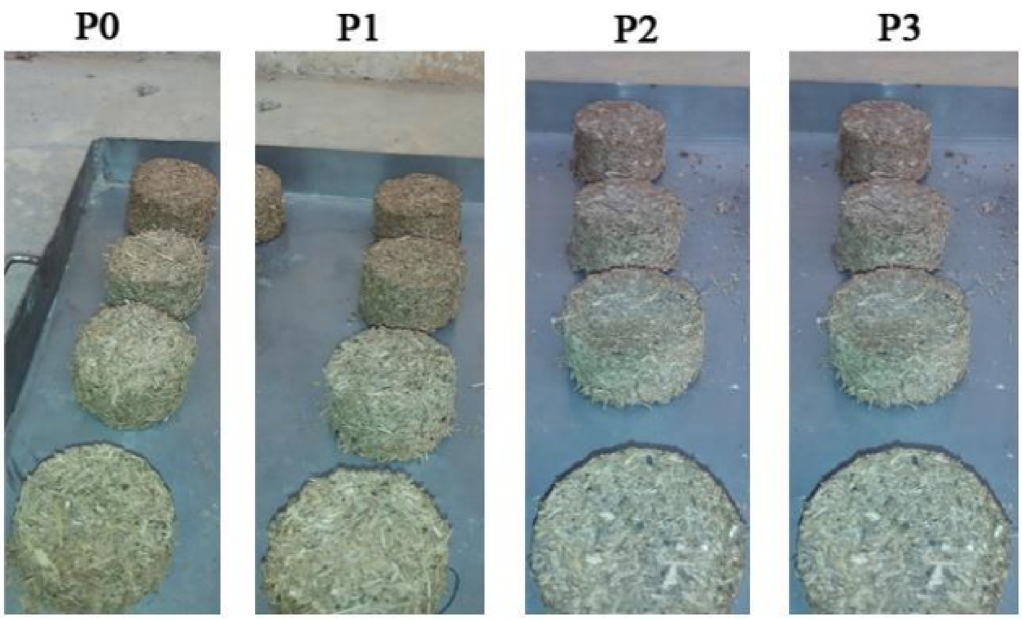

Fig. 1. Physical form of biscuits with different levels of types of legumes

Feed biscuits are round and flat, and has dimensions of diameter and thickness. This feed biscuits have a surface with a coarse texture. This is due to the material used only roughly milled using a cooper and a blender. The rough texture on biscuits due to the high fiber content in each treatment [11].

Biscuits feed produced had a color of chocolate, caramel aroma, and a compact form. The brown color is due to non-enzymatic browning reactions during heating in the oven. Non enzymatic browning reaction is a reaction between organic acids and reducing sugars, and between amino acids and reducing sugars or Maillard reactions, resulting in a caramel aroma for heating the feed material [12]. The emergence aroma is due to molasses in the mix formula biscuits. When the biscuit oven, the aroma of biscuits will smell like burnt sugar aroma derived from molasses. This is according to research Retnani [6] using molasses as an adhesive as well, which produces biscuits brown and has a fragrant aroma of sugar (caramel). Biscuits feed of this study had an average weight of 31.33 to 39.96 g..

3.2 Physical Quality of Feed Biscuits

The physical characteristics of the biscuit is helpful in determining the value of efficiency during the storage, transportation, and storage time [8]. Physical qualities tested include density, gravity, angle stacks, and water absorption. The mean value of the physical tests are shown in Table 3.

Table 3. Mean values of physical test of biscuits diet

Treatments	Parameters				
	Water content (%)	Density (g/cm³)	Gravity (g/ml)	Pile corner (°)	Water absorption (%)
P0	7.951	0.320± 0.05	0.783 ± 0.05[a]	36.958 ± 10.81	264.558 ± 6.18[b]
P1	8.529	0.355± 0.03	0.880,± 0.08[b]	44.023 ± 8.03	243.508± 9.13[b]
P2	8.211	0.358± 0.03	0.948± 0.04[c]	41.023± 8.43	224.558± 11.0[a]
P3	7.996	0.353± 0.03	0.980 ± 0.05[c]	48.577 ± 1.70	223.358±10.59[a]

Note: The numbers in the same column followed by different letters indicate significantly different at test level 5% (DMRT). P0 = 70% fermented kumpai grass + 30% concentrate + 0% legume (control); P1 = 55% fermented kumpai grass + 7.5% lamtoro + 7.5% *Hymenacne acutigluma* + 30% concentrate; P2 = 55% fermented kumpai grass + 7.5% acacia leaves + 7.5% *Hymenacne acutigluma* + 30% concentrate ; P3 = 55% fermented kumpai grass + 5% lamtoro + 5% *Hymenacne acutigluma* + 5% acacia leaves + 30% concentrate.

3.2.1 Water Content

The water content is a factor that can affect the quality of rations. Results of variance showed that the use of legumes biscuits diet had no significant effect (P> 0.05) on the water content of biscuits. In Table 3, it appears that the water content of the ration biscuits complete this study ranged from 7.951 to 8.529%. The water content of biscuits is compliant with national quality standard ration with a maximum moisture content of 14%. Biscuits containing high levels will be easily damaged and moldy. Microbial activity can be reduced by 12-14% moisture content, so that the biscuits were not easily damaged and moldy, and more durable during storage. Conditions during handling such as storage, are expected to increase the water content. This is due to the influence of environmental temperature and humidity in the storage area [8, 6]. Water content of biscuits using different legumes in this study was lower than the results Retnani et al. [13] by using biscuits biosuplemen, where water levels ranged from 7.83 to 11.55%.

3.2.2 Density

Results of variance showed that by using legumes biscuits diet had no significant effect (P> 0.05) to the density of the biscuits. Table 3 shows that the density of a complete ration biscuit ranges from 0.320 to 0.358 g/cm3. In the treatment of P2, biscuit has the highest density value, namely 0.358 g/cm3, while biscuits diet in the treatment of P0 has the lowest density value is 0.320 g/cm3. The density value is a measure of compactness of particles in the sheet [14]. This means the higher the density, the more compact the material. When a material more compact, the easier handling both in transportation and storage. In general, the formula of biscuits with the addition of legumes tend to have a high density. It allows to maximize the capacity of the storage area and in the handling. The density of the material related to the fiber content in the material. Different legume supplementation would decrease the value of crude fiber biscuit. Toharmat et al. [15] found that the higher the fiber content, the lower the density, or the material is increasingly bulky

Khalil [9] reported that forage generally have a low density. Due to this feed biscuits made of forage, feed biscuits density value is low. The density of the biscuits in this study is lower than the results Retnani et al [6], where the density of the biscuits with the formula 50% maize leaves, and 50% kolobot corn, is the best, namely 0.52 g / cm3. Toharmat et al., [15] states that the density of fiber-rich feed is very varied. High and low density is dependent on the composition of the material preparation of biscuits, especially crude fiber content.

Feed wafers that have a high density will provide a solid and hard texture so that it is easy in handling both in storage and shock during transportation, and is expected to be more resistant in storage [8]. The density of the wafer determine the dimensional stability and physical appearance of the wafer [10]. The density differences due to differences in density of the materials used, as well as printing pressure given during the manufacture of biscuits. Variations in the density due to different raw material particle size, causing the particle distribution of forages and concentrates becomes unequal [6, 14].

3.2.3 Specific Gravity

Results of variance showed that the biscuits diet using different legumes significantly influenced (P <0.05) the value of the density of the biscuits. The specific gravity value of the biscuits can be seen in Table 3.1. Biscuits diet of treatment P0 has the lowest density is 0.783 g / ml3, while biscuits from treatment P3 has the highest density value (0.980 g / ml3).

Results of further tests showed that P0 differ significantly with P1, P2 and P3. Between P1 to P2 and P3 are also significantly different, while P2 and P3 showed results that were not significantly different. In general, the provision of different legumes in treatment increases the density of the biscuits. This is because the chemical composition in legumes and other constituent materials. The highest density in this study is P3 followed by P2, P1 and P0. The increase in density due to the supplementation of a legume that is rich in mineral (inorganic). Retnani et al [16] suggest that the density has an important role in the processing, handling, and storage. In addition, specific gravity also has an important role in the density. The higher the water content, density, and density, the better form of wafer feed during storage. Simanjutak [17] states that the specific weight was positively affected by the ash (inorganic). A positive value means an increase in density. thus, the value of ash content will also increase and vice versa.

3.2.4 Stacks Corner

Results of variance showed that the biscuits using legume had no significant effect (P> 0.05) on the corner of the pile. Thus, it can be said that the use of different types of legumes can provide the same effect on the corner piles of biscuits, with almost the same value in the range 36,958°- 48,577°.

Corner pile of biscuits that tend lowest (36.958°) are biscuits on P0 treatment (without the use of legume), while the highest inclined (48.577°) is on biscuits P3. This shows that the administration of legumes only slightly affect pile corner. in general, pile in the corner of this study is still good with a value of less than 50° and includes material that is very easy to flow. Khalil [18] stated that the pile of corner will affect the flow of materials, particularly the speed and efficiency of the process of emptying the silo vertically at the time of transfer and mixing the ingredients. This is consistent with the statement Mujnisa [19] that the ideal material particle movement is shown by the feed liquid form, with a pile angle equal to zero. Feed solids have ranged corner pile 20°-50° and biscuits diet is classified in feed solid form. Value of biscuits pile corner in this study is greater than the result of research by Syamsu [20], which measures the angle pile on the feed solid form (pellets) with an adhesive cassava flour has the average value of angle stacks of 33.31°

3.2.5 Water Absorption

One of the factors that affect the physical properties of the material is water absorption [13]. Water absorption of biscuits diet in this study is the change in gain of biscuits after immersion for five minutes. Results of variance showed that the biscuits using a different legumes significantly affect (P <0.05) water absorption. It could be argued that the use of different legumes can affect water absorption of biscuits. The value of the lowest water absorption is at P3 (223.358%) and the highest at P0 (264.558%). In general, the provision of different types of legume in the biscuit tends to lower water absorption. This is because the decline in fiber content on biscuits. Legumes have a small fibers, so that even the addition of legumes but undermines the provision of grass kumpai copper containing high crude fiber in treatment, thereby crude fiber treatment tends to decrease. This is explained by Haroen et.al, [21] that the absorption of water by the partition is made from solid wastes that are high in fiber tend to be higher with increasing percentage of solid waste added.

The high fiber content showed that the biscuits are capable of binding water because of the OH bond of water with fiber biscuits [6]. Results of research Siregar [22] states that there is a positive relationship between the water absorption of particles with chemical composition of the fiber fraction in the material. The value of water absorption in this study tended to be lower than the biscuits on research by Retnani, et al., [6], which uses 50% kolobot corn and 50% field grass with water absorption reached 514.48%,

4 Conclusions

The conclusion of this study is the addition of different legumes in kumpai grass-based diets can improve the physical quality of the complete ration biscuit. The addition of lamtoro leaves, water mimosa and acacia at the level of 5%, gave the best result in specific gravity and water absorption.

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