Chalaza Journal of Animal Husbandry
Url: http://usnsj.id/index.php/CJAH
Email: chalaza.usnsj@gmail.com

Digestibility and Nutritional Value of Fermented Straw Supplemented with Green Concentrate as Feed Ingredients for Holstein Friesian Dairy Cattle

AUTHORS INFO

Abdul Hakim Fattah
Universitas Muhammadiyah Sinjai
hakimabdulfattah@gmail.com +6281341937152

Khaeruddin
Universitas Muhammadiyah Sinjai
erukhaeruddin@gmail.com
+6281356770857

ARTICLE INFO

p-ISSN: 2548-5504
e-ISSN: 2548-3803
Vol. 7, No. 1, June 2022
URL: https://dx.doi.org/10.31327/chalaza.v7i1.1864

Abstract

The purpose of this study was to determine the effect of fermented straw supplementation with green concentrate on nutrient content and nutrient digestibility. Green concentrate used as treatment was white lead tree leaf flour (*Leucaena leucocephala*), *Gamal* leaf meal (*Gliricidia sepium*), and *Indigofera* leaf meal. Proximate analysis was carried out on fermented rice straw, 70% fermented rice straw + 30% lamtoro (FRS + white lead tree), 70% fermented rice straw + 30% *Gamal* (FRS + *Gamal*) and 70% fermented rice straw + 30% *Indigofera* (FRS + *Indigofera*). The livestock used for the nutrient digestibility test was 12 Friesian Holstein dairy cows. A randomized block design was used to test nutrient digestibility. The results showed that supplementation of green concentrate in fermented rice straw was able to increase crude protein, crude fat, and BETN and decrease crude fiber. Crude protein digestibility did not differ in the three types of green concentrates. Crude fat digestibility of FRS + white lead tree and FRS + *Indigofera* was higher than FRS + *Gamal*. The digestibility of BETN FRS + *Gamal* was higher than the digestibility of FRS + white lead tree and FRS + *Indigofera*. This study concludes that the three types of green concentrate can be used for the supplementation of fermented rice straw as dairy cattle feed.

Keywords: nutrient digestibility, green concentrate, fermented rice straw, dairy cow

A. Introduction

Indonesia as a tropical country has 2 seasons, namely the rainy season and the dry season. In the dry season, the supply of grass or forage is very poor, both in quality and quantity. This is an obstacle to the maintenance of dairy cows whose staple food is forage. On the other hand, the provision of grazing land is getting narrower which has implications for the provision of forage.

Rice straw is one of the agricultural wastes that have the potential to be used as ruminant animal feed when grass supplies are reduced. However, rice straw has a weakness, namely high lignin, and silica content while low energy, protein, minerals, and vitamins. In addition, the digestibility of straw is also low because it is difficult to be degraded by rumen microbes (Van Soest, 2006; Sarnklong et al., 2010). The low digestibility of rice straw is due to the old plant supporting tissue structure (Yanuartono et al., 2017). This tissue has undergone a lignification process so that lignocellulose and lignohemicellulose become difficult to digest (Balasubramanian, 2013).

Processing causes the digestibility of rice straw to be increased by up to 70% and increases its protein content (Silitonga et al., 2013). Fermentation is a simple method of processing straw as animal feed which is generally able to increase its nutritional value (Yanuartono et al., 2019).

The use of rice straw directly or as the sole feed cannot meet the nutritional needs of livestock. (Silitonga et al., 2013). Required the addition of concentrate to increase nutrition. Conventional concentrate materials are increasingly expensive, so efforts need to be made to increase production efficiency, especially in the supply of feed by utilizing local resources by optimizing the use of high-quality forages from leguminous feed plants to substitute the use of concentrates from cereals, seeds, and agro-industrial waste which are expensive. getting more and more expensive every day.

Lamtoro leaves (Leucaena leucocephala), Gamal leaves (Gliricidia sepium), and Indigofera leaves can be used as green concentrate alternatives. Lamtoro leaves contain crude protein above 21% (Zapata-Campos et al., 2020; Rusdy et al., 2019) and an ash content of 8.7%% (Zapata-Campos et al., 2020). Gamal leaves are known to be a source of protein that is easily degraded in the rumen (Ramadhan et al., 2022), with a crude protein content of 22.7% (Rusdy et al., 2019), 4.38% crude fat and 6.08% ash (Herdiawan and Sutedi, 2015). Whereas Indigofera contains higher protein, which is above 23% (Kumalasari et al., 2017; Ali et al., 2014; Sirait et al., 2012; Gilang et al., 2014), 6.15% crude fat (Sirait et al. ., 2012) and ash content above 6.4% (Sirait et al., 2012; Herdiawan and Sutedi, 2015).

Based on this, this research is expected to contribute in the form of scientific information by utilizing local resources by optimizing the use of high-quality forage from leguminous feed plants in increasing production efficiency, especially in the supply of feed so that sustainability is maintained in meeting the demand for forage in livestock. This study aims to determine the effect of supplementation of fermented straw with green concentrate on nutrient content and nutrient digestibility.

B. Methodology

1. *Research Design*

Research on nutrient digestibility used a randomized block design (RBD) consisting of 3 treatments, each treatment was repeated 8 times. The composition of the treatment is as follows:

A: Fermented rice straw 70% + lamtoro 30% (FRS + lamtoro)
B: Fermented rice straw 70% + gamal 30% (FRS + gamal)
C: Fermented rice straw 70% + 30% indigofera (FRS + indigofera)

2. *Rice Straw Fermentation*

Rice straw of the Ciliwung variety is stacked into several layers and then sprinkled with 6 kg of starbio and 6 kg of urea for every 1 ton of straw. The straw is then sprayed with water until the straw's moisture content is about 60%. Straw pile compacted and covered with plastic. The fermentation process was carried out for three weeks. After 21 days, the rice straw was opened and air-dried.

3. *Analysis of Feed Nutrition Levels*

Proximate analysis of feed nutrient content was carried out at the Animal Feed Chemistry Laboratory, Faculty of Animal Husbandry, Hasanuddin University, Makassar using the van Soest method.

a. Crude Protein Analysis

0.5 gram sample was added with 1 gram of selenium mixture and 25 ml of concentrated H_2SO_4 then digested in a fume cupboard until clear. The sample is poured into a 100 ml volumetric flask and rinsed with distilled water, then compressed to the mark with distilled water and then shaken until homogeneous. Prepare a reservoir consisting of 10 ml of 2% H_3BO_3 + 4 drops of mixed indicator solution in Erlenmeyer. The 5 ml sample solution was put into a distillation flask, added 10 ml of 30% NaOH and 100 ml of distilled water and then distilled until the volume of the container was ± 50 ml. Rinse the tip of the distiller with distilled water then the reservoir and its contents are titrated with a solution of 0.0171 N H_2SO_4. Formula:

$$\text{Crude protein (\%)} = \frac{\text{V x N x 14 x 6.25 x P}}{Sample\ weight\ (mg)} x100\%$$

Information:
V: Sample titration volume
N: Normality of H2SO4 solution
P: Dilution factor

b. Crude Fat Analysis

1 g sample was put in a 15 ml test tube, added chloroform close to 10 ml scale, shaken, and left overnight. Chloroform was used to compress the sample to a scale of 10 ml, shake it again, and filtered using filter paper into a test tube. Pipette 5 ml into a cup of known weight (a gram). Then put it in the oven at 100°C for 4 hours and put it in the desiccator for half an hour and weigh (b grams). Formula:

$$\text{Crude fat (\%)} = \frac{\text{P x (b − a)}}{Sample\ weight} x100\%$$

Information:
P: Dilution (10/5)

c. Crude Fiber Analysis

Sample 0.5 gram sample added 30 ml of 0.3 N H_2SO_4 and refluxed (heated) for 30 minutes. The sample was added 15 ml of 1.5 N NaOH and refluxed for 30 minutes. Samples were filtered into sintered glass No. 1 while sucked using a vacuum pump. Then washed successively with 50 ml of hot water, 50 ml of 0.3 N H_2SO_4, 50 ml of hot water, and 50 ml of acetone. Samples were dried in an oven for 8 hours, cooled in a desiccator for half an hour then weighed (A). The sample was incubated in an electric furnace for 3 hours at 500°C, allowed to cool slightly then put in a desiccator for half an hour then weighed. Formula:

$$\text{Crude fiber (\%)} = \frac{\text{A − B}}{Sample\ weight} x100\%$$

d. Ash Content Analysis

The porcelain cup with the sample for determining the water content was put into the electric furnace at 600°C for 3 hours until it turned to ash. The sample was allowed to cool slightly then put in the desiccator for half an hour and then weighed. The formula used is:

$$\text{Ash content (\%)} = \frac{\text{C − A}}{B} x100\%$$

Information:
A: the weight of the cup and ash after being fired
B: weight of empty cup after baking
C: sample weight

4. Livestock Maintenance

The test animals used were Friesian Holstein (FH) dairy cows, totaling 12 cows. Livestock is kept in individual pens for ten weeks. The first two weeks are used as a period of adaptation to the feed (preliminary) and in the third to the tenth week observations are carried out. Feeding 2.5-3% of body weight is done twice a day. Feed is given by mixing fermented rice straw with forage concentrate while giving drinking water ad libitum.

The collection of fecal samples was carried out at the end of the study. Fresh fecal samples were collected as much as 5% of the total fresh feces, while samples for proximate testing in the laboratory were as much as 1% of the total dry weight of feces.

5. Nutritional Digestibility Analysis

Analysis of nutrient digestibility observed was protein, fat and non-nitrogen extract (NNE). The formula used is:

$$\text{Crude protein digestibility (\%)} = \frac{\text{A − B}}{B} x100\%$$

$$\text{Crude fat digestibility (\%)} = \frac{\text{A} - \text{B}}{B} x100\%$$

$$\text{NNE digestibility (\%)} = \frac{\text{A} - \text{B}}{B} x100\%$$

Information:
A: crude protein/crude fat/NNE content of the feed
B: crude protein/crude fat/NNE content of fecal

6. *Data analysis*

Digestibility data were analyzed for variance (ANOVA). If a significant effect was found, it was continued with Duncan's multiple range test. Data were analyzed using SPSS 16 software.

C. Result and Discussion

1. Feed Nutrition Content

Green concentrate supplementation was able to increase crude protein, crude fat, and BETN and reduce fermented rice straw crude fiber (Table 1). The crude protein content of feed with lamtoro and Indigofera supplementation tends to be higher when compared to Gamal supplementation. This is because the crude protein in lamtoro and Indigofera leaves is higher than in Gamal leaves. In line with the research of Herdiawan and Sutedi (2015) that the crude protein content in Indigofera leaves is higher than in Gamal leaves. Meanwhile, research by Ali et al. (2014) showed that the crude protein of Indigofera leaves was higher than that of lamtoro leaves. However, a report by Ramdhan et al., (2022) showed the opposite result, namely rice straw silage supplemented with 30% Gamal produced higher crude protein (15.58%) when compared to 30% Indigofera supplementation (13.13%).

Differences in protein content in plants can be caused by various factors, one of which is environmental stress and soil acidity. As explained by Yayneshet et al. (2009) that the crude protein content of forage in semi-acidic soils decreased drastically due to drought stress and soil acidity.

Table 1 Results of proximate analysis of feed ingredients

Treatments	Crude protein (%)	Crude fat (%)	Crude fiber (%)	NNE(%)	Ash (%)
FRC	6.56	2.44	40.84	26.92	23.23
FRC + Lamtoro	16.17	6.30	24.52	41.55	11.46
FRC + Gamal	15.31	5.15	22.01	46.44	11.09
FRC + Indigofera	16.84	6.98	23.47	41.07	12.64

Source: results of analysis of Animal Feed Chemistry Laboratory, Faculty of Animal Husbandry, Hasanuddin University, Makassar

Even though there were differences in protein levels as a result of laboratory analysis in each treatment, all three treatments contained protein above the minimum level of the minimum requirement for ruminant ration crude protein, namely 7.5% (Mide and Natsir, 2013).

Nutrient supplementation, both energy and protein together, in this case, fermented rice straw with a combination of green concentrates, is intended to optimize microbial growth so that the utilization of fibrous feed can be optimal (Suhartanto et al., 2003). Widyobroto et al., (2001) explained that the ideal conditions for the formation of microbial protein are when a fermented carbohydrate source is available simultaneously with a protein source, thus a balance of energy and protein levels is a requirement for the preparation of concentrates for ruminants.

The fat content in the Indigofera supplementation treatment was higher (6.98%) than in the Gamal supplementation (5.15%). Meanwhile, the fat content with lamtoro supplementation (6.3%) was higher when compared to the study by Juwandi et al. (2018) the supplementation of 30% lamtoro leaves in rice straw produces a fat content of 3.3%. The fat content of this feed is quite high, according to Faradilla et al. (2019), the maximum fat content in the feed is 5% so that fat will not interfere with the digestion process of the feed.

The crude fiber in this study is quite low when compared to the study of Ramadhan et al. (2022) namely 24.81% in 30% Gamal supplementation to rice straw and 27.80% to 30% Indigofera supplementation to rice straw. The digestibility of fiber in a food ingredient greatly affects the digestibility of feed, both in terms of the quantity and chemical composition of the fiber (Tillman et al., 2005). According to Wirahadikusumah (2004), high crude fiber content in complete feed will reduce the digestibility efficiency of the feed ingredients, because crude fiber contains parts that are difficult to digest. The low crude fiber in fermented rice straw with a combination of green concentrates results in a proportional increase in BETN levels. Anggorodi (1994) states that if the crude fiber content is low, the BETN content will increase. BETN levels in this study were almost the same as those of Juwandi et al. (2018) by supplementing 30% of lamtoro leaves with rice straw, namely 42.03%.

Ash content is a mixture of inorganic or mineral components contained in a material (Kamal, 1998). Wibowo (2010), states that the crude fiber content and ash content have a positive relationship, the high crude fiber content will have a positive effect on the amount of ash content of the material. The ash content in this study was lower than that of Ramadhan et al. (2022) namely 15.62% in 30% Gamal supplementation to rice straw and 16.14% to 30% Indigofera supplementation to rice straw. Mucra (2007) states that the ash content and composition depend on the type of material and the combining process.

2. Crude Protein Digestibility

The results showed that there was no difference (P>0.05) in crude protein digestibility in fermented rice straw with various green concentrates. This study is in line with previous research that the digestibility of JPF + lamtoro organic matter was no different from that of JPF + Gamal (Fattah et al., 2020).

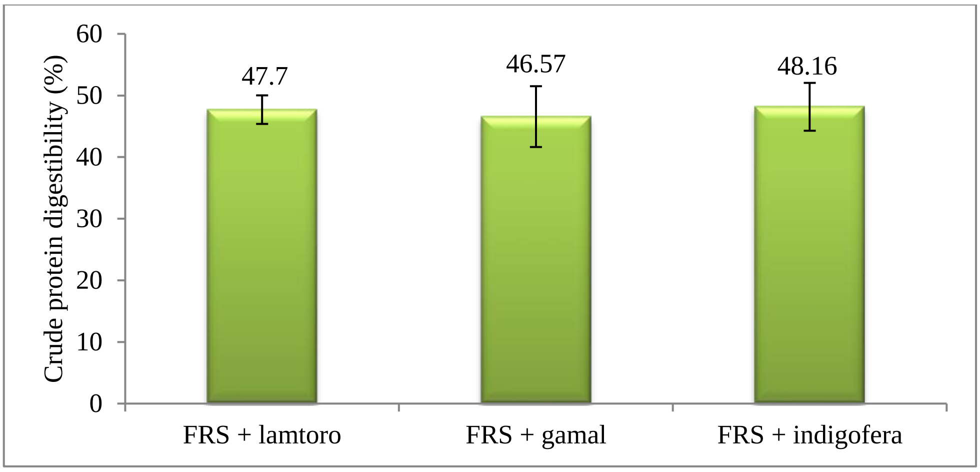

Figure 1. Crude protein digestibility of fermented rice straw supplemented with green concentrate

The digestibility of crude protein in this study was almost the same as that reported by Phesatcha et al. (2021) by giving mixed concentrate to FH-breeding cattle, a crude protein digestibility of 46.4% was obtained. However, it is lower than the report by Polii et al. (2020) that the crude protein digestibility of FH cattle given 70% corn husk + 30% concentrate was 82.18%. Crude protein digestibility in FH cattle was also reported to be higher by Cahyono et al. (2015) used natural grass, namely 74.03%.

Various factors affect the digestibility of feed ingredients, namely type of animal, age of the animal, composition of feed ingredients, harvesting stage, level and frequency of feeding, processing of feed ingredients, animal health conditions, stage of feed maturity, animal individuality, exercise and so on (Patil and Patil, 2022). Differences in legume digestibility can also be affected by differences in legume cutting ages (Sutaryono et al., 2019).

3. Crude Fat Digestibility

The results showed that there was a highly significant difference (P>0.05) in crude fat digestibility between fermented rice straw and various green concentrates. The digestibility of crude fat in the use of lam toro and Indigofera was higher than that of Gamal. Meanwhile, the digestibility of crude fat in lamtoro leaves is no different from that of Indigofera. This is due to the high crude fat content of feed containing lamtoro and Indigofera when compared to Gamal (Table 1). Following the statement of Faradilla et al. (2019) that the digestibility of dry matter, organic matter, and crude fat is affected by the nutrient content in the feed ingredients.

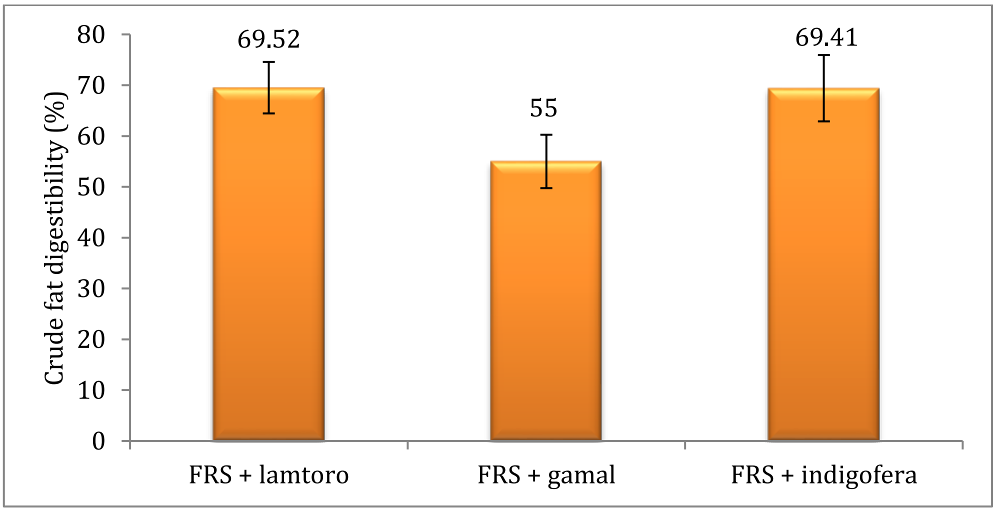

Figure 2. Crude fat digestibility of fermented rice straw supplemented with green concentrate

This is in line with previous research that the digestibility of JPF + Indigofera organic matter was higher than that of JPF + Gamal (Fattah et al., 2020). This result is also in line with the research of Sutaryono et al. (2019) that the digestibility of Indigofera organic matter was not different from that of lamtoro at the age of 2 months of cutting.

The digestibility of crude fat is lower than reported by Polii et al. (2020) that the crude fat digestibility of FH cattle given 70% corn husk + 30% concentrate was 84.33%. However, the digestibility of crude fat in this study was higher than that reported by Cahyono et al. (2015) used natural grass on FH cattle, namely 50.53%.

4. NNE digestibility

The digestibility of the extracted material without nitrogen was significantly different ($P<0.01$) in the three types of green concentrates (Figure 3). The highest NNE digestibility was in the Gamal treatment, followed by the Indigofera treatment and the lowest was in the Lamtoro treatment. These results are relatively in line with the composition of the feed NNE, namely the Gamal treatment has the highest NNE while the lamtoro and Indigofera treatments have the lowest NNE (Table 1).

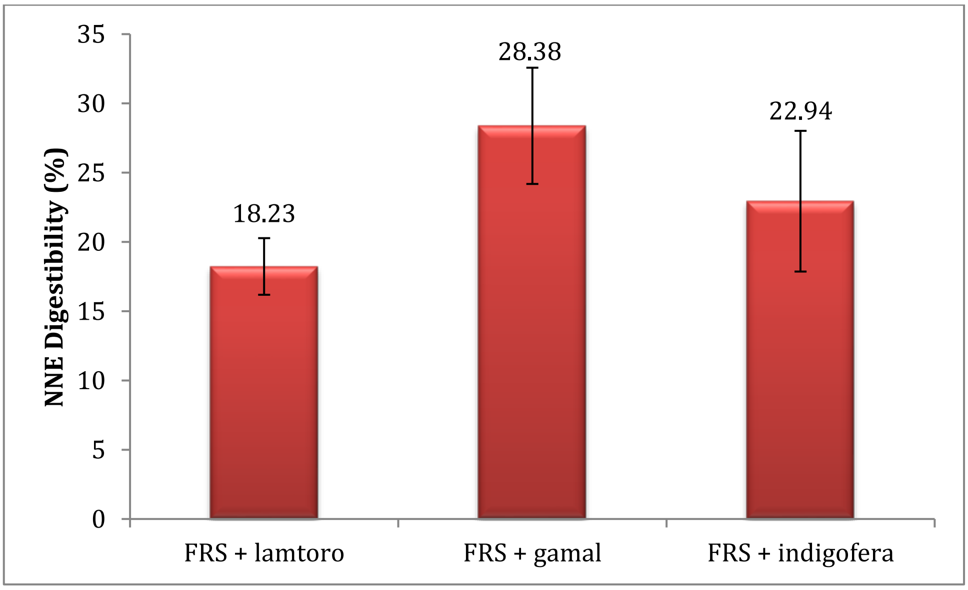

Figure 3. NNE digestibility of fermented rice straw supplemented with green concentrate

NNE digestibility is thought to be influenced by the fat content of the feed. Toharmat et al. (2006) stated that a high-fat content causes a low digestibility value because feed digestibility is negatively correlated with feed fat. The fat content of the feed containing gamal in this study was lower than that of lamtoro and Indigofera (Table 1) so the digestibility of NNE with gamal treatment was higher.

NNE digestibility in this study was relatively low. This is following the statement of Richards and Reid (1953), that nitrogen-free extract materials contain relatively indigestible parts, such as lignin, and crude fiber fractions in very large quantities by ruminants. The digestibility of NNE is lower than in previous reports, namely the digestibility of crude fat of Ongole Peranakan cattle given 50% corn husk + 50% concentrate is 73.85% (Aling et al., 2020).

D. Conclusion

Based on the results of the study it can be concluded that the supplementation of the three types of green concentrates (Lamtoro, Gamal, and Indigofera leaves) in fermented straw resulted in differences in nutrient levels, fat digestibility, and NNE digestibility so that they could potentially be used as dairy cattle feed.

E. Acknowledgment

The authors would like to thank the Muhammadiyah Sinjai University Research and community service institute for providing funding for this research

F. References

Abdullah, A. (2014). *Mewujudkan konsentrat hijau (Green Concentrat) dalam industri baru pakan untuk mendorong kemandirian pakan dan daya saing peternakan nasional*. *Orasi Ilmiah*. Bogor, Indonesia: IPB.

Ako, A. (2013). *Ilmu Ternak Perah Daerah Tropis*. Bogor, Indonesia: Institut pertanian Bogor Press.

Aling, C., Tuturoong, R. A. V., Tulung, Y. L. R., & Waani, M. R. (2020). Kecernaan serat kasar dan BETN (bahan ekstrak tanpa nitrogen) ransum komplit berbasis tebon jagung pada sapi Peranakan Ongole. *Zootec. Vol. 40*(2), pp. 428 – 438.

Amin, M., Hasan, S. D., Yanuarianto, O., & Iqbal, M. (2015). Pengaruh lama fermentasi terhadap kualitas jerami padi amoniasi yang ditambah probiotik Bacillus Sp*. Jurnal Ilmu dan Teknologi Peternakan Indonesia*, *Vol. 1* (1), pp. 8 – 13.

Balasubramanian, M. K. (2013). Potential utilization of rice straw for ethanol production by sequential fermentation of cellulose and xylose using Saccharomyces cerevisiae and Pachysolen tannophilus. *International Journal of Science, Engineering, Technology, and Research*, *Vol. 2*(7), pp. 1531-1535.

Cahyono, B. D., Sulistyowati, E., & Badarina, I. (2015). Kecernaan nutrisi konsentrat-PUFA yang mengandung curmiyeast pada sapi perah laktasi. *Jurnal Sain Peternakan Indonesia*, *Vol. 10*(1), pp. 59-70.

Doyle, P. T., Devendra, C., & Pearce, G. R. (1996). *Rice straw as a feed for ruminants*. Canberra, Australia: International Development Program of Australian Universities and Colleges Limited (IDP).

Eastridge, M. L. (2006). Major advances in applied dairy cattle nutrition. *J. Dairy Sci*. *Vol. 89*, pp. 1311–1323.

Faradilla, F., Nuswantara, L. K., Christiyanto, M., & Pangestu, E. (2019). Kecernaan bahan kering, bahan organik, lemak kasar dan total digestible nutrients berbagai hijauan secara in vitro. *Jurnal Litbang Provinsi Jawa Tengah*, *Vol. 17*(2), pp. 185-193.

Fattah, A. H., Syamsu, J. A., Natsir, A, & Garantjang, S. (2020). *In vitro* digestibility of fermented rice straw combined with different levels of green concentrate. *IOP Conf. Series: Earth and Environmental Science*, 492 (2020) 012026.

Hanum, Z., & Usman, Y. (2011). Analisis proksimat amoniasi jerami padi dengan penambahan isi rumen. *Agripet*, *Vol. 11*(1), pp. 39-45.

Herdiawan, I., & Sutedi, E. (2015). Productivity of Calliandra calothyrsus, Indigofera zollingeriana, and Gliricidia sepium on Acid Soil in the Greenhouse. *Jurnal Ilmu Ternak dan Vetetiner, Vol. 20*(2), pp. 105-114.

Jayanegara, A., Ridla, M., Laconi, E. B., & Nahrowi, N. (2019). *Buku Ajar: Komponen Antinutrisi pada Pakan.* Bogor, Indonesia: IPB Press.

Juwandi, J., Munir, M., & Fitriani, F. (2018). Evaluasi kandungan lemak kasar dan BETN silase daun lamtoro pada level yang berbeda sebagai bahan pakan utama pakan komplit. *Jurnal Bionature, Vol. 19*(2), pp. 112-118.

Kamal, M. (1998). Nutrisi Ternak I. Rangkuman. Yogyakarta: Lab. Makanan Ternak, Jurusan Nutrisi dan Makanan Ternak, Fakultas Peternakan, UGM.

Lamid, M, Puspaningsih, N. N. T., & Sarwoko, M. (2013). The addition of lignocellulolytic enzymes into rice straw improves in vitro rumen fermentation products. J. Appl. Environ. Biol. Sci., *Vol. 3*(9), pp. 166-171.

Malik, K., Tokkas, J., Anand, R. C., & Kumar, N. (2015). Pretreated rice straw as an improved fodder for ruminants-An overview. *J. Appl.Nat. Sci. Vol.* 7 (1), pp. 514 – 520.

Rakhman, A. (2012). *Respon Fisiologis Sapi Dara Peranakan Fries Holland dengan Manajemen Waktu Pemberian Pakan dan Penggunaan Minyak Kelapa dalam Konsentrat*. *Tesis*. Bogor, Indonesia: Institut Pertanian Bogor.

Odunsi, A. A., Ogunlele, M. O., Alagbe, O. S., & Ajani, T. O. (2002). Effect of feeding *Gliricidia sepium* Leaf meal on the performance and egg quality of layers. *Int. J. Poult. Sci*. *Vol*. 1 (1), pp. 26 – 28.

Patil, P. V., & Patil, M. K. (2022). Factors affecting nutrient digestibility in animals. *Just Agriculture*, Vol. 2(7), pp. 1-6.

Phesatcha, B., Phesatcha, K., Viennaxay, B., Thao, N.T., & Wanapat, M. (2021). Feed Intake and Nutrient Digestibility, Rumen Fermentation Profiles, Milk Yield, and Compositions of Lactating Dairy Cows Supplemented by *Flemingia macrophylla* Pellet. *Tropical Animal Science Journal*, *Vol.* 44(3), pp. 288-296.

Polii, D. N. Y., Waani, M. R., & Pendong, A. F. (2020). Kecernaan protein kasar dan lemak kasar pada sapi perah peranakan FH (Friesian Holstein) yang diberi pakan lengkap berbasis tebon jagung. *Zootec. Vol.* 40(2), pp. 482 – 492.

Richards, R., & Reid, J. T. (1953). The digestibility and interrelationships of various carbohydrate fractions of pasture herbage and a resolution of the components of crude fiber and nitrogen-free extract. *Journal of Dairy Science,* 36(9), pp. 1006-1015.

Rusdy, M., Yusuf, M., & Ismartoyo, I. (2020). Utilization of Leucaena leucocephala and Gliricidia sepium as supplements by goats fed Panicum maximum basal diet. *Tropical Animal Health and Production*, *Vol.* 52(2), pp. 541-545.

Sarnklong, C., Cone, J. W., Pellikaan, W., & Hendriks, W. H. (2010). Utilization of rice straw and different treatments to improve its feed value for ruminants: A review. *Asian-Aust. J. Anim. Sci*., *Vol.* 23(5), pp. 680-692.

Sarwar, M., Khan, M. A., & Nisa, M. (2004). Effect of organic acids of fermentable carbohydrates on digestibility and nitrogen utilization of urea treated wheat straw in buffalo bulls. *Australian Journal of Agricultural Research*, *Vol.* 55, pp. 223-228.

Sutardi, T. 2006. *Landasan Ilmu Nutrisi.* Jilid 1. Bogor, Indonesia: Intitute Pertanian Bogor.

Sutaryono, Y. A., Abdullah, U., Imran, I., Harjono, H., Mastur, M., & Putra, R. A. (2019). Produksi dan nilai nutrisi pada pertumbuhan kembali beberapa legum pohon dengan umur pemangkasan berbeda. *Jurnal Ilmu dan Teknologi Peternakan Indonesia*, *Vol.* 5 (2), pp. 93 – 104.

Syamsu, J. A. (2006). Kajian penggunaan starter mikroba dalam fermentasi jerami padi sebagai sumber pakan pada peternakan rakyat di Sulawesi Tenggara. *Seminar Nasional Bioteknologi*. Bogor: Puslit Bioteknologi LIPI.

Toharmat, T., Nursasih, R., Nazilah, R., Hotimah, N., Noerzihad, T. Q., Sigit, N. A., & Retnani, Y. (2006). Sifat fisik pakan kaya serat dan pengaruhnya terhadap konsumsi dan kecernaan nutrien ransum pada kambing. *Media Peternakan*, *Vol.* 29(3), pp. 146–154.

Tillman, A. D., Hartadi, H., Reksohadiprodjo, S., Kusuma, S. P., & Lebdosoekoekojo, S. (1998). *Ilmu Makanan Ternak Dasar*. Yogyakarta, Indonesia: Gadjah Mada University Press.

Trisnadewi, A. A. A. S., Sumardani, N. L. G., Tanama Putri, B. R. I, Cakra, G. L. O., dan Aryani. I G. A. I. 2011. Peningkatan kualitas jerami padi melalui penerapan teknologi amoniasi urea sebagai pakan sapi berkualitas Di Desa Bebalang Kabupaten Bangli. *Buletin Udayana Mengabdi*, *Vol.* 10 (2), pp. 72 – 74.

Van Soest, P. (2006). Rice straw, the role of silica and treatments to improve quality. *Animal Feed Science and Technology*, *Vol.* 130 (1- 4), pp. 137-171.

Yanuartono, Y., Purnamaningsih, H., Indarjulianto, S., & Nururrozi, A. (2017). Potensi jerami sebagai pakan ternak ruminansia. *Jurnal Ilmu-Ilmu Peternakan*, *Vol.* 27 (1), pp. 40 – 62.

Yanuartono, Y., Indarjulianto, S., Purnamaningsih, H., Nururrozi, A. & Raharjo, S. (2019). Fermentasi: Metode untuk meningkatkan nilai nutrisi jerami padi. *Jurnal Sain Peternakan Indonesia, Vol.* 14(1), pp. 49-60.

Zapata-Campos, C. C., García-Martínez, J. E., Salinas-Chavira, J., Ascacio-Valdés, J. A., Medina-Morales, M. A., & Mellado, M. (2020). Chemical composition and nutritional value of leaves and pods of Leucaena leucocephala, Prosopis laevigata, and Acacia farnesiana in xerophilous shrubland. *Emirates Journal of Food and Agriculture*., *Vol.* 32(10), pp. 723-730.