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QUALITY OF SILAGE MADE FROM A COMBINATION OF CORN STRAW AND PEANUT STRAW AND ITS EFFECTS ON BALI CATTLE PERFORMANCE

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ABSTRACT

This experiment aimed to study the nutrient quality of the silage made from a combination of corn straw and peanut straw and the silage effects on the feed consumption, average daily gain, and feed efficiency of bali cattle. Twelve heads of bali cattle were randomly assigned to the experimental diets according to the completely randomized design, consisted of four treatments and three blocks giving a total number of the experimental unit of 12. The treatments were R0 = Corn straw silage, R1 = Silage consisted of 60% corn straw + 40% peanut straw), R2 = Silage consisted of 50% corn straw + 50% peanut straw, and R3 = Silage consisted of 40% corn straw + 60% peanut straw. In addition to the experimental diets, each animal was given 2 kg concentrate/d. The silage was provided ad libitum and drinking water was freely available. The results of the study indicated that chemical and physical characteristics of the silages were not different. The silage pH ranged between 3.2 -4.2 and it was considered as optimum pH. Other characteristics such as odor, color, compare, and the existence of fungi were found similar. In terms of bali cattle performance, the cattle fed on ration R2 had a better performance (feed consumption, average daily gain, and feed efficiency) compared to the cattle fed on either R0, R1, and R3. In conclusion, silage made with a combination of 50% corn straw and 50% peanut straw was the best combination compared to other treatment combination.

Keywords: *corn straw, fermentation, peanut straw, bali cattle performance, silage*

1. INTRODUCTION

Indonesia is an agricultural country that has a lot of agricultural byproducts and is available every year. However, the utilization of agricultural by products for ruminants feed has not been optimal. It is caused by low palatability and nutrition, while other forage is still available primarily from natural vegetation. However, in the dry season, the availability of natural vegetation is decreasing. Therefore, It needs to utilize other feedstuff such as agricultural wastes. In general, the provision of feedstuffs is available all times. The quality and qua ntity of feedstuff are one of the successful live-stock business. The feed used should be cultivated with low cost or easily obtained and its use as a feed does not compete with human needs. The avail-ability of cheap feed is very important, but the reality in the field indicated that feed production not only should be cheap to reach by breeders but also must be guaranted quality (Dwiyanto et al., 2003).

To optimize its production, ruminant animals require good quality feedstuff, especially forage that must be continuously available through the year. However, forage yield is fluctuated, abundantly available during the rainy season but very scare during the dry season. One alternative to overcome this problem is by utilizing such agricultural byproduct as rice straw, corn straw, soy bean straw and peanut straw. In Indonesia, the use of rice straw during the dry season is commonly practice by the farmers in the field. But the use of corn straw and peanut straw is as an intense as the use of rice straw. However, several factors such low palatability, low nutrient content, low digestibility, imbalance mineral contents (Natsir, 2012) are needed to be considered when using this stuff as feeding for ruminants.

The processing of agriculture waste by physical, chemical, or biological treatments are typically used to improve the nutritional value of agricultural byproduct. However, application of those technologies at farmer level sometime fail due to several reasons such as difficulty in collecting and storing the stuff waste, lack of labor, and additional cost related to the processing itself (Djajanegara, 1999). Therefore, an easy and simple technology is important in order the technology can be implemented by the farmers. One of technology that might be possible to be applied by the farmer is a fermentation technology. The fermentation of rice straw through ensiling process of the low quality stuff showed an improvement in feeding value of rice

straw by ensiling (Cai, 2006; Kim et al., 2006). The optimal incubation period of fermentation varies both with the organism and fermentation conditions. The fermentation gives higher production (Sardar et al., 2007). Other agriculture byproducts such as corn stover, peanut straw is not intensively used. Ensiling those stuff is expected to improve their nutrient quality which is in turn could improve productivity of beef cattle. The purpose of this research was to study the nutrient characteristics of the mixture of fermented corn stover and peanut straw and its effects on the productivity of beef cattle.

Research Methods

This research was conducted in the Integrated Agricultural Area, Huluduotamu Village, Suwawa District, Bone Bolango Regency, Gorontalo Province, Indonesia for 4 months, starting from July 2016 to October 2016. Twelve heads of bali cattle with 2 - 2.5 years of age and body weight ranged between 200 and 250 kg were randomly assigned into individual pen. according to completely randomized block design consisted of four treatments and three blocks based on the body weights as replication. The treatments were:

R0 = Corn straw silage

R1 = Silage consisted of 60% Corn Straw + 40% Peanut Straw

R2 = Silage consisted of 50% Corn Straw + 50% Peanut Straw

R3 = Silage consisted of 40% Corn Straw + 60% Peanut Straw

Corn straw and peanut straw was obtained from the research sites. First, Forage sources (corn straw and peanut straw) were cut 3 - 5 cm by using chopper. Then drifted for 12 hours. Each forage is mixed and stirred until adjusted accordingly. The mixture of corn and peanut straw was put into silos (350-liter plastic barrels), solidified, sealed and incubated in anaerobic condition for three weeks. The silage samples from each treatment were taken before and after analyzing. The analyses of fermentation quality and silage nutrient in Chemical and Livestock feed laboratory. Feed and drinking water are given by *ad libitum* and feedstuff combined between corn straw and peanut straw and also with concentrate.

Chemical composition of the silage and the concentrate were analyzed according to the procedures of AOAC (1999) (Table 1). All experimental data were subject to analysis of variances according to completely randomized block design. Significant effect of the treatment was further determined using New Duncan Multiple Range Test (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

1. ***The characteristics of the silage according to the treatment:*** In general, the quality of silage produced was acceptable in terms of chemical components (Table 1) and physical characteristics (Table 2). The crude protein content of the silage was varied between 8.99% (R1) and ID 37% (R3). The minimum crude protein content of the feed for ruminant is minimum 7.5%. Other chemical components of the silage such as crude fibre, crude fat, nitrogen free extract, mineral, calcium and phosphor as well as gross energy were relatively similar across the treatment.

Table 1: Chemical composition of the treatment (silages) and concentrate

Feedstuffs	Composition (%)								
	Water	CP	CF	Cfiber	NFE	Ash	Ca	P	GE (kkal)
R_1	54.26	8.99	3.25	29.87	48.00	9.89	1.07	0.49	2403
R_2	55.24	9.05	3.30	30.15	48.24	9.27	1.09	0.59	2418
R_3	58.29	10.37	3.18	29.46	47.37	9.62	0.61	0.48	2421
R_0	71.63	9.81	3.9	33.02	45.66	7.61	1.05	0.36	2389
Consentrate	9.95	18.96	8.91	20.96	39.97	11.20	1.24	1.62	2898

CP: Crude Protein, CF: Crude Fat, CF: CFiber, NFE: Nitrogen Free Extract, Ca: Calcium, P: Posfor, and GE: gross Energy. Source : Chemical and Livestock Feed Laboratory, Animal Science Department Hasanuddin University (2016).

The physical characteristics (Table 2) of the silage showed similarities among the treatments. Evaluation of physical characteristics of the silage are based on several parameters, i.e. pH, color, odor, texture, and the existence of fungi. The pH of the silage ranged between 3.5 (R0) and 4.2 (R2). Pure *et al*., (2008) explained that the fermentation of silage begins when oxygen has been used up by plant cells. Bacteria use WSC (Water Soluble Carbohydrate) to spend lactic acid and decrease the pH of silage. Plants in the field have a pH that varies between 5 and 6, during the fermentation it down to 3.6-4.5. The value of pH descend rapidly of breaking protein and inhibit the growth of anaerobic microorganisms such as *enterobacteria* and *clostridia*. The production of lactic acid will desc-end the pH which can inhibit the growth of all bacteria continuously. The product fermentation is bacteria and it was produced by chemical synthesis and microbial fermentation (Teleghani et al., 2014).

Table 2: Physical characteristics of the silages

Variables	Treatments			
	R_0	R_1	R_2	R_3
Color	Mixture of green, yellow and brown	Mixture of green, yellow and brown	Mixture of green, yellow and brown	Mixture of green, yellow and brown
Odor	Typical lactic acid fermentation	Typical lactic acid fermentation	Typical lactic acid fermentation	Typical lactic acid fermentation
Texture	Whole and compact	Whole and compact	Whole and compact	Whole and compact
The existence of mold %	Nil	7	5	4
pH	3.5	3.7	4.2	3.6

The color, odor, and the texture of the silage were similar across the treatment. In general, the color of the silage was a mixture of green, yellow and brown. This type of color is considered normal when making silage using agricultural byproduct (Hasan, 2012). With regard to the odor, all silage from four treatments produced similar odor which was a typical odor of lactic acid fermentation as a result of straw fermentation process. Fermentation process will be more appropriate for production of lactic acid while demand for naturally producing lactic acid has increased (Abdel-Rahman et al,. 2013, Kadam et al., 2006). In terms of texture, all treatments were the same, showing intact and compact form (Bruning *et al*., 2017).

Another important factor determines the quality of silage is the presence of fungi or mold. The percentage of fungi observed on this experiment ranged from 0% (R0) to 7% (R1). There are several factors that might be contribute to the presence of fungi during the ensiling process, including silage storage factor. During the silage storage, the fermentation is not processed well. Other factor, the existence of air on the surface of the silage causing the growth of mold on the top surface of the silo. Air exposure up to several days will affect both the ensiling process and the quality of silage during storage (Bruning *et al*., 2018; Mills and Kung, 2002). It is well known that there are two requirements for efficient preservation of silage, namely the exclusion of oxygen and the prevention of anaerobic decomposition during ensiling. When both oxygen and plant sugars remain in the silo, respiretion and aerobic microorganism activity take place during the very early stages of ensiling. Therefore, the volume of air trapped in a silo affects the duration of respiration and aerobic microorganism's activity (McDonald *et al*., 1991; Shao *et al*., 2005, Sial et al., 2017).

Regarding the utilization of silage for ruminant feeding, its quality is mostly determined by the presence of fungi and pH. Based on those factors, all four treatments are suitable for cattle consumption. This is explained by Winarto (2008), that the excellent quality of silage that has a fresh texture, greenish to dark green, odorless, favored by livestock, does not contain fungus, not clot and not slimy, has a pH 3.2 - 4.2 and the amount of N as ammonia is less than 10% of total N. This statement is supported by Saun and Heinrichs (2008) who stated that the quality of silage is influenced by the maturity of forage, moisture content, particle size, storage at ensilage and use additives.

2. ***Performance of bali cattle:*** Parameters of bali cattle performance which includes feed consumption, weight gain and feed efficiency have been presented in Table 3.

Table 3: Mean ± SD of Bali cattle productivity parameters at various treatments

Produktivity	Treatment			
	R0	R1	R2	R3
Feed Consumption (kg/h/d)	4.90 ± 0.15^{a}	6.50 ± 0.52^{c}	6.81 ± 0.22^{d}	5.76 ± 0.12^{b}
Weight Gain (kg/d/d)	0.51 ± 0.03^{a}	0.72 ± 0.01^{c}	0.80 ± 0.03^{d}	0.64 ± 0.03^{b}
Feed Efficiency	0.10 ± 0.008^{a}	0.11 ± 0.001^{ab}	0.11 ± 0.005^{b}	0.12 ± 0.003^{ab}

Different superscripts following the same values on the same line showed significant differences ($P < 0.05$)

Feed Consumption: Analysis of variance showed that the treatment affected ($P < 0.05$) the feed consumption. The highest feed consumption (6.81 kg/h/ d) was R2 treatment compared to those given ration R0, R1, and R3, respectively.

R2 treatment for dry matter consumption was able to exceed the consumption of R0, R1 and R3 treatments where the control treatment showed the lowest consumption. Thus, R2 treatment is a higher palatability level than other treatments. The ration of R2 treatment showed that higher feed intake than other rations. This is suspected to fulfill the protein needs (syahrir et al., 2012)

Increasing consumption of silage combination is indicated by the higher level of palatability due to the quality of fermentation (physical and chemical) silage. It was presented in Table 2. And also, nutrition quality is quite good, especially the cont-

ent of nutrients proteins in proximate analysis (Table 1). Palatability is determined by the taste, smell and color. In ruminant cattle some factors affect palatability such as the brightness of forage, taste, texture and nutritional content (Ensminger, 1990).

Weight Gain: Analysis of variance indicated that treatment affected (P <0.05) on the weight gain of cattle. The daily weight gain of Bali cattle was directly proportional to feed consumption of each treatment, in which cows that consumed more feeds resulted in higher body weight gain than other cows. Tillman, et al., (1991) mentioned that weight gain is a physiological activity that can be expressed by weight gain of the average per time. The speed of weight gain is influenced by the amount of consumption is spent. This is supported by Boer et al., (2003), that the difference in the value of weight gain is influenced by different feed consumption levels. The higher the total feed consumption, will affect the amount of weight gain value.

Table 3 indicated that R2 treatment resulted the highest average weight gain about 0.80 kg/head /day and R0 treatment resulted the lowest weight gain about 0.52 kg/head /day and significantly differrent from other treatments. Increasing of body weight gain in R2 treatments is caused by the protein and energy needs of the rations consumed has sufficient daily protein and beef cattle for maintenance of life compared with the control treatment and other combination treatments, nutritional substances are higher than the control treatment so that protein nutrients contained in the combination treatment can be digested and absorbed by the gastrointestinal tract in large quantities to weight compared with the waste through feces and urine.

The use of peanut straw is limited to 50% percentage although the peanut treatment percentage of peanuts 60% has nutritional value better than other treatments. Percentage of peanut straw over 50% in the field show that cows consuming the feed feces become more dilute (diarrhea) and tend to reduce consumption. Therefore, it is better combined with corn straw. Silage from corn or sorghums are mode rate too high in energy as well (John et al., 2009).

Analysis of variance Indicated that the treatment had a significant effect (P <0.05) on the feed efficiency of Bali cow ration. R2 treatment had the highest use efficiency of ration compared to other treatments. R2 treatment has higher phosphorus (P) content than other treatments. So that, the R2 treatment has weight gain and better feed efficiency (Table 3).

The treatment of R2 has the highest efficiency of feed compared to other treatments. This means each kilogram of R2 ration will produce weigh gain as many as 0.12 kg. The treatment of R2 has the highest average weight gain that is balanced with high feed intake as well. Soehadji (1991), explained that the increasing value of efficient feed related to level of feed consumption and weight gain. The value of feed efficiency resulting from this study indicates the potential use of ground corn and peanut straw for up to 50% in rations.

CONCLUSION

1. The physical quality of corn straw and peanut straw silage fermentation is characterized by green color. The typical of odour silage is lactic acid and the silage texture is complete and compact. The chemical quality of silage fermentation show that the more composition of peanut straw, the less value of fungi in feed content. The silage fermentation has pH optimum from 3.2 to 4.2.
2. The R2 treatment indicated that it caused a better response than other treatments, i.e weight gain and feed efficiency.

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